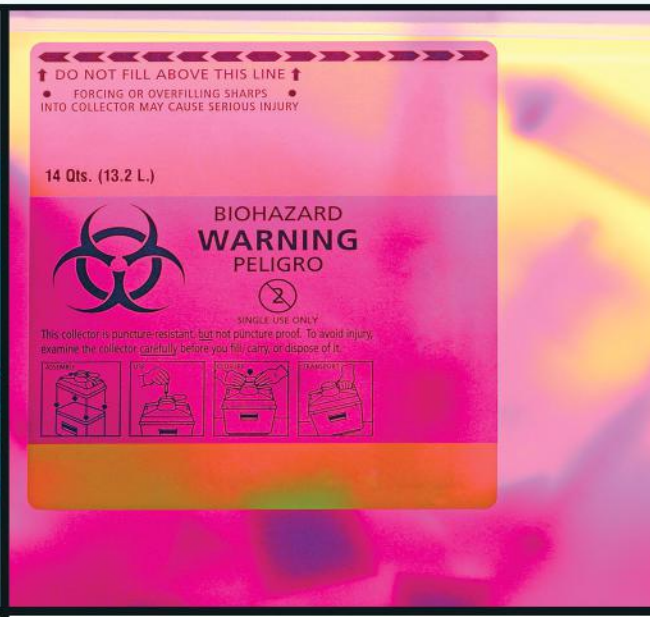
Healthcare Hazard Control and Safety Management

Third Edition



James T. Tweedy,

MS, CHSP, CPSO, CHEP, CHCM

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With a father's heart of love, I dedicate this book to the memory of my precious daughter, Elizabeth Cheryl Tweedy, who in her brief 19 years touched the lives of so many for time and eternity. She taught all who knew her the true meaning of the words love *and* friendship.

I have come to realize that the completeness of one's life cannot be measured in length of years but in the way in which we choose to live the time allotted us.

So I Pray

By

Elizabeth Cheryl Tweedy

January 18, 1977–June 26, 1996

In a world where sorry is so commonplace
That undeniable pain is evident on every face
We are guided by theory
Led by a blackened light
And virtues are just a concept
Of a long forgotten time

Where happiness is misunderstood
And confusion reigns supreme
I look around and tremble
As I think of what it means

But I know who I am in You …
Called out and commissioned by Christ
To go unto all the nations
And make the sacrifice

So I pray …

Let me love with your love
Let me shine with your light
Let me care with your compassion, Lord
In this world black as night
Let me trust with all my heart
Let me speak only the truth
Let me teach so they might understand
What it means to know you

So I pray …

Send me Lord today

Contents

Preface

This third edition is a complete rework of the previous edition and is not just a cosmetic makeover. Much of the text uses the active voice to present information more succinctly and in fewer words. The text focuses on preventing accidents and controlling hazards in hospitals and other healthcare settings. This third edition presents a broad but comprehensive overview of healthcare hazard control and safety management concepts as they relate to real-world challenges. The author presents healthcare hazard control and safety management as an organizational function and not just another program. The text focuses on achieving results because safety is more than just meeting accreditation requirements or regulatory compliance. Achieving hazard control and safety is the right thing to do. Many healthcare organizations still refer to their hazard control and safety management efforts as programs. Practicing effective healthcare hazard control requires senior leaders and other supervisory personnel to motivate others to support their organizational safety efforts. This text provides a solid foundation for those working in healthcare safety and other related healthcare positions. It should serve as a valuable on-the-job resource. The text addresses the need for good leadership and management. The author also briefly addresses the importance that practicing human relation and communication skills can have on healthcare hazard control efforts. The textbook now contains 14 chapters instead of 10. The text also contains more than 30 helpful appendices. Some chapters with major changes include emergency management, infection control, and patient safety. The text will also serve as the primary study reference and resource for those preparing to sit for the Certified Healthcare Safety Professional (CHSP) examination.

Acknowledgments

I would like to thank Jan Mosier for proofreading and editing each of the chapters. Her tireless efforts identified many of my errors, duplications, and omissions. Without her help and personal motivation, this revision project would have taken much longer to complete. I would also like to express my thanks to my son Aaron, daughter-in-law Mary, and grandsons Alex and Patrick for their support and understanding during the project. I also want to acknowledge Harry Stern for his continued support and encouragement during the completion of this project.

Author

James (Jim) T. Tweedy has served as the executive director for the International Board for Certification of Safety Managers (IBFCSM), which is also known as the Board of Certified Hazard Control Management (BCHCM) since 2007. IBFCSM was founded in 1976 and offers the following personal credentials: certified healthcare safety professional (CHSP), certified patient safety officer (CPSO), certified hazard control manager (CHCM), certified healthcare emergency professional (CHEP), certified product safety manager (CPSM), and certified hazard control manager-security (CHCM-SEC).

James founded TLC Services, a healthcare, hazard control, organizational performance, and educational consulting organization in 1996. He has more than 25 years of experience with expertise in the areas of credentialing, hazard control, healthcare safety, leadership and team development, education, and compliance. He holds an MS in safety management from Central Missouri University and a BS in liberal studies from Excelsior College. He holds master level designations as a CHCM, CPSO, CPSM, CHSP, and certified healthcare emergency professional (CHEP). He also holds a professional membership in the American Society of Safety Engineers (ASSE) and is a member of the American Society of Healthcare Engineering (ASHE).

Jim is a polished speaker who presents safety-related topics at seminars, conferences, and in the workplace. He taught more than six years at the college level and is an experienced curriculum developer. He has developed and presented original training programs at locations in more than 40 states. He is a recognized leader in the area of healthcare safety and hazard control management. You may contact Jim at IBFCSM, Helena, Alabama. The Board phone number is 205-664-8412 and the website can be accessed at www.ibfcsm.org. He can be contacted at www.ibfcsm.org.

1 Healthcare Hazard Control

INTRODUCTION

This chapter presents a proactive hazard control approach based on leadership involvement and the practice of effective management. The author frequently uses the term hazard control instead of safety when placing emphasis on preventing accidents, illnesses, and injuries. Senior healthcare leaders must learn to promote hazard control and safety as an organizational value. Hazard control effectiveness impacts both the overt and covert cultures of any healthcare organization. The safety culture of healthcare organizations must be recognizable by those served. Healthcare organizations seeking to maintain revenues, minimize losses, serve their communities, and meet regulatory or accreditation requirements need effective safety functions. Healthcare is one of the fastest growing sectors of the US economy, employing over 12 million workers with women representing about 80% of the healthcare workforce. Rates of occupational injury to healthcare workers have risen over the past decade. Safety issues facing healthcare organizations include needlesticks, back injuries, slips and falls, laser hazards, chemical exposures, biological hazards, workplace violence, and community safety issues. An increased emphasis on topics such as emergency management, indoor air quality, and patient safety indicates that safety will remain a key function in healthcare organizations. Effective healthcare hazard control management continues to be overlooked despite the number of workers employed in healthcare-related occupations. Advances in medical technology and clinical treatment techniques expose workers and patients to a variety of potential hazards. The Occupational Safety and Health Administration (OSHA) continues to highlight the importance of safety and health for all healthcare organizations including hospitals, nursing homes, surgery centers, and physician practices (see Tables 1.1 and 1.2).

INTERNATIONAL BOARD FOR CERTIFICATION OF SAFETY MANAGERS

The International Board for Certification of Safety Managers (IBFCSM), founded in 1976 as a not-for-profit credentialing organization, operated for some time as the Board of Certified Hazard Control Management (BCHCM). The board offers qualified working healthcare professionals an opportunity to earn their Certified Healthcare Safety Professional (CHSP), Certified Healthcare Emergency Professional (CHEP), or Certified Patient Safety Officer (CPSO) credential. Many healthcare professionals hold more than one credential. The board offers CHSP and CHEP credential holders with the opportunity to add the healthcare Fire Safety Management (FSM) designation to their primary certification. The board now offers a registration credential for frontline environmental services personnel. The registered healthcare safety technician-environmental services (RHST-EVS) designation fills a vital need for a credential for those responsible for cleaning and disinfecting healthcare facilities.

The board also offers qualified candidates the opportunity to earn their Certified Hazard Control Manager (CHCM), Certified Hazard Control Manager-Security (CHCM-SEC), or Certified Product Safety Manager (CPSM) credential. The IBFCSM motto, *Individual Credentials—The Key to Upgrading the Profession*, reflects the impact that individual certifications have on improving organizational safety and hazard control functions.

TABLE 1.1
Top 12 OSHA Citations for 2011–2012

Health services industries (all categories)
Bloodborne pathogens (1910.1030)
Hazard communication (1910.1200)
Formaldehyde (1910.1048)
Recordkeeping forms (1904.0029)
Medical services and first aid (1910.0151)
Maintenance, safeguards, and operational features for exit routes (1910.0037)
Electrical systems design, general requirements (1910.0303)
Electrical wiring methods and components (1910.0305)
Personal protective equipment, general requirements (1910.0132)
Annual illness/injury summary (1904.0032)
Respiratory protection (1910.0134)
Portable fire extinguishers (1910.0157)

TABLE 1.2
OSHA Comparative (Nonfatal) Incidence Rates for 2011

Industry	Rate
Private industry	3.5
Construction	3.9
Manufacturing	4.4
Health services	8.2
Hospitals	8.5
Nursing facilities	12.7

Source: Data from OSHA Website (Accessed June 1, 2013).
Note: Incidence rates are per 100 employees.

HAZARD CONTROL

IBFCSM defines a *hazard* as "any solid, gas, or liquid with the potential to cause harm when interacting with an array of initiating stimuli including human-related factors." The scope of a hazard can include any activity, behavior, error, event, incident, occurrence, operation, process, situation, substance, or task with potential to cause human harm, property damage, risk to the environment, or a combination of all three. The board defines *hazard closing* as the process of two or more hazards or causal factors attempting to occupy the same space at the same time. Some hazard control professionals refer to this interaction of causal factors as the *accident generation cycle*. Accidents, mishaps, and hazardous exposures can result in injuries, illnesses, property damage, and work interruptions. Companies, businesses, and institutions must make hazard control a *priority* organizational function. Proactive hazard control can improve operational efficiency, organizational effectiveness, and the bottom line. The hazard control profession should focus on using management, leadership, and improvement principles to prevent accidents, injuries, and other losses. Senior leaders must ensure that organizational members promptly report accidents, hazards, close-call incidents, and unsafe behaviors. Organizations can unknowingly promote activities that do little to improve safety-related behaviors or encourage continuous learning processes. Passive hazard control efforts

can communicate a general awareness about the importance of working safely. However, many well-intended initiatives do not achieve measurable results when the organization fails to make hazard control a priority function. Most organizations must comply with a number of safety and environmental standards. However, making compliance the centerpiece of hazard control efforts can send the wrong message to many organizational members. Once, a healthcare maintenance supervisor leaving a safety responsibility presentation that I conducted made this comment to me, "I will never again tell any of my technicians to work safely because of compliance, accreditation, or organizational requirements." He then said, "I will tell my subordinates that we will work safely on every task because it is the right thing to do." He decided to become a leader instead of using compliance standards and organizational policies as the key motivators for working safely. When organizational leaders and supervisors make people the priority, adherence to established policies and compliance standards becomes easier to achieve. Most experienced hazard control managers understand the importance that engineering principles play in preventing accidents and injuries. Some well-known engineering innovations such as fire prevention technologies and safer machine designs make workplaces much safer for everyone. Effective hazard control managers must use leadership to minimize risky and unsafe behaviors. Failing to so can impact morale, operational productivity, and result in higher accident rates.

HAZARD CONTROL MANAGEMENT

Using the phrase of *hazard control management* does not diminish the importance of safety and other disciplines such as risk management, occupational health, or industrial hygiene. Hazard control management must focus on developing processes or systems that can help prevent harm and loss. An uncorrected hazard or hazardous situation could contribute to an event resulting in property damage, job interruption, personal harm, or adverse health effects. The process of controlling hazards may require development of written policies, plans, or procedures. Never consider hazard control as a program but as a function of the organization. The hazard control function must connect with organizational structures and operational philosophies (Table 1.3).

Program or Function

I once asked a safety coordinator to let me review the organizational hazard control plan. He handed me a three-ring binder that came from a bookshelf near his desk. The binder, labeled safety program, contained a number of documents still encased in their original shrink wrap. Program comes from the French word *programme*, which means agenda or public notice. We can also refer to the Greek word *graphein*, which means to write. When used with the prefix *pro*, it became *prographein*, which means to write before. Many organizations develop written safety programs to satisfy organizational mandates or to demonstrate visual compliance with regulatory requirements.

TABLE 1.3
Seven Values of Hazard Control Management

- Never-ending process
- People focused
- Leadership driven
- Operational priority
- Benefits everyone
- Reduces organizational losses
- Prevents human harm

TABLE 1.4
Proactive versus Reactive Hazard Control

Proactive	Reactive
Anticipates, recognizes, and identifies hazards	Evaluates and investigates past incidents or accidents
Analyzes and determines risks	Uses risk management to control losses
Controls hazards to reduce accident potential	Satisfied with reducing accident recurrence
Educates and encourages safe behaviors	Disciplines unsafe actions and behaviors
Focuses in preventing losses	Accepts some losses if not too severe
Analyzes to determine root causes	Documents errors and primary causes
Operates to open and hidden cultures	Responsive to formal culture expectations
Involves leaders in hazard control	Leaders delegate responsibilities to others

TABLE 1.5
Traditional Hazard Control Assumptions

- Hazard control manager retains responsibilities for solving all safety-related problems.
- Senior leaders view hazard control as a necessary expense.
- Training and education focuses on documentation and not human performance.
- Organizational efforts focus on hazards with minimum emphasis on unsafe behaviors.

Written plans, policies, and procedures should direct the hazard control function. The word function, first used in the early sixteenth century, denotes the concept of performance or execution. A function can relate to people, things, and institutions. A function can refer to serving a designated or defined role in some manner. A function can also relate to participation in an ongoing cultural or social system. Considering hazard control as a function of the organization elevates its priority in the minds of everyone (Tables 1.4 and 1.5).

Hazard Control Is Good Business

Liberty Mutual, in its *2007 Workplace Safety Index*, estimated that in 2005, employers paid almost $1 billion per week in direct compensation costs for disabling workplace injuries and illnesses. Senior leaders must make hazard control a priority function. Proactive efforts can help reduce workers' compensation premiums, injury costs, and lost productivity. Liberty Mutual sent a survey to hundreds of chief financial officers in 2005. More than 60% of those responding to the survey indicated that they could document a return on investment (ROI) for money allocated to hazard control–related initiatives. OSHA reports that the average work site participating in the OSHA Voluntary Protection Program (VPP) documented days away, restricted, or transferred (DART) rates of 52% below the national average for their industrial classification. Organizational leaders making hazard control part of a good business initiative must understand accidents impact their organization in the terms of cost, time, performance, and morale. Proactive hazard control can also help achieve compliance with the myriad of regulatory requirements placed businesses today.

HAZARD CONTROL RESPONSIBILITIES

Many organizations with high accident or injury rates fail to outline specific hazard control responsibilities in their plans, procedures, directives, and job descriptions. The concept of responsibility relates to a person's obligation to carry out assigned duties in an efficient, effective, and safe

TABLE 1.6
Senior Management Responsibilities

- Develop, sign, and publish an organizational hazard control policy statement.
- Describe key expectations related to accomplishing hazard control objectives.
- Ensure that all organizational members can explain the major objectives.
- Develop methods to track progress and provide feedback to all organizational members.
- Require managers and supervisor to visibly support established objectives.

manner. Senior leaders must ensure that managers and supervisors understand the importance of their assigned hazard control responsibilities. Senior leaders must ensure that job descriptions address hazard control responsibilities inherent with each position or task. Hazard control efforts will yield results when leaders encourage participation and hold key managers accountable. Senior leaders and hazard control managers must learn to focus on the hazards, behaviors, and risks that pose the most potential harm (Table 1.6).

Hazard Control Manager Responsibilities

An effective hazard control manager serves as a consultant and adviser to managers at all operational levels. Hazard control managers must persuade management action rather than attempt to correct every hazardous situation. The need for improving hazard control efforts must remain proportional to the need for improving other organizational functions. Hazard control objectives must focus on accident prevention, reducing operating costs, and efficiently using human and other organizational resources. Hazard control managers learn to compile and disseminate important safety-related information to managers throughout the organization. Hazard control managers must teach others about accident prevention principles and solicit their input. When seeking senior leader's approval for hazard control expenditures, use a well-prepared cost–benefit analysis document. Hazard control managers should anticipate opposition from certain segments within their organization. When dealing with opposition, use effective human relation and communication skills to persuade others to support hazard control objectives.

Hazard control managers should *know what they know* and acknowledge the things they *don't know*. However, they must know where to go to find answers. Hazard control managers must acknowledge that many operational managers and supervisors face issues beyond their control. Understanding this important concept can help hazard control managers gain their respect. Conducting periodic perception surveys can reveal what people in the organization truly think or believe about hazard control efforts (Table 1.7).

TABLE 1.7
Hazard Control Manager Responsibilities

- Guide development of hazard control training and educational sessions.
- Serve as the hazard control consultant and information center.
- Provide hazard control–related technical assistance as necessary.
- Provide information about legal and compliance requirements affecting safety and health.
- Evaluate overall hazard control performance as related to established objectives or goals.
- Maintain communication with regulatory agencies and professional safety organizations.
- Oversee accident investigations, hazard analysis, and preparation of reports or summaries.
- Monitor progress of corrective actions required to address hazards or other safety deficiencies.

Supervisor Involvement

Supervisors must possess the knowledge and experience to provide hazard control guidance to those they lead. First-line supervisors occupy a key hazard control position in many organizations. This position of trust can require supervisors to conduct area inspections, provide job training, ensure timely incident reporting, and accomplish initial accident investigations. Supervisors in many organizations possess little control over factors such as hiring practices, working conditions, and equipment provided to them. Supervisors must understand the role that human factors can play in accident prevention and causation. They must ensure that each person they supervise understands the behavior expectations of the job. Some organizations require employees to sign a safe work agreement. Such an agreement requires the individual to commit to working safely and adhere to organizational policies or procedures. Supervisors must ensure that their subordinates can access all hazard control plans, policies, and procedures (Table 1.8).

ADDRESSING BEHAVIORS

Supervisors must explain work rules and behavioral expectations to all new or transferred employees. Supervisors must never tolerate individuals that encourage others to disregard work rules or established procedures. When disciplining an individual, do so in private but always document the facts. Senior leaders, managers, and supervisors must set an example for others. They must discourage poor behaviors by reinforcing the importance of acceptable behaviors. Never confuse correcting a behavior with undertaking needed disciplinary action. When correcting an unsafe behavior, always state the facts about the situation but limit personal opinions. Use statements that begin with *I* but never use *they* statements. Take time to recognize good behaviors by using positive reinforcement. Keep in mind that some individuals may not recognize a hazard or hazardous situation. Some may recognize a hazard but not possess the ability to deal with it. Too many injuries occur when a person recognized the hazard but failed to respect its potential for causing harm. Some individuals, for unknown reasons, purposely decide to engage in unsafe or risky behaviors (Table 1.9).

Employee Engagement

Employee engagement occurs when an individual personally feel their connection to their position or job. This engagement also refers to their personal commitment to the success of the organization. Employee engagement can contribute to individual satisfaction and personal mental wellness. Engaged employees also help improve the productivity, morale, and motivation of others. Today, many organizations realize the need for balancing work demands with a person's family and other life issues.

TABLE 1.8
Supervisor Responsibilities

- Enforce work rules and correct unsafe or at-risk behaviors.
- Implement hazard control policies, procedures, and practices in their areas.
- Provide job or task-related training and education.
- Immediately report and investigate all accidents in their work areas.
- Conduct periodic area hazard control and safety inspections.
- Ensure proper maintenance and servicing of all equipment and tools.
- Lead by example and personally adhere to hazard control requirements.
- Conduct safety and hazard control meetings on a regular basis.
- Work with organizational hazard control personnel to correct and control hazards.
- Ensure all personnel correctly use required PPE.

TABLE 1.9
Behavior Correction Process

- Step 1: Identify the unsafe action.
- Step 2: State concern for worker's safety.
- Step 3: Demonstrate the correct and safe way.
- Step 4: Ensure the worker understands.
- Step 5: Restate concern for personal safety.
- Step 6: Follow-up.

Organizational members, when off the job, serve in a variety of roles including volunteer, caregiver, and parent. Understanding employee engagement helps leaders and hazard control managers deal with the complexity of human behaviors. Conflicting responsibilities can lead to role misunderstandings and work-related overloads that can impact organizational objectives including hazard control efforts.

Working with Employee Organizations

Organizational leaders and hazard control personnel must cooperate with labor groups. When working with labor groups, seek to find common ground for agreement but never sacrifice the principles of hazard control. However, never let hazard control or safety become a *bargaining chip* during negotiations. Collective bargaining organizations can help by promoting positive worker attitudes. When negotiating, ensure that all safety demands relate to objective criteria. Hazard control personnel must advise management on labor-related hazard control and safety issues. Hazard control personnel should also attempt to participate in collective bargaining sessions to address hazard control concerns.

HAZARD CONTROL PRACTICE

Hazard Control Policy Statements

A hazard control policy statement should clearly address an organization's philosophy and objectives related to accident prevention. The policy statement should cover broad hazard control expectations and outline some key responsibilities. The policy statement, when written in precise and unambiguous language, should communicate organizational commitment to a safe and healthy work environment. Senior leadership must sign and disseminate the policy statement to all organizational members. Some organizations publish a well-written policy statement that conflicts with actual operational reality. Ensure the published policy reflects the *real* organizational beliefs and expectations. For most organizations, policy statements should facilitate the decentralization of the hazard control function. The decentralization of hazard control occurs when an organization promotes accident prevention efforts as part of everyone's job. As discussed previously, the hazard control manager's role becomes primarily focused on coordinating, promoting, and communicating accident prevention techniques.

Hazard Control Plan

I believe that many hazard control managers can take some planning tips from emergency and disaster planners. Emergency management planners develop their emergency operations plans by using results obtained from a hazard vulnerability analysis (HVA). Hazard control managers should use a similar approach when beginning to develop their master hazard control directive. Conducting a thorough *hazard vulnerability assessment* would provide a solid foundation on which to build

necessary procedures, policies, and action plans. Hazard control plans must *direct* some type of action, intervention, or behavior. Many well-meaning safety programs look good on paper but fail to provide direction on how to reduce hazards, accidents, and injuries. Developing a master hazard control plan based on accurate assessments can provide direction to all accident prevention efforts. The plan should focus on the immediate correction of hazards discovered by the use of hazard assessment data, periodic inspection results, and accident investigation reports. A master hazard control plan should function as *the directive* for all organizational accident prevention efforts. An effectively written document should provide the road map for meeting organizational hazard control expectations, objectives, and goals. A comprehensive plan must hold managers and supervisors accountable for ensuring all operational policies, procedures, and job practices meet the requirements outlined in the master directive. I once discovered, during an on-site hazard control assistance visit, the existence of two *conflicting* OSHA emergency action plans for the same facility. During an actual emergency situation, the existence of two plans could contribute to confusion. Organizations should supplement hazard control–related education with specific on-the-job training. Hazard control managers must monitor a plan's effectiveness. Hazard control plans should stress the importance of establishing procedures for the immediate reporting of accidents, incidents, mishaps, and other *close-call* events. Promoting personal ownership of the hazard control function helps promote its organizational priority. Senior leaders must ensure that key managers provide visible hazard control function involvement. Poor management practices can contribute directly and indirectly to the generation of accidents. The best written plans will fail if leaders tolerate or ignore known management deficiencies or inefficiencies.

I once asked a hazard control coordinator during a healthcare facility consultation visit a four-part question, "What is your most flammable substance, how much do you store on-site, how and where do you store it, and which departments use the substance?" He could only answer part one of the question. The hazard control coordinator did not know or understand that this flammable substance created *fire load* hazard at several locations throughout the facility. This situation created other hazard control issues such as human exposure risks, sprinkler system coverage, proper storage room configuration, and portable fire extinguisher assessments. Once, during an on-site survey, I entered a supply room located between two nursing facility *resident* rooms. I discovered more than 100 gal of isopropyl alcohol (90%) in single-gallon containers stacked neatly on wooden shelves. No one could or *would* provide an explanation for this major flammability hazard. Once, I walked into an area of a large facility where noise levels exceeded 100 dB. My escort never offered me noise protection before we entered the area. The organizations failed to recognize or simply ignored the existence of these hazards. Hazard control personnel, managers, and supervisors must know about the hazards existing under their watch. Hazard control practice also requires individuals to take responsibility for doing the right thing. Plans, procedures, and policies can't identify and correct hazards—people do (Table 1.10).

TABLE 1.10
Content Suggestions for Written Hazard Control Plans

- Outline key duties and responsibilities of managers, supervisors, and organizational members.
- Develop measurement tools and maintenance requirements for all accident prevention efforts.
- Identify the processes used to identify, analyze, and control hazards and unsafe operations.
- Create effective communication and feedback processes to keep everyone informed.
- Establish sound accident investigation methods, procedures, and priorities.
- Ensure the effectiveness of information reporting and collection processes.
- Describe the methods and procedures for hazard analysis and hazard control implementation.
- Provide clear policies about the requirement to adhere to safe work practices and requirements.
- Implement orientation, training, and educational objectives that address *real-world* topics.

Objectives and Goals

Organizations and hazard control managers must ensure the development of realistic objectives and goals. The attainment of hazard control objectives and goals will require development of written plans, procedures, policies, and directives. Develop and implement written documents that *direct* or *require* specific hazard control–related actions and behaviors. Written documents can assign hazard control responsibilities, communicate hazard control issues, and address issues such as inspections, training, and job-related processes.

Reviewing Plans, Policies, and Procedures

Conduct periodic reviews of hazard control directives, plans, policies, procedures, and practices. The evaluations must determine reasons that the organizational objectives and goals went unmet. The review should determine if managers, supervisors, and other organizational members actually supported hazard control efforts. Some OSHA standards can require periodic review of written plans and policies. For example, OSHA requires an annual review of the Bloodborne Pathogen Local Exposure Control Plan. When reviewing written plans, place a strong emphasis on accuracy, duplicity, currency, and effectiveness. I suggest that organizations develop a suspense and documentation process to help manage a thorough review of each written hazard control document. Establish a suspense process that focuses on the information listed in Table 1.11.

Make minor changes to hazard control plans using ink and inform all interested parties of the change. Develop a log or spreadsheet to maintain a catalog of suggestions for possible future changes to the plan, policy, or procedure. Documenting ink changes and maintaining a log of possible changes can help during the actual revision of the plan. Word processing permits quick updates of plans, policies, and procedures. However, ensure that the written hazard control documents don't become *sanitized versions* for show or display only. Organizations that do not refer to actual hazard control policies, procedures, and plans on an ongoing basis may not need the documents at all. After reviewing hundreds of written hazard control documents during the past 20 years, I came to a simple conclusion—most documents experienced little use.

UNDERSTANDING HAZARDS

Classifying and defining hazards can vary greatly depending on a number of factors including type of industry, process, or operation. For example, mechanical energy hazards can involve components that cut, crush, bend, shear, pinch, wrap, pull, and puncture. Biological hazards can include pandemic, bioterrorism agents, bloodborne pathogens, and infectious waste. Chemical hazards include substances such as solvents, flammable liquids, compressed gases, cleaning agents, and even disinfectants. Physical hazards can include risks posed by fire, radiation, machine operation, and noise.

TABLE 1.11
Tips for Developing Effective Written Plans, Policies, and Procedures

- Accurately title and date each plan, policy, and procedure.
- Ensure each document begins with a purpose statement.
- Clearly identify the function, division, or office responsible for the document and the frequency of review.
- Determine the type of documentation procedures needed to support the plan or policy.
- Validate the standards, directives, or regulations that mandate the existence of the document.
- Review the application and scope of each plan, policy, or procedure.
- Describe the need for any special coordination requirements among affected departments, functions, or units.
- Develop and then evaluate all processes used to communicate changes and revisions to the documents.

Environmental and ergonomic hazards include slip, trip, and fall hazards, walking and working surfaces, lighting, and tasks with repetitive motions. Psychosocial hazards address issues such as workplace violence, work-related stress, sleep deprivation, mental problems, chemical dependency, alcohol abuse, and horseplay on the job.

Hazard Identification

Hazard identification requires the identification of hazards, unsafe conditions, and risky behaviors. Hazard anticipation relies on human intuition, training, common sense, observation, and continuous awareness. To identify hazards, rely on the use of inspections, surveys, analysis, and human recognition reporting. Hazard identification efforts should focus on unsafe conditions, hazards, broken equipment, and human deviations from accepted practices. Require supervisors or unit safety coordinators to conduct periodic area inspections. These individuals should understand hazardous areas and the workers better than anyone. However, supervisors can fall prey to *inspection* bias that results in poor survey results. Many supervisors conduct limited *ongoing* inspections as part of their daily job duties. Periodic inspections and surveys can focus on critical components of equipment, processes, or systems with a known potential for causing serious injury or illness. Some equipment inspections help meet preventive maintenance requirements or hazard control plan objectives. Safety standards can mandate that *qualified persons* periodically inspect some types of equipment, such as elevators, boilers, pressure vessels, and fire extinguishers, at regular intervals. Establish the frequency of inspections by considering the scope and type of the hazardous operations. Many hazard control plans fail to provide sufficient guidance about how to conduct hazard surveys, inspections, and audits. For example, I know of very few organizations that provide training or education about the proper use of *general* or *demand response* checklists. Inspections, audits, and hazard surveys can only help identify hazards when conducted properly. Providing a checklist to an untrained person can result in his or her failure to properly identify hazards or unsafe conditions. General checklists serve as tools that guide an inspection process. These documents do not contain information about all potential hazards. The effective use of *demand response checklists* will also require some type of education or training. Demand response checklists address specific operations and complex job processes such as the operation of robotic systems or controlling hazardous energy.

Managing Hazards

Organizations covered by OSHA standards must conduct a formal hazard assessment to determine the need for personal protective equipment (PPE). This requirement provides an opportunity for organizations to establish a baseline hazard inventory and assessment. OSHA requires the use of PPE when other controls prove inadequate. A senior manager must certify the accomplishment of the PPE assessment. Hazard control managers can use the information from the PPE hazard assessment to create a *facility hazard index (FHI).* The FHI should catalog biological, chemical, physical, ergo-environmental, and psychosocial hazards. These categories could be subdivided as needed to provide a better management tool and better hazard documentation. For example, physical hazards could be subdivided into fire hazards, radiation exposure risks, and hearing conservation. Some personnel may wish to structure the FHI using other categories such as safety, security, hazardous materials, patient safety, and occupational safety. The FHI should provide a clear overview of key hazards. Update the list at least annually.

Recommend documenting the following information: (1) comprehensive hazard description, (2) date listed, (3) reason listed, (4) applicable hazard analysis information, (5) controls used to reduce risk, (6) PPE issued to employees, and (7) training or education provided to deal with a hazard.

Controlling hazards that contribute to accidents requires the use of appropriate administrative, work practice, and engineering controls. Encourage and enforce the use of proper PPE when

TABLE 1.12
Occupational Hazard Categories

- Biological hazards include bacteria, viruses, infectious waste, and bloodborne.
- Chemical hazards can pose a variety of risks due to their physical, chemical, and toxic properties.
- Ergonomic and environmental hazards include repetitive motion, standing, lifting, trips, and falls.
- Physical hazards include things such as radiation, noise, and machine-generated hazards.
- Psychosocial hazards include substance abuse, work-related stress, and workplace violence.

Note: Some hazards may fit in more than one category.

TABLE 1.13
Some Common Factors Inherent in Good Work Environments

- Good workplace design and proper equipment placement including guards and controls.
- Equipment inspections and preventive maintenance conducted as scheduled.
- Organization conducts inspections, audits, and hazard surveys on regular basis.
- Corrective actions and hazard controls implemented immediately to eliminate risks.
- Employees formally commit to work safely and maintain hazard-free work areas.
- Work areas equipped with proper lighting, ventilation, and environmental controls.
- Employees must use PPE when mandated.
- Supervisors conduct job instruction, inspections, and initial accident investigations.

mandated by the job or task. Teach supervisors how to observe, recognize, and correct unsafe behaviors. Maintain all equipment and machinery in top condition. Install and maintain appropriate safety devices or guards. Other important considerations should include designing safe work areas and properly placing machinery to meet human capabilities or limitations. Develop and implement an effective emergency action plan to address injury response, evacuations, and other contingencies. Organizations should conduct comprehensive baseline and periodic surveys to identify all safety, health, and ergonomic hazards. The results of well-conducted surveys can provide valuable information for use by the hazard control and training functions. Information technology permits organizations to provide timely hazard-related information to its members. Information accessed can include regulations, codes, standards, best industry practices, training material, and hazardous material information. Many manufacturers develop and disseminate hazard information for use by those who buy and operate their equipment and products. The information can include safety warnings, hazard label information, and operational instructions (Tables 1.12 and 1.13).

Preparing for Inspections

Conduct education and training sessions about how to conduct inspections. Periodic inspections provide opportunities for hazard control personnel, line supervisors, and top managers to listen to concerns of those doing the work. Inspections must accurately assess all environments, equipment, and processes. Don't *just look* for hazards but learn to observe individuals accomplishing specific job tasks or processes. Learning to identify hazards and recognize unsafe behaviors requires inspectors to use their observation skills. Inspectors must focus on using all five human senses. Look for deviations from accepted work practices and rely on intuition or *gut* feelings to assist with the identification of hazards. Curiosity can help uncover *hidden* hazards. Learning to use visualization techniques to *connect the dots* can create a *mind picture* of a hazardous situation.

TABLE 1.14
Common Inspection Observations

- Operating vehicle at unsafe speeds or violating safe practice rules
- Removing machine or equipment guards and tampering with safety devices
- Using defective tools and equipment or using them in unsafe ways
- Handling materials in unsafe or careless ways and lifting improperly
- Repairing/adjusting equipment while in motion, under pressure, or electrically charged
- Failing to use or improperly using PPE
- Unsafe, unsanitary, or unhealthy conditions including poor housekeeping practices
- Standing or working under suspended loads, scaffolds, shafts, or open hatches

Never allow human emotions or personal issues to drive the inspection process. Inspectors should maintain a professional demeanor and rely on logic when assessing tough situations. Inspectors must always point out potential or immediate dangers. Inspectors must never operate any equipment unless trained and authorized to do so. Inspectors should ask questions about tasks or processes but refrain from disrupting operations or creating distractions. Well-designed checklists can assist with the documentation of any key findings (Table 1.14).

Inspection Reports

When writing an inspection report, provide a summary of key unsafe conditions, unsafe behaviors, and hazards. Ensure the report includes recommendations for correcting all identified hazards. Document hazard locations by department, function, or cost center. Number or title each finding and use a hazard classification description or priority system as mandated by the organization. If possible, assign a priority to each finding. Communicate findings, to appropriate levels of management, in a concise and factual manner. Senior leaders should ensure all action items receive immediate corrective attention. If a permanent control will take time to implement, ensure that interim controls protect exposed personnel. If possible, specify the recommended corrective action for each identified hazard or unsafe condition (Table 1.15).

HAZARD ANALYSIS

Organizations can use a variety of processes to analyze workplace hazards and accident causal factors. Hazard evaluations and accident trend analysis can help improve the effectiveness of established hazard controls. Routine analysis enables an organization to develop and implement appropriate controls for hazardous processes or unsafe operations. Analysis processes rely on information collected from hazard surveys, inspections, hazard reports, and accident investigations. This analysis process can provide a *snapshot* of hazard information. Effective analysis can then take the *snapshots* and create viable pictures of hazards and accident causal factors.

TABLE 1.15
Categorizing Hazard Correction Priorities

- Category 1 or A: Major hazards that require immediate correction
- Category 2 or B: Serious hazards that require short-term correction
- Category 3 or C: Minor hazards that require correction as soon as possible
- Category 4 or D: Hazard identified but corrected on the spot

Change Analysis

Change analysis helps hazard control personnel identify hazards inherent in new processes and job-related tasks. Change analysis actually works as a proactive problem-solving technique. To solve a problem, hazard control personnel must look at situations using some type of logic process. Change analysis must attempt to identify all anticipated hazards and concerns generated by the change. Begin by defining a problem or concern. Attempt to determine what happened. Next, determine the norm or standard. Ask the question, what should have happened? Attempt to identify, locate, and describe the change by focusing on what, where, when, and to some extent how. Describe exactly the things impacted and things not affected by the change. Identify distinctive features of any change and list all possible causes. Finally, select and validate all causes before continuing with corrections or controls.

Creative Hazard Analysis

Creative hazard analysis combines innovation with human expertise to identify, discover, and analyze hazards of a process, operation, or system. Ensure the analysis team understands the problem statement. Provide the team with sufficient information such as known hazards, related technologies, operational procedures, equipment design issues, instrumentation controls, and necessary historical information. As the team works through each step of the hazard process, it should collectively generate a list of *what or why* questions related to hazards. After completing this list of *probing* questions, the team must systematically answer each question. This process can provide answers that can help achieve consensus. The answers can also generate additional questions that seek to clarify important information. The use of intuitive questions and answers provides insight for all team members. The team then works to achieve a consensus on each question and answer. The answers that achieve consensus form the foundation for developing recommendations or dictating the requirement for additional action or study. The team then can make recommendations to reduce operational hazards.

Risk Analysis

Risk analysis helps hazard control personnel assess the probability that an uncontrolled hazard could contribute to an accident event with resulting organizational losses. Risk assessments must also consider the potential severity associated with an adverse event occurrence. Analysis personnel should use available empirical data when attempting to determine probability of a risk-related event. Severity consideration should become the controlling issue when other factors indicate a low probability of an event. Risk personnel can consider hazards with acceptable risks as safe and those with unacceptable risks as unsafe. The phrase “safety first” makes a great sounding slogan and many organizations use it. Taken literally, the slogan implies that safety becomes the *primary objective* and not job or task accomplishment. However, in many very hazardous jobs and operations, a more appropriate slogan should read, “accomplish the job with safety.”

Phase Hazard Analysis

Phase hazard analysis processes work very well for construction projects and other settings with rapidly changing work environments. Consider *phase hazards* as a new or unique set of hazards not present during operations. Prior to transitioning to a new phase, conduct an analysis to identify and evaluate new or potential hazards. Use the information gained through analyses to develop action plans that can ensure implementation of appropriate controls.

Process Hazard Analysis

The OSHA Process Safety Management standard requires completion of a process hazard analysis for any activity involving the use of highly hazardous chemicals. The OSHA standard applies to

entities using, storing, manufacturing, handling, or on-site moving of highly hazardous chemicals. Process hazard analysis permits employers to accomplish detailed studies to identify every potential hazard. The analysis must include all tools and equipment, each chemical substance, known hazards, and every job-related task. The analysis must show that each element of the process poses no hazard, poses an uncontrolled hazard, or poses a hazard controllable in all foreseeable circumstances. Recommend using process hazard analysis during the design and development phases of any hazardous project or operation under development.

JOB HAZARD ANALYSIS

Job hazard analysis (JHA) permits the examination of job-related tasks, operations, and process to discover and correct inherent risks and hazards. Supervisors and other experienced personnel can perform the process by working sequentially through the steps of a job process or task. JHA can help tools, machines, and materials used to perform a job. JHA does require an understanding of potential job hazards. Personnel conducting the analysis must possess knowledge of hazard control including use of PPE. A well-developed JHA can also serve as an effective teaching tool. Organizations should develop a JHA for all tasks, processes, or phase-related jobs. Conduct and update a JHA when a process changes or an accident occurs. Recommend that each organization develops standardized procedures and formats for conducting the analysis. An effective analysis provides the basis for developing and implementing appropriate control measures. Post analysis results at appropriate workstations and other job or process locations (Table 1.16).

Job Design

Creating well-designed jobs, tasks, and processes can help reduce worker fatigue, reduce repetitive motion stress, isolate hazardous tasks, and control human factor hazards. The concept of job design refers primarily to administrative changes that help improve working conditions. Designing safe work areas must address workstation layout, tools and equipment, and the body position needed to accomplish the job. Safe work area design reduces static positions and minimizes repetitive motions and awkward body positions. Consider the importance of human factor issues when designing work processes.

HAZARD CONTROL AND CORRECTION

Organizations must use the concept known as *hierarchy of controls* to reduce, eliminate, and control hazards or hazardous processes. Hazard controls can also include actions such as using *enclosure,*

TABLE 1.16
Job Hazard Analyses

Step A: Break the job down—Examine each step in the process for hazards or unsafe conditions that could develop during job accomplishments

Step B: Identify hazards—Document process hazards, environmental concerns, and any anticipated human issues

Step C: Evaluate hazards—Assess identified hazards and behaviors to determine their potential roles in an accident event

Step D: Develop and design hazard controls—Develop or design the best hazard control based on evaluating each hazard. Coordinate implementation of all feasible controls

Step E: Implement required controls—Coordinate and obtain management approval for implementation

Step F: Revise and publish the JHA information—Update the JHA and then communicate implementation actions with the organizational members

TABLE 1.17
Hazard Correction Monitoring System

- Implement a system to report and track hazards correction actions.
- Establish a timetable for implementing hazard controls.
- Prioritize hazards identified by inspections, reporting, and accident investigations.
- Require employees to report hazards using established processes.
- Provide quick feedback about the status of hazard correction.
- Delegate responsibility for correcting and documenting completion actions.
- Permit supervisors and experienced employees to initiate hazard correction actions.

TABLE 1.18
Common *Never-Ever* Hazards

- Obstacles preventing the safe movement of people, vehicles, or machines
- Blocked or inadequate egress routes and emergency exits
- Unsafe working and walking surfaces
- Using worn or damaged tools and equipment or misusing tools
- Failing to identify hazards and provide proper equipment including PPE
- Operating equipment with guards removed or bypassed
- Permitting the presence of worn, damaged, or unguarded electrical wiring, fixtures, or cords
- Lack of or inadequate warning, danger, or caution sign in hazardous areas

substitution, and *attenuation* to reduce human exposure risks. An enclosure keeps a hazard *physically* away from humans. For example, completely enclosing high-voltage electrical equipment prevents access by unauthorized persons. Substitution can involve replacing a highly dangerous substance with a less hazardous one. Attenuation refers to taking actions to weaken or lessen a potential hazard. Attenuation could involve weakening radioactive beams or attenuating noise to safer levels. The use of system safety methods, traditional hazard control techniques, and human factors must begin at the initial stages of any design process (Table 1.17).

Passive hazard controls would not require continuous or even occasional actions from system users. Active controls would require operators and users to accomplish a task at some point during the operation to reduce risks and control hazards (Table 1.18).

Engineering Controls

Seek to eliminate hazards by using appropriate engineering controls. Make the modifications as necessary to eliminate hazards and unsafe conditions. The design of machine guards, automobile brakes, traffic signals, pressure relief valves, and ventilation demonstrates engineering controls at work. For example, proper ventilation can remove or dilute air contaminants in work areas. Air cleaning devices can also remove contaminants such as particulates, gases, and vapors from the air. Using engineering, design, and technical innovation remains the top priority for controlling or eliminating hazards. Establishing preventive and periodic maintenance processes can help ensure tools and equipment operate properly and safely. Preventive maintenance must also address engineered hazard controls and emergency equipment. If needed, schedule shutdowns to address preventive and predictive maintenance issues. Ensure the preventive maintenance addresses safety and hazard control issues as well as operational or production requirements.

TABLE 1.19
Hierarchies for Controlling Hazards

- Engineering and technological innovation remains the preferred type of hazard control.
- Substitution results in using a less hazardous substance or piece of equipment.
- Isolation moves either workers or hazardous operations to reduce risks.
- Work practices such as policies or rules can reduce human exposure to the hazard.
- Administrative controls limit human exposures through the rotation and scheduling.
- Consider PPE when other controls prove inadequate.

Administrative Controls

Use administrative controls such as scheduling to limit worker exposure to many workplace hazards such as working in hot areas. However, OSHA prohibits employee scheduling to meet the requirement of air contaminant exposure limits. The scheduling of maintenance and other high exposure operations during evenings or weekends can reduce exposures. Use job rotation to limit repetitive motion tasks or reduce the exposure time to occupational noise hazards. Use a work–rest schedule for very hazardous or strenuous tasks.

Work Practice Controls

These controls can reduce hazard exposure through development of standard operating procedures (SOPs). Another important work practice relates to conducting training and education about the safe use of tools and equipment. Practices can also include knowing emergency response procedures for spills, fire prevention principles, and dealing with employee injuries. Job-related education and training helps individuals work safely and minimize hazard exposure risks. Work practice controls must address task accomplishment and ensure workers understand all job-related hazards (Table 1.19).

PERSONAL PROTECTIVE EQUIPMENT

Consider the use of appropriate PPE and clothing when engineering, administrative, and work practice controls fail to provide adequate or mandated protection for individuals exposed to hazards and unsafe conditions. OSHA can require PPE to protect the eyes, face, head, and extremities. Examples can include protective clothing, respiratory devices, protective shields, and barriers. When employees provide their own PPE, the employer must ensure its adequacy, including proper maintenance, and sanitation. Employers must assess the workplace to determine hazards that would require the use of PPE. Employers must select and require the use of PPE that will protect from the hazards identified in the PPE hazard assessment. OSHA requires the employer to verify completion of the assessment through a written certification that identifies the workplace, certifying person, and assessment date. Never permit use of defective or damaged PPE. Train employees on the proper selection and use of PPE. Employees must demonstrate the ability to use PPE properly before using it on the job. Provide retraining whenever employees fail to demonstrate an understanding of proper PPE use. Never use PPE as a substitute for engineering, work practice, or administrative controls. Consider PPE as all clothing and other work accessories designed to create a hazard protection barrier. PPE should comply with applicable American National Standards Institute (ANSI) standards. Using PPE can create hazards such as heat disorders, physical stress, impaired vision, and reduced mobility. Review PPE policies at least annually. The review should include evaluation of accident and injury data, current hazard exposures, training effectiveness, and documentation procedures. The employer must verify that affected employees receive and understand required training through

a written certification that contains the name of each employee, dates of training, and topics covered. Employers in most situations must provide PPE mandated by OSHA at no cost to employees. OSHA does not require employers to pay for nonspecialty safety-toe footwear including steel-toe shoes or boots and nonspecialty prescription safety eyewear if employees wear them away from job site. The employer must pay for replacement PPE, except when the employee loses or intentionally damages PPE. When employees provide their own PPE, employers may permit use. OSHA does not require reimbursement to the employee for that equipment. Employers cannot require employees to provide their own or pay for PPE.

Eye and Face Protection

Refer to 29 Code of Federal Regulations (CFR) 1910.133 for OSHA standards covering eye and face protection requirements. Employers must provide suitable eye protection when flying particles, molten metal, liquid chemicals, acids or caustic liquids, chemical gases or vapors, potentially injurious light radiation, or any combination hazard exists in the workplace. Protective eye and face devices must comply with ANSI Z-87, Occupational and Educational Eye and Face Protection. Eye protectors must prove adequate against particular hazards with a reasonably comfortable fit when worn under designated conditions. Protectors must demonstrate durability and fit snugly without interfering with the movements or vision of the wearer. Finally, keep eye protectors disinfected and in good repair.

Head Protection

Refer to 29 CFR 1910.135 for information about OSHA head protection. Ensure workers wear appropriate head protection that can resist penetration and absorb the shock of blows. Evaluate the need for using protective hats to protect against electric shock. OSHA requires head protection hats to meet the requirement of ANSI Z-89.1, Industrial Head Protection, and Z-89.2, Requirements for Industrial Protective Helmets for Electrical Workers. Each type and class of head protector must provide protection against specific hazardous conditions. An understanding of these conditions will help in selecting the right hat for the particular situation.

Foot Protection

Refer to 29 CFR 1910.136 for OSHA standards addressing foot protection. Select safety shoes made of sturdy materials with impact-resistant toes. Some shoes contain metal insoles that protect against puncture wounds. Additional protection in the form of metatarsal guards can provide additional protection. Today's safety shoes come in a variety of styles and materials. Classification of safety shoes relates directly to their ability to meet requirements of compression and impact tests. Protective footwear must comply with the requirements found in the ANSI Z-41.1 Standard.

Arm and Hand Protection

Refer to 29 CFR 1910.137 for OSHA standards addressing arm and hand protection. Employers must provide appropriate protection when hazard assessments reveal engineering and work practice controls cannot eliminate injury risks. Potential hazards can include skin absorption of harmful substances, chemical or thermal burns, electrical dangers, bruises or abrasions, cuts or punctures, fractures, and amputations. Protective equipment can include gloves, finger guards, arm coverings, and elbow-length gloves. Employers must evaluate the use of engineering and work practice controls before requiring glove use. The nature of the hazard and the operations involved will affect the selection of gloves. Require employees to use gloves designed for the specific hazards and tasks.

Body and Torso Protection

Certain hazards may require the use of body protection clothing or equipment. For example, exposure to address biohazards or chemical hazards during the mixing of dangerous drugs would require body protection. However, other hazards that could pose a risk to the body include heat sources, hot metal exposures during welding operations, hot liquids, and radiation exposures. Body protection clothing can vary and could include gowns, vests, jackets, aprons, coveralls, and full bodysuits. Refer to manufacturer or supplier selection guides for information on the effectiveness of specific materials against specific hazards. Inspect clothing to ensure proper fit and function.

HAZARD CONTROL COMMITTEES

Safety committees can make positive contributions to the success of the hazard control function. Committees can help review results of inspections, audits, and other evaluations. Top management that fails to properly assign committee responsibilities and delegate authority will undermine their effectiveness. Some top management personnel do acknowledge committee existence but ignore their contributions and suggestions. An effective committee must work hard to interact with all organizational members to improve their hazard control awareness. Top management ultimately must take responsibility for committee successes and failures. Top management must also provide supporting systems, authority, and necessary resources to help ensure committee success. Committee membership must include nonsupervisory and hourly personnel with representation from key functions, departments, and divisions. Committee authority and responsibilities can vary depending on the organization. Some organizations refrain from using the term *committee* and opt to use another term such as *advisory panel*. Regardless of the term used, committees, teams, and panels can help improve organizational hazard control efficiency and effectiveness if proactively involved (Table 1.20).

Hazard Survey Teams

Organizations should consider establishing a hazard survey team to supplement the established hazard control committee. This team functions best when comprised of screened volunteers with no formal supervisory responsibilities. This team can help inspectors conduct walking hazard surveys to identify unsafe conditions and risky behaviors. Provide the team with a pretour educational session that informs them of tour expectations and procedures. For example, if the survey will target basic electrical hazards, provide them with realistic information about how to recognize and document these hazards. The team should meet after the survey to discuss and validate the findings. The organization can start determining corrective actions. Team members should remember what they learned during the survey.

TABLE 1.20
Basic Safety Committee Duties

- Participate in self-inspections and hazard surveys.
- Encourage organizational members to work safely.
- Assist with the JHA processes.
- Provide input for hazard control policies, procedures, and rules.
- Promote hazard control efforts at organizational meetings.
- Assist supervisors with initial accident investigations.
- Communicate employee hazard control concerns to management.

TABLE 1.21
Symptoms of Ineffective Hazard Control

- Managers fail to recognize or acknowledge existence of hidden cultures.
- Organizational members do not view hazard control as operational priority.
- Accident investigations fail to focus on documenting causal factors and root causes.
- Senior managers fail to provide visible hazard control leadership.
- Leaders do not provide sufficient resources to support hazard control efforts.
- Leaders view hazard control as a necessary program but not vital to organizational success.
- Orientation, education, and training objectives fail to address *real-world* issues.
- Hazard control managers expected to prevent all accidents and injuries.
- Leaders fail to hold accountable organizational members not supporting hazard control efforts.

HAZARD CONTROL EVALUATION

OSHA uses injury and illness rates to assess effectiveness of occupational safety and health efforts. Insurance companies use an experience model to determine good and poor risks for underwriting workers' compensation coverage. Accident and injury experience does provide a good indicator about the effectiveness of hazard control initiatives. However, accident frequency and severity rates alone do not always accurately evaluate effectiveness of an accident prevention function. For example, an organization may experience an underreporting of occupational disease cases and hazardous materials exposures (Table 1.21).

Placing too much emphasis on injury-producing events but not focusing on potentially serious close-call incidents can result in unreliable effective assessments. Rather than relying solely on injury rates or other postevent assessments, organizations could use a broader hazard control audit process. This management style audit would address several key components of the accident prevention process. The audit forms would help evaluators rate each component against prepublished standards. Evaluators should review policies, plans, and organizational records. They should also conduct interviews, personally observe, and use employee questionnaires to help validate audit scores assigned to each component. Organizational leaders must then evaluate all other related initiatives designed to support the hazard control function. Evaluations must assess reporting accuracy and effectiveness of hazard analysis activities. Review hazard surveys and self-inspection reports to determine accuracy and comprehensiveness (Table 1.22).

Areas to Evaluate

Evaluate senior leader commitment by determining time and resources allocated to hazard control efforts. Determine which policies and procedures enhanced hazard control effectiveness. Conduct evaluations to determine how well interfacing staff functions support hazard control efforts and accident prevention initiatives. Review submitted cost–benefit analysis reports to determine accuracy

TABLE 1.22
Improving Hazard Control Effectiveness

- Use hazard analysis to define and pinpoint organizational problems or trends.
- Improve the hazard control function proportionally with improvements made in other areas.
- Emphasize the importance that safe behaviors and good communication play in reducing losses.
- Consider hazard control as a production tool that can improve the bottom line.
- Provide off-the-job safety and health education to all employees on regular basis.
- Recognize the existence of covert cultures operating within the organization.

and documentation reliability. If conducted, review results of perception surveys completed during the evaluation period. Refer to a sample perception survey located in the appendices of this book. Review and assess the information included in organizational property damage reports. Attempt to compare or *benchmark* accident and injury data with similar types of organizations or industries. Refer to compliance and insurance inspection to ensure completion of corrective actions of all recommendations and findings. Organizations can also conduct risk measurements by reviewing historical accident and injury frequency and severity data. This retrospective measurement can provide valuable information about exposure sources that contributed to the injury or illness. Historical accident and inspection reports can also shed light on causal factors and the circumstances contributing to the injury or damage. Knowledge of accident causal factors when connected to specific job and tasks can provide insight for recognizing potential risk.

Accreditation Standards

Safety and security risks affect all individuals in the organization including patients, visitors, and staff. Safety risks may arise from the structure of the physical environment or the performance of everyday tasks. Security incidents are often intentional. Proper security protects individuals and property against harm or loss. Safety and security risks associated with the environment of care (EOC) should be assessed. Risks are best identified from internal sources using ongoing monitoring of the environment, results of root cause analyses (RCA), and results of annual proactive risk assessments of high-risk processes and from credible external sources such as Sentinel Event Alerts. One or more persons should be assigned to manage risks associated with the management plans described in the Joint Commission's EOC chapter. They should coordinate and manage risk assessment and risk reduction activities and intervene when conditions threaten life or health. Risks come from many places within the EOC, including (1) safety of patient, staff, and visitors; (2) security of patients, staff, visitors, and the facility; (3) hazardous materials and waste; (4) medical equipment; and (5) utility systems. Written plans should address the scope and objective of the organization's risk assessment and how those risks will be managed. By conducting environmental tours every 6 months in patient care areas, evaluation of the effectiveness of these plans can be identified. The goal is to minimize or eliminate EOC risks. An annual environmental tour conducted in nonpatient-care areas allows for evaluation of the effectiveness of activities intended to minimize or eliminate risks in that environment. Evaluate each management plan's objectives, scope, and performance for effectiveness at least every 12 months.

HAZARDS

The Joint Commission requires environmental tours to identify hazards at least semiannually in all patient or clinical areas. Conduct at least annual surveys in nonclinical areas. Large organizations should develop a schedule for conducting environmental tours. Plan to conduct tours based on a departmental schedule. Attempt to identify hazards by location, category, or specific topics such as electrical. Proper scheduling permits trained personnel to be throughout the facility on a frequent basis. Document findings but remember that identifying hazards remains the key objective. Documentation for outside agencies should never be the goal of a good hazard surveillance plan. Attempting to identify all hazards throughout the facility during the annual or semiannual tours would not be realistic. Recommend use of a multidisciplinary team comprised of personnel with clinical or technical expertise. The team, led by a health or safety professional, should have expertise in several specialties, including policy development. The team leader must be able to develop and maintain an effective plan. Surveillance involves collecting, obtaining, and using employee data or information to determine trends, problems, and risks associated with hazards. There are two primary types of surveillance. The first is referred to as *passive surveillance* and involves utilizing existing data to describe past trends. Documentation that is collected through recordkeeping

provides data for an analysis of trends. The availability and access to these records will depend on hospital policy and legal limitations such as access to employee medical records. The person accessing and reviewing these records must be cognizant of the limitations of access to such information. The second type of surveillance involves collecting data that are not currently documented to describe current trends and identify problem areas. This active or proactive surveillance uses a number of tools to obtain information. The data can be obtained from sources such as questionnaires, screening documents, or actual surveys.

Conducting Hazard Surveys and Environmental Tours

There are many approaches that can be used to conduct hazard surveys and environmental tours in a healthcare organization. The Joint Commission establishes some minimum requirements of frequency in patient and nonpatient areas. However, each organization must establish their own policies and procedures for these tours. It can vary depending on facility size, staffing, and organizational structure. One outstanding way to conduct these tours and surveys is to use a decentralized approach. This decentralized approach must use several *hazard survey documents* to ensure effectiveness. Hazard survey documents can include (1) general hazard guides, (2) well-developed general safety checklists, and (3) demand response or algorithm type of checklists. Hazard guides serve as specific documents that provide guidance in the identification of hazards related to exposures such as radiation, lasers, or hazardous drugs. General checklists address common hazards such as electrical safety, ladder safety, or general fire safety issues. Demand response checklists address specific hazards related to processes or equipment such as lockout procedures, boiler safety, or fire alarm devices. Each department or function should develop their own guides or checklists. It is not possible in many organizations for the healthcare safety staff or director to conduct thorough tours or surveys of safety subsystems. The decentralization of safety does not mean that the designated safety staff has no real responsibilities. To the contrary, the staff must oversee the entire organizational safety system. Duties include collecting and analyzing hazard data, assisting supervisors and managers at all levels, and coordinating all the components of an effective safety system. However, with the myriad of safety subsystems existing in healthcare, the safety staff must rely on the actions of key supervisors and safety liaisons (formal or informal) located within every department, function, or area. Hazard surveys should be an ongoing process throughout the organization. Many healthcare organizations have not compiled an accurate hazard inventory of their facility and associated operations.

FACILITY HAZARD INDEX

The information obtained in the OSHA PPE assessment can also be used by healthcare safety personnel to create a personal management tool called the FHI. The FHI has the same basic purpose as does the Life Safety Statement of Conditions (SOC) but in reality is closer to an HVA. It presents a *hazard picture* of the entire facility and campus. The FHI should present information about the key hazards existing within the facility. The index could contain information on the five basic hazard categories: (1) biological, (2) chemical, (3) physical, (4) ergo-environmental, and (5) psychosocial. These categories could be subdivided as needed to provide a better management tool and better hazard documentation. For example, physical hazards could be subdivided into fire hazards, radiation exposure risks, and hearing conservation. Some safety personnel may wish to structure their FHI using other categories such as safety, security, hazardous materials, patient safety, and occupational safety. Some hazards or type of accidents may be included because of harm caused to employees or by frequency of events. Remember that hazards may be classified in different ways and some hazards may be included in multiple categories. Regardless of the hazard categories used, the information contained in FHI provides an overview about hazards of concern. The FHI is an informal management tool used to remind facility personnel about hazards of greatest concern. The hazard list should be updated at least annually. Delete a hazard or accident event type from the list

when it no longer meets the local threshold or definition of a serious hazard. I recommend that facility personnel document the following information about each hazard listed in FHI document: (1) complete hazard description, (2) date listed, (3) reason listed, (4) applicable hazard analysis information, (5) controls used to reduce risk, (6) PPE issued to employees, and (7) training or education provided as result of the hazard. Remember that all hazards are not equal. Many hazards have the potential to cause serious harm to people and damage to property if not controlled.

SAFETY ACTION TEAMS

Many people have heard politicians use the phrase *trickle-down* economics. Some believe it works and others do not. However, safety can trickle down within most healthcare organizations that promote proactive methods. One of the best ways to get people involved in safety within healthcare organizations is a simple one. Place hourly employees on a *safety action* team (SAT). A team is comprised of screened volunteers who have no direct supervisory responsibility. This special team is designed to assist with hazard surveys and environmental tours of the facilities. The team will conduct walking tours, under supervision of a safety or facility specialist, to identify hazards. They should also be encouraged to look for serious hazardous situations and unsafe behaviors. Meet with the group on scheduled basis. Conduct a pretour session to educate them about the hazards to be identified during the walking tour. For example, electrical hazards can exist throughout a healthcare facility. Provide them a clip board, paper, and pencil. Challenge them to identify three of four hazards during the tour. Some common healthcare electrical hazards include things such as tape used to repair electrical cords, extension cords misused, and blank spaces in electrical panels. Once the tour is complete, meet with the entire group to conduct a debriefing. Discuss the hazards identified during the tour. Compile a complete report from the information provided. Not only has the team identified electrical hazards during their tour but you have also educated each team member about the importance of electrical safety. Many of the team members will remember what they learned. Their knowledge will *trickle down* to others including their peers. Organizations that implement effective SAT will never be short of volunteers. Create teams for all three shifts at the facility. Develop a way to recognize all SAT members for their service to the organization.

SYSTEM SAFETY

Two early pioneers in system thinking, Daniel Katz and Robert Kahn, viewed most organizations as open social systems. These open systems consisted of specialized and interdependent subsystems. These subsystems possessed processes of communication, feedback mechanisms, and management intervention that linked them together. Katz and Kahn held that the closed-system approach failed to take into account how organizations reciprocate and depend on external environments. For example, environmental forces such as customers and competitors exert considerable influence on corporations. This influence highlights the essential relationship between an organization and its environment. That relationship promotes the importance of maintaining external inputs to achieve organizational stability. We can describe a system using three brief definitions: (1) a set of interrelated parts that function as a whole to achieve a common purpose, (2) a piece of software that operates to manage a related collection of tasks, or (3) a design for an organization that perceives sets of processes as a related collection of tasks. Systems operate as either open or closed entities or processes. Systems can take various forms or shapes and express themselves as mechanical, biological, or social entities. Open systems can interact with other inside subsystems or the outside environment. Closed systems exert little interaction with other systems or the outside environment. Open-systems theory originated in the natural science fields. It subsequently spread to fields as diverse as information technology, engineering, and organizational management. Open systems view an organization as an entity that takes inputs from the environment, transforms those inputs, and releases outputs. This results in reciprocal effects on the organization itself along with

TABLE 1.23
Design-Related Weaknesses

- Failure to design adequately
- Missing or inadequate policies and rules
- Training and education objective not developed
- Poorly written plans
- Inadequate processes
- Lack of appropriate procedures

TABLE 1.24
Operational-Related Failures

- Not implementing or carrying out required functions or processes
- Not adhering to established policies, procedures, and directives
- Not developing and presenting appropriate education and training sessions
- Not ensuring adequate supervision or failing to provide required oversight
- Not conducting comprehensive accident or RCA after a mishap
- Not evaluating plans, procedures, and processes to determine weaknesses

the environments in which the organization operates. An organization can become part of the environment in which it operates. The majority of systems operate as open entities. These systems require interaction with the environment for the source of inputs and the destination of outputs (Tables 1.23 and 1.24).

Safety engineering addresses fundamental principles and rules used to identify, evaluate, and control hazards within *man and machine* interface systems. Consider safety engineering as the physical and mathematical components of loss control efforts. We must view hazard control management as an organizational function that addresses the leadership, behavioral, and administrative aspects of preventing loss. Hazard control management must provide the structure and insight for applying safety engineering and human factors principles to accident prevention. Safety engineers analyze the early design of a system to discover potential faults and flaws. Safe design attempts to achieve an acceptable mishap risk through a systematic application of guidance obtained from standards, specifications, regulations, handbooks, checklists, and other sources. Safe design needs derive from the selected parameters and associated acceptance criteria. The life cycle of systems includes design, research, development, evaluation, production, inventory, operational support, and disposal. Probabilistic fault tolerance adds redundancy to equipment and systems.

The expression "safety critical" refers to any condition, event, operation, process, or item whose proper recognition, control, performance, or tolerance is essential to safe system operation. The underlying concept of system safety considers the whole as more than the sum of its parts. System processes focus on eliminating, controlling, and managing hazards throughout the life cycle of the system. The following steps contribute to safe operational designs: (1) planning, (2) hazard identification, (3) hazard analysis, (4) risk assessment, and (5) making proper decisions through the use of risk management to implement suitable controls. System safety techniques can help control accidents and loss by focusing on discovering the underlying causal factors. System safety must accept an optimized level of risk constrained by cost, time, and operational effectiveness/performance. *Normative safety* describes products that meet applicable design specifications or standards. We can define a mishap (another term for accident) as an unplanned event or series of events resulting in death, injury, illness, damage to or loss of equipment or property, or damage to the environment. Mishap risk

TABLE 1.25
Key System Safety Elements

- Standardize, simplify, and automate as much as possible.
- Minimize fatigue, stress, and boredom.
- Reduce reliance on human memory but promote human vigilance.
- Encourage teamwork and improve reporting accuracy and timeliness.
- Enhance information transfer within the organization.
- Design safe equipment and use periodic maintenance to reduce failures.
- Consider technology and human interface when designing processes.
- Study history to ensure that patient safety continues to improve over time.
- Statistics can help measure impact of interventions or innovations.
- Continuous improvement processes shift focus from an individual to a team.

relates to potential severity and probability of occurrence. Mishap probability relates to an arbitrary categorization that provides a qualitative measure of the most reasonable likelihood of occurrence.

This undesired event can result from personnel error, environmental conditions, design inadequacies, and procedural deficiencies. It can also relate to system, subsystem, or component failure or malfunction. System safety methods require acceptance of some level of mishap risk, determine mishap probability, establish severity threshold, and create appropriate documentation procedures (Table 1.25).

System reliability refers to the probability that a system or process will consistently perform as designed. We can view reliability as opposite of a system's rate of error or failure. Many reliable systems will not work effectively unless accepted in an organizational culture that values teamwork, communication, accountability, and learning from mistakes. Many improvement processes focus too much on operational effort expended instead of focusing on process or system design issues. Too much focus on individual outcomes can exaggerate overall reliability. Autonomy permits systems to have wide margins of performance (Table 1.26).

Hazard and Operability

Hazard and operability (HAZOP) studies can help systematically investigate each element of an operational system or process. HAZOP can also help discover ways in which important parameters can deviate from intended designs or configurations. Deviations can create hazards and other operational problems. An expert team can address hazards and operability problems using diagrams to study the effects of such potential hazards. The team must seek to identify and then select the parameters needing study. The team must assess the impact of design deviations. The team agrees

TABLE 1.26
System Failure and Error Considerations

- Complex systems can break or fail, which can result in harm.
- Systems and processes may contain a latent defect that leads to harmful results.
- Humans tend to develop or modify behaviors to compensate for chronic system flaws.
- Errors can occur far from the actual operational location of the system or process.
- Some organizational cultures can promote too much individual accountability.
- Those attempting to fix system errors may not see how their actions impact operations.
- Personnel can spend valuable time trying to determine factors that contribute to harm.
- Personnel must understand that any part of a system can impact operational integrity.

on a list of descriptive key words such as *more of* or *part of* to describe each noted deviation. The team evaluates the system as designed. However, the team also notes all deviations that could cause failure. The team then seeks to identify effectiveness of any existing controls or protective safeguards. Finally, the team must evaluate causal factors, determine the consequences of failure, and determine the corrective actions needed to control or eliminate the hazards.

Failure Mode and Effects Analysis

Failure mode and effects analysis (FMEA) uses a diagram of a system or process to determine potential failures and resulting severity consequences. System safety personnel must consider failure outcomes at each block or point of the diagramed system. The analysis permits assessment of potential failures using frequency of occurrence empirical data. The process would evaluate and document by failure mode the potential impact of each functional or hardware failure. Such failures could impact system success, safety, maintainability, and performance. If possible, consider analyzing multiple concurrent failures during an analysis process. Consider each component's effect on operational safety and impact of failure. An effective analysis must consider both the frequency and severity of possible component failure. Analyze each component to determine potential mode of failure, effects of failure, and failure detection methods. The final aspect of the FMEA process consists of analyzing component data to develop hazard controls that lower risks and consequences of failure. The last step in the process involves the analysis of the data for each component or multiple component failure. Finally, develop recommendations that address appropriate risk management action or intervention. FMEA helps identify parts, processes, or systems that are most likely to fail. Using FMEA during the design phase can reduce overall costs by identifying single-point failures and other concerns prior to system development. FMEA works well as a troubleshooting tool to identify corrective actions for a potential failure. FMEA addresses the areas of design, operating parameters, and maintenance of the system. It will address system safety challenges, risks, and problems. FMEA processes can discover and document issues in the following areas: (1) design and development, (2) complex processes, (3) safety and hazard control, and (4) environment-related concerns. Human harm remains the top consequence of failure.

Fault Tree Analysis

Fault tree analysis (FTA) focuses on the identification of multiple-point failures by using a deductive top-down method to analyze effects of initiating faults and events occurring in complex systems. FTA works very well illustrating how complex systems can overcome single or multiple initiating faults that could result in failure. FTA does not work well in discovering all possible initiating faults. More than one condition must occur for a particular failure to happen. The probability of failure for various components uses Boolean algebraic symbols. Determine and place on the fault tree each situation or hazard that could impact the system. Do this by using a series of *logic* expressions. Fault trees using actual numbers permit the calculation of failure probabilities. Event trees can start from an undesired initiator such as the loss of critical power supply or component failure. Event trees follow a fault through other system components. This allows for determination of final consequences. When considering a new event, add a new node on the tree. This permits a splitting of probabilities by taking either branch. FTA considers external events while FMEA does not. FTA starts by examining an undesirable outcome and then *traces back* through the diagram to identify all possible events or combinations of events that would need to occur to produce *that* specific outcome. FTA requires the use of logic symbols to trace the sequences of events that could result in an incident. The resulting diagram looks like a tree with many branches with each branch listing sequential events or failures for different independent paths to the top event. Analysts then can better assign failure rate data to each event and calculate the probability of an undesired event occurrence.

Hazard Control and Risk Management

Risk management in any setting can be described as the probability that a hazard will cause injury or damage. In some organizations, risk management operates separately from the hazard control function. For example, hospitals consider risk management to be a separate function from environmental safety efforts. Some other types of organizations may consider risk management as an integral element of hazard control function. Risk management from an insurance and loss control perspective can quickly become a reactive managerial element. Risk management views all losses to the organization and not just human injury. Risk assessment relates to the process by which risk analysis results drive decision making. Risk control efforts address hazardous events by implementing interventions to reduce severity. Risk management includes not only control efforts but finance as well. Risk control considers all aspects of system safety, hazard control management, and safety engineering. Risk finance considers insurance, risk pooling, and self-insurance.

Instructional Systems Design

Instructional Systems Design (ISD) can maximize effectiveness, efficiency, and appeal of instruction. The process must determine the current knowledge or competence of the learner. The process must also know the level of competence the learner must achieve during the instructional process. ISD can help define learning objectives and employs proven instructional methods to achieve results. The basic model works in most training environments. The military used some basic pre-ISD concepts during World War II. Leaders broke down important tasks and subtasks. They treated each one as a separate learning goal. Training rewarded correct performance and used remediation processes to address incorrect performance. ISD concepts developed from contributions from a number of disciplines including system engineering, behavioral science, cognitive psychology, and instructional methodology (Table 1.27).

ERGONOMICS

The word ergonomics comes from the Greek words ergo, which means work, and nomos, which means law. It can also be referred to as the science or art of fitting the job to a worker. A mismatch between the physical requirements of a task and the physical capacity of the worker can result in musculoskeletal disorders (MSDs). Ergonomics should focus on designing equipment and integrating work tasks to benefit the ability of the worker. Healthcare facility work environments expose patient and resident caregivers to ergonomic stressors. Successful ergonomic interventions must deal with personal issues instead of attempting to solve problems with universal solutions. Healthcare organizations should address ergonomic issues, risks, and injuries by developing a written ergonomics safety management plan.

Ergonomics and human factors are often used interchangeably. Ergonomic hazards refer to workplace conditions that pose the risk of injury to the musculoskeletal system of the worker. Ergonomic hazards include repetitive and forceful movements, vibration, temperature extremes,

TABLE 1.27
System Functions

- Management: Directing or controlling instructional system development and operations
- Support: Maintaining or servicing all parts of the system
- Administration: Addresses issues such as day-to-day processing and recordkeeping
- Delivery: Providing effective training and education to students
- Evaluation: Obtaining feedback and information by using operational evaluations

and awkward postures that arise from improper work methods and improperly designed workstations, tools, and equipment. Ergonomics addresses issues related to the *fit* between people and their technological tools and environments. Ergonomics draws on many disciplines in its study of humans and their environments, including anthropometry, biomechanics, mechanical engineering, industrial engineering, industrial design, kinesiology, physiology, and psychology. Many organizations develop and implement an ergonomics policy with written goals, objectives, and accountability policies. Leaders should encourage worker involvement in the ergonomics improvement efforts. The National Institute for Occupational Safety and Health (NIOSH) recommends reducing or eliminating potentially hazardous conditions using engineering controls or implementing work practices and improved management policies. To meet ergonomics challenges, equipment should comply with ergonomics principles. Effective training covers the problems found in each employee's job. Training and education can go a long way toward increasing safety awareness of both managers and employees. Training and education can keep employees informed about workplace hazards. Soliciting suggestions from workers about ergonomic hazards can help improve work practices. Effective training can ensure employees properly use equipment, tools, and machine controls.

Reactive ergonomics only takes corrective actions when required to do so by injury or complaint. Proactive ergonomics seeks to identify all areas needing improvement. Attempt to solve problems by changing equipment design, modifying job tasks, and improving environmental designs. Healthcare providers need to be familiar with worker jobs and tasks and participate in matching jobs and work environments to worker needs. Use information obtained from JHAs, job descriptions, photographs, and videotapes to identify ergonomic hazards. According to the International Ergonomics Association, physical ergonomics addresses human anatomical, anthropometric, and physiological issues that relate to physical activity. Cognitive ergonomics addresses the concern with mental processes such as perception, memory, reasoning, and motor response. Macro-ergonomics emphasizes a broad system view of design considering organizational environments, culture, history, and work goals. It deals with the physical design of tools and the environment. It is the study of the society and technology interface and considers human, technological, and environmental variables and their interactions (Table 1.28).

Human factors, as a science, cover the science of understanding the properties of human capabilities. The application of this understanding to the design, development, and deployment of systems and services relates to human factors engineering. Human factors can include sets of human-specific physical, cognitive, or social properties. These human factor sets can interact in a critical or dangerous manner with technological systems, the human natural environment, or human organizations. Human factors engineering applies knowledge about human capabilities and limitations to the design of products, processes, systems, and work environments. It also relates to the design of all systems having any type of human interface. Its application to system design improves ease of use and performance while reducing errors, operator stress, training, user fatigue, and product liability. It is the only discipline that relates humans to technology. Human factors engineering focuses on how people interact with tasks, machines or computers, and the environment with the consideration that humans have limitations and capabilities (Table 1.29).

TABLE 1.28
Examples of Ergonomic Risk Factors

- Jobs requiring identical motions every 3–5 s for more than 2 h
- Work postures such as kneeling, twisting, or squatting for more than 2 h
- Use of vibration or impact tools or equipment for more than a total of 2 h
- Lifting, lowering, or carrying more than 25 lb more than once during a work shift
- Piece rate or machine-paced work for more than 4 h at a time
- Workers' complaints of physical aches and pains related to their work assignments

TABLE 1.29
Factors Impairing Human Performance

- Limited short-term memory
- Running late or being in a hurry
- Inability to multitask
- Interruption of the job or task
- Stress or the lack of sleep
- Fatigue or effects of shift work
- Environmental factors
- Personal or home distractions
- Drug and substance abuse

Musculoskeletal Disorders

Early indications of MSDs can include persistent pain, restriction of joint movement, or soft tissue swelling. Activities outside of the workplace that involve substantial physical demands may also cause or contribute to MSDs. In addition, development of MSDs may be related to genetic causes, gender, age, and other factors. There is evidence that reports of MSDs may be linked to certain factors such as job dissatisfaction, monotonous work, and limited job control. Encourage workers to participate in the design of work, equipment, procedures, and training. Evaluate equipment regularly and respond to employee surveys. Effective solutions usually involve workplace modifications that eliminate hazards and improve the work environment. Proper training is necessary to ensure that employees and managers can recognize potential ergonomics issues in the workplace and understand measures that are available to minimize the risk of injury. Ergonomics training can be integrated into general training on performance requirements and job practices. Work-related MSDs should be managed in the same manner and under the same process as any other occupational injury or illness. Like many injuries and illnesses, employers and employees can benefit from early reporting of MSDs. Early diagnosis and intervention, including return-to-duty procedures, can improve the effectiveness of employee treatment. Return to duty can also minimize the likelihood of disability and reduce workers' compensation costs.

Evaluate Ergonomics Efforts

Leaders should evaluate the effectiveness of ergonomics efforts and follow-up on unresolved problems. Evaluation and follow-up are central to continuous improvement and long-term success. Good medical management can help eliminate or reduce development of ergonomics-related problems. The goal should be early identification, evaluation, and treatment of problems. Elements of medical management should include the following: (1) accurate reporting and recording, (2) responding to complaints and symptoms, (3) providing employee education, (4) conducting periodic surveys, (5) establishing baseline health assessments, and (6) implementing surveillance procedures.

Workstation Evaluations

Evaluations should assess prolonged work in any posture that may result in harm or injury. Assess offices, computer areas, and nursing stations. Evaluate force, duration, position, frequency, and metabolic expenditure of workers. Workers should be provided with good chairs that have arm and leg rests if required. Provide workstations that permit posture variations and with sufficient space

for knees and feet. Workers such as admission personnel, appointment desks, transcription functions, medical coding personnel, and other data entry personnel that work on computers 4 h or more each are at risk for developing hand, arm, shoulder, neck, or back disorders.

Computer Workstation Interventions

Signs of problems can include complaints of pain, tingling, numbness, swelling, and other discomforts. Employers should analyze trends, absenteeism, and turnover rates for those involved in data entry tasks. Workers should take short breaks often to allow the eye muscles to relax. Teach workers to glance at an object about 20 ft away. Some workers get relief by blinking or shutting their eyes for just a few seconds. Some other helps include having padded keyboards, adjustable tables, and tilting screens. Allow workers to experiment to find a position that is comfortable to them. Ensure lighting is sufficient to help prevent glare and eyestrain. Provide glare control devices if necessary. Data entry personnel should take two or three short breaks for every hour of continuous work. Consider chair height as correct when the sole of a person's foot can rest on the floor or a footrest with the back of the knee slightly higher than the seat of the chair. Workers should arrange desk accessories to reduce twisting and turning. The body is most relaxed with arms loose, wrists straight, elbows close to the body, with neck and spine straight. Any standing workstation should have an antifatigue mat, work surface below the elbows, and a footrest so the worker can elevate one foot. A sitting station should have a surface at least 18 in. wide and rounded in the front. Chairs should allow unrestricted movement, be adjustable, and support the lower back (Table 1.30).

Back Pain

Common causes of back pain can relate to poor physical condition and being unaccustomed to a task. Other factors that contribute to pain include poor posture and lifting objects beyond a person's ability. Contributing factors for back injuries include understaffing, inadequate training, poor body mechanics, inadequate safety precautions, and not using assist devices. The natural curves of the spine are held in place and supported by muscles in the back and abdomen. These muscles must be strong and healthy.

If standing for a prolonged period, one foot should rest on a low stool to support the lower back. Keep the head up and chest lifted. Select a chair that supports the lower back but is not too high. Tuck the buttocks and keep feet flat on the floor. Sleep on the back if possible with a small

TABLE 1.30
Common Ergonomics-Related Disorders

- Tenosynovitis: This malady results in the inflammation of the tendons and their sheaths. It often occurs at the wrist and is associated with extreme wrist movement from side to side.
- Trigger finger: A condition caused by any finger being frequently flexed against resistance.
- Tendinitis: A condition where the muscle–tendon junction becomes inflamed due to repeated abduction of a body member away from the member to which it is attached.
- Tennis elbow: This form of tendinitis is an inflammatory reaction of tissues in the elbow region caused by palm upward hand motion against resistance such as the violent upward extension of the wrist with the palm down.
- Carpal tunnel syndrome: A common affliction caused by the compression of the median nerve in the carpal tunnel. It is often characterized by tingling, pain, or numbness in the thumb and first three fingers. It is often associated with repeated wrist flexion.
- Reynaud's syndrome: A condition where the blood vessels in the hand constrict from cold temperature, vibration, emotion, or unknown causes. It is easily confused with the one-sided numbness of carpal tunnel syndrome.

pillow under knees or sleep on the side with knees bent. Never sleep on stomach or on back with legs straight out. A fitness program that improves aerobic capacity while strengthening back muscles can help prevent back pain. Each individual should choose an exercise program that fits their needs and abilities. NIOSH has now concluded that the use of lumbar support belts to reduce the risk of injury remains unproven. NIOSH previously concluded that the lumbar supports do not reduce spinal compression during heavy lifting tasks. NIOSH also expressed concerns that the belts might give workers a false sense of security and result in some lifting excess weights. The NIOSH study only reviewed data from other studies and did not do any original research. Several recent scientific studies conducted at leading universities indicate that correctly fitted lumbar support belts could help alleviate pressure on the soft tissue of the back and spine. Some associations and insurance groups claim that the use of support belts has resulted in a significant reduction in workers' compensation costs. Recommend use back support belts only when an integral part of total back care management efforts.

REVIEW EXERCISES

1.1 Why should a proactive hazard control management approach be important to any organization?
1.2 What contribution can using system safety methods make to hazard control effectiveness?
1.3 How does IBFCSM describe the concept of hazard closing?
1.4 Describe the origin of the words *program* and *function*.
1.5 Why does the word *function* better describe hazard control efforts than the word *program*?
1.6 List five assumptions of *traditional* hazard control management.
1.7 List five key hazard control responsibilities of senior organizational management.
1.8 List seven key responsibilities of a hazard control manager.
1.9 List seven key hazard control responsibilities of front supervisors.
1.10 Describe the concept known as employee engagement.
1.11 Why should effective hazard control be considered a *good* business practice?
1.12 What three elements should be included in an organizational hazard control policy statement?
1.13 What tool does an effective emergency planner use to create their operations plan?
1.14 List the nine key elements of an effective hazard control plan.
1.15 List two situations where the use of a demand response safety checklist would be appropriate.
1.16 Why should a hazard control manager develop and maintain an FHA?
1.17 List the five occupational hazard categories and give two examples of each.
1.18 List five common factors found to be present or active in hazard-free environments.
1.19 What role can visualization play in addressing a hazardous situation?
1.20 List five common safety inspection observations.
1.21 Describe the steps involved in JHA.
1.22 List at least three hazard correction techniques.
1.23 What is the difference between work practice controls and administrative controls?
1.24 List the six hierarchies of controls presented in the text.

2 Understanding Accidents

INTRODUCTION

We can simply define an accident as *an unplanned event that interferes with job or task completion*. When an accident occurs, someone will lose valuable time dealing with the event. An accident can result in some kind of measureable loss such as personal injury or property damage. We can also classify an accident event as a *nearmiss* with no measurable loss. Accident causes normally result from unsafe acts, hazardous conditions, or both. Accident prevention efforts must emphasize development of necessary policies, procedures, and rules. The hazard control plan should outline organizational objectives, goals, and responsibilities. The organization needs to evaluate the priority and effectiveness of accident prevention efforts. The costs of accidents should provide motivation for senior leaders to support hazard control efforts. Accidents resulting in injuries or property damage can cause interruption of production or other operations. Hazard control managers must endeavor to obtain management's attention and support by communicating to them losses in terms of dollars and manpower utilization. We can calculate or closely determine the direct costs associated with an accident. However, determining indirect costs can pose a challenge to the best managers and hazard control managers. Traditionally, most hazard control and safety personnel held the view that indirect costs of an accident *far exceed* the calculated or known direct costs. Fred Manuele wrote a thought-provoking article entitled *Accident Costs, Rethinking Ratios of Indirect to Direct Costs*, which appeared in Professional Safety in January of 2001. His article encouraged safety to refrain from using any ratios that data could not accurately support. He wisely pointed out that the direct costs of accidents did increase significantly in recent years due to indemnity and soaring medical costs (Table 2.1).

ACCIDENT CAUSATION THEORIES

Henri Heinrich's Five-Factor Accident Sequence

Heinrich's research in the area of accident causation concluded that 88% of *investigated* accidents resulted from unsafe acts. Heinrich attributed 10% to unsafe conditions and he classified 2% as unpreventable. Heinrich suggested that an individual's life experiences and background could *predispose* them to take risks during job or task accomplishment. Heinrich believed that removing a *single* causal factor from a potential situation could result in preventing an accident. Interrupting or breaking the *accident cycle* by preventing unsafe acts or correcting an unsafe condition could reduce accident risks for individuals engaging in risky behaviors. Heinrich proposed an accident sequence in which a single causal factor could actuate the next step in the cycle process. He believed that a person's background and social environment could impact engagement in faulty behavior. The accident occurrence then resulted in personal injury and/or property damage. Heinrich's conclusions pointed to what we now refer to as multiple causation theory.

Accident Causes

System safety methods assume that accidents and mishaps result from multiple causal factors. System *thinking* views hazards and causal factors as moving in logical sequences to produce accident events. Traditional approaches to accident prevention simply classify causal factors as *unsafe acts* and *unsafe conditions*. Hazard control personnel should use root cause processes to discover, document, and

TABLE 2.1
Common Myths about Accidents

- Accidents result from a single or primary cause.
- Accidents must generate injury or property damage.
- Accidents occur when random variables interact.
- Accidents can result from an act of God or nature.
- Accident investigations must determine fault.

analyze accident causal factors. Accident investigations and RCA should focus on discovering information about system operation, deterioration, and original design errors. System-related hazard control efforts focus on unsafe system conditions and the interaction of human factors with these and other hazards. When a hazard contacts or comes close to another hazard, the result can cause death, injury, or property damage. Hazard closing occurs when two or more hazards attempt to occupy the same space at the same point in time. Consider the concept of hazard closing as similar to the accident generation cycle. These events can result in property damage, personal injuries, or both. Hazard closings can also result in close calls, near hits, or nearmiss events. Hazard control management recognizes and acknowledges that an accident event occurs at a *specific* point in time. Many times anticipated or previously identified causal factors can interact resulting in a mishap. These uncontrolled primary factors can set the accident generation cycle into motion. Hazard control efforts must eliminate the hazard or dangerous situation to reduce or eliminate the potential for harm. System thinking promotes the concept of *providing* separation between an individual and potential operational hazards. The hazard may remain within the system but in a controlled state. Attempt to reduce hazardous exposures by providing controls such as warning systems, monitoring equipment, and danger information. Attempt to motivate safe behavior through education, training, and supervision.

Multiple Causation Theory

This theory promotes the idea that accidents result from various hazards or other factors interacting in some manner. Accident prevention professionals use different descriptors to describe these factors. Some refer to the factors as primary and secondary causes, while others use the terms such as immediate and contributing causes, surface and root causes, or causes and subcauses. Most investigators agree that accidents happen due to multiple and sometimes complex causal factors. Causal factors seldom contribute equally in their ability to trigger an event or contribute to accident severity. Accidents result from some type of interaction of causal factors. Human factors such as an unsafe act, error, poor judgment, lack of knowledge, and mental impairment can interact with other contributing factors creating an opportunity for an accident to occur.

Biased Liability Theory

Biased liability promotes the *view* that once an individual becomes involved in an accident, the chances of that same person becoming involved in a future accident increases or decreases when compared to other people. The accident proneness theory promotes the *notion* that some individuals will simply experience more accidents than others because of some personal tendency.

Accident Pyramid

Heinrich introduced the *accident pyramid* in his book, *Industrial Accident Prevention: A Scientific Approach*. This pyramid illustrated his accident causation theory. Heinrich believed that unsafe acts led first to minor injuries and then over a period of time to a major injury event. The accident

pyramid proposed that 300 unsafe acts produced 29 minor injuries and 1 major injury. The concept of the accident pyramid remained unchallenged many years. However, some recent studies challenge the assumed shape of the equilateral triangle used by Heinrich. Some professionals now believe the actual shape of the model would depend on organizational structure and culture.

Prevention of Fatal Events

The March 2003 edition of the journal of Professional Safety contained an article entitled *Severe Injury Potential*. The article, authored by Fred Manuele, suggested that accident prevention efforts should focus more on preventing fatal events. He highlighted some specific examples that lead to fatalities in industrial settings. His list included not controlling hazardous energy, no written procedures for hazardous processes, failing to ensure physical safeguards, using unsafe practices for convenience (risk perceived as insignificant), and operating mobile equipment in an unsafe manner.

HUMAN FACTORS

Hazard control personnel and top management must recognize that human behavior can help prevent and cause accidents. Understanding human behaviors can pose a challenge to most individuals. Behavior-based accident prevention efforts must focus on how to get people to work safely. Hazard control managers, organizational leaders, and frontline supervisors deal with human behaviors on a daily basis. The definition of behavior-based hazard control could read as follows: "the application of human behavior principles in the workplace to improve hazard control and accident prevention." Organizational issues such as structure and culture along with personal considerations impact individual behavior (Table 2.2).

The term *human factors* covers a wide range of elements related to the interaction between individuals and their working environment. Management styles, the nature of work processes, hazards encountered, organizational structure, cultures, and education or training can influence individual behaviors. Hazard control efforts must address factors that impact human conduct or behavior. Organizations must ensure all members possess the knowledge, skill, and opportunity to act in preventing accidents. Motivation to act responsibly relates to a person's desire to do the right thing. Human factors can refer to personal goals, values, and beliefs that can impact an organization's expectations, goals, and objectives. Flawed decision-making practices and poor work practices can create atmospheres conducive to human error. Causal links between the accidents and *unseen* organizational factors may not appear obvious to most investigators. However, these factors could easily interact with trigger mechanisms to contribute to accident events.

Error

An essential component of accident prevention relates directly to understanding the nature, timing, and causes of errors. Error, as a normal part of human behavior, many times becomes overlooked

TABLE 2.2
Understanding Human Issues

- Consider character as the moral and/or ethical structure of individuals or groups.
- Belief refers to a mental act and habit of placing trust in someone or something.
- Base value with what people believe and things with relative worth or importance.
- Define culture as socially accepted behaviors, beliefs, and traditions of a group.
- Consider attitude as a state of mind or feeling about something.
- Behaviors relate to the open manifestation of a person's actions in a given situation.

TABLE 2.3
Common Unsafe Acts

- Not following established job procedures
- Cleaning or repairing equipment with energy hazards not locked out
- Failing to use prescribed PPE
- Failing to wear appropriate personal clothing
- Improperly using equipment
- Removing or bypassing safety devices
- Operating equipment incorrectly
- Purposely working at unsafe rates or speeds
- Accomplishing tasks using incorrect body positions or postures
- Incorrectly mixing or combining chemicals and other hazardous materials
- Knowingly using unsafe tools or equipment
- Working under the influence of drugs or alcohol

during accident investigations and analysis processes. Errors can result from attention failure, a memory lapse, poor judgment, and faulty reasoning. These types of errors signify a breakdown in an individual's information-processing functions. When analyzing accident causes, hazard control personnel may never determine individual intent. However, focusing on the nature of behaviors in play at the time of error occurrence can provide some insight. When categorizing errors, attempt to differentiate between those occurring during accomplishing skilled behavior tasks and those related to unskilled tasks such as problem solving. Rule-based errors can occur when behaviors require the application of certain requirements. Process errors occur when individuals lack an understanding of procedures or complex systems. Knowledge-based errors occur when an individual lacks the skill or education to accomplish a certain task correctly. Planning errors occur when individuals fail to use a proper plan to accomplish a task. Finally, execution errors occur when using a correct plan but an individual fails to execute the plan as required (Table 2.3).

Motivating People

Motivating individuals to work safely requires the use of various approaches depending on the situation. Little evidence exists that supports using punitive measures to motivate safe behaviors. The use of good human relations and effective communication skills can help improve individual motivation. The development of policies, procedures, and rules can never completely address all unsafe behaviors. Taking risks depends on individual perceptions when weighing potential benefits against possible losses. Some professionals believe that providing incentives to work safely coupled with appropriate feedback can enhance hazard control efforts in at least the short term. However, employee incentives with tangible rewards can also cause some individuals not to report hazards, accidents, and injuries.

ACCIDENT DEVIATION MODELS

Accident or mishap *deviation models* as used in system safety processes can permit analysis of events in terms of deviations. The value assigned to a system *variable* becomes a deviation whenever it falls outside an established norm. When measuring system variables, these deviations can assume different values depending on the situation. Hazard control policies and procedures should detail any *specified requirements.* A deviation from a specified requirement could result in a human error for failure to follow procedures. Therefore, we must consider incidental factors as deviations from an *accepted practice.* An unsafe act relates to a personal action that violates or deviates from a commonly accepted safe procedure. Time functions as the basic dimension in a system deviation

TABLE 2.4
Promoting Employee Involvement

- Develop an open-door policy to provide employee access to managers.
- Develop an easy-to-use accident, injury, and hazard reporting system.
- Require supervisors to conduct periodic safety meetings.
- Develop off-the-job safety and health education objectives.
- Encourage employee participation in job hazard analyses.
- Disseminate hazard control and accident information in a timely fashion.
- Place emphasis on people and less emphasis on compliance.
- Solicit employee suggestions on using hazard control resources and funds.
- Mandate hourly employee representation on the hazard control committees.
- Conduct special shift worker education and training sessions.
- Conduct periodic organizational perception surveys about hazard control efforts.

model since incident analysis becomes a linear process rather than focusing on a single incident or a series of causal factors. Consider appropriate prevention measures by focusing on prior assessments and evaluations of the entire system. Active protection control would require constant repetitive actions on an individual. Passive protection controls would use relevant automatic protection innovations. Active interventions would require modifying and sustaining behavioral changes. Always stress the importance of behavior change or modification rather than any need for additional education. An effective approach to behavior modification may also require actions such as redesigning equipment or modifying physical environments to achieve the practice of safe behaviors. When top management demonstrates concern and commitment to the hazard control, individuals will more likely support organizational initiatives. The accountability factor for individual performance can serve as a key motivator for many individuals. Top management should continually remind everyone that the organization views hazard control as a priority function. Recognize and reward individuals for supporting hazard control efforts. Promote the use of toolbox talks, personal coaching, and supervisory involvement to promote hazard control (Table 2.4).

ACCIDENT REPORTING

The timely and accurate reporting of accidents and injuries permits an organization to collect and analyze loss-related information. This information can help determine patterns and trends of injuries and illnesses. Organizations should encourage reporting by all members. The reporting process should focus on the importance of tracking hazards, accidents, and injuries, including any organizational trends. Educate all personnel to understand the need for maintaining a systematic process that accurately and consistently provides updated information. The system must not only permit data collection but provide for a means to display any measure of success or failure in resolving identified hazards. Maintain records that enable managers at all levels to access data. Information made available to managers can assist them with changing policies, modifying operational procedures, and providing job-related training. Senior leaders must ensure the use of a system that meets the needs of the organization. Many vendors now offer accident/injury reporting and tracking software. Many of these processes permit the creation and printing of electronically generated reports. Using electronic reporting can help the organization save time and money. Make all the forms accessible on your internal computer network. Electronic reporting will encourage people to conform to your expectations and report nearmisses, accidents, and injuries in a timely manner. A sample of a completed form will help illustrate and remind users what information you need from them. Include a phone number and e-mail address for the person who can answer questions as they arise. Provide instructions for where and how to submit the report once completed. Electronic submission will save

paper and retyping or scanning. Input and track all safety incidents across your organization through one centralized online portal accessible to all employees and locations. New technology lets users easily create their own online forms. Customize fields and drop-downs to build an incident reporting form unique to your organization's needs. They can create incident reports sorted by employee, workgroup, unit or department, type of injury, or body part. Report incident frequency and severity rates and easily disseminate using an appropriate electronic format. Customizable dashboards provide instant access to safety incident metrics from across your organization providing real-time data and analysis needed to drive continual improvement. Manage the entire accident life cycle of incident reporting, responding, investigating, taking corrective action, tracking, and developing summary reports. Incident reporting forms can trigger automatic, escalating follow-up emails to employees responsible for corrective actions ensuring prompt resolution. Technology makes reporting and analysis easier and quicker than ever before. Organizations can no longer make excuses for not accurately collecting, tracking, and evaluating accident, hazard, and injury information.

ACCIDENT INVESTIGATIONS

A successful accident investigation must first determine what happened. This leads to discovering how and why an accident occurred. Most accident investigations involve discovering and analyzing causal factors. Conduct accident investigations with organizational improvement as the key objective. Many times an investigation focuses on determining some level of fault. Some organizations seek to understand the event to prevent similar occurrences. Most large organizations would benefit if the responsible supervisor conducted the initial investigation. Accident causal factors can vary in terms of importance because applying a value to them remains a very difficult challenge. Sometimes investigators can *overvalue* causal factors immediately documented after the accident. These *immediate causal* factors reveal details about the situation at the time of occurrence. Investigators can also *devalue* less obvious causes that remained removed by time and location from the accident scene. Identifying and understanding causal factors must include a strong focus on how human behaviors contributed to the accident. Organizations must conduct comprehensive investigations when preliminary information reveals inconsistencies with written policies and procedures. Using *sound* investigational techniques can help determine all major causal factors. Investigations should seek to find out what, when, where, who, how, and *most of all* why. Organizations must work to reduce the time between the reporting of a serious accident and the start of the investigation. Provide investigators with all the necessary tools and equipment to conduct a thorough investigation. Investigators must also seek to identify any failures of organizational-related management systems. These managerial failures contribute directly or indirectly to many accident events. Before attempting to discover and document causal factors, examine the site and take steps to preserve any important evidence. Attempt to identify and document a list of witnesses. In some investigations, a particular physical or chemical law, an engineering principle, or equipment operation may explain a sequence of events. Some investigators use diagrams, sketches, and measurements to support their understanding of what happened. This type of information can also assist in future analysis efforts. Consider using video recorders or cameras when conducting investigations. Use charts or sequence diagrams to help develop a probable sequence of events. Sequence charts can also help to understand events that occurred simultaneously. When conducting an investigation, attempt to look beyond the obvious to uncover direct and indirect causal factors. Evaluate all known human, situational, and environmental factors. Research studies indicate that most workplace accident investigations reveal 10 or more causal factors. Determine what broken equipment, debris, and samples of materials need removal from the scene for further analysis. Investigators should develop written notes about any items removed from the scene including their positions at the accident scene. Make every effort to interview as many witnesses as possible before leaving the scene. These witnesses can serve as primary sources of information in many investigations. Accident scene tampering and evidence removal prior to the investigator arriving would make witnesses very important.

Classifying Causal Factors

Understand the importance of initially documenting and classifying causal factors in one of the following three categories. The first category relates to *operational factors* such as unsafe job processes, inadequate task supervision, lack of job training, and work area hazards. The second category relates to *human motivational factors* including risky behaviors, job-related stress, poor attitudes, drug use, and horseplay. The third category relates to *organizational factors* including inadequate hazard control policies and procedures, management deficiencies, poor organizational structure, or lack of senior leadership.

Interviewing Witnesses

Interview witnesses individually and never in a group setting. If possible, interview a witness at the scene of the accident. It also may be preferable to carry out interviews in a quiet location. Seek to establish a rapport with the witness and document information using their words to describe the event. Put the witness at ease and emphasize the reason for the investigation. Let the witness talk and listen carefully and validate all statements. Take notes or get approval to record the interview. Never intimidate, interrupt, or prompt the witness. Use probing questions that require witnesses to provide detailed answers. Never use leading questions. Ensure that logic and not emotion directs the interview process. Always close the interview on a positive note.

ACCIDENT ANALYSIS

Organizations can use a variety of processes to analyze accident causal factors. Hazard evaluations and accident trend analysis can help improve the effectiveness of established hazard controls. Routine analysis efforts can also enable organizations to develop and implement appropriate controls in work procedures, hazardous processes, and unsafe operations. Analysis processes rely on information collected from hazard surveys, inspections, hazard reports, and accident investigations. This analysis process can provide a *snapshot* of hazard information. Effective analysis can then take the *snapshots* and create viable pictures of hazards and accident causal factors.

When attempting to understand accident causes, hazard control personnel must identify, catalog, and then analyze the many factors contributing to an adverse event. Analyze to determine how and why an accident occurred. Use findings to develop and implement the appropriate controls. Don't overlook information sources such as technical data sheets, hazard control committee minutes, inspection reports, company policies, maintenance reports, past accident reports, formalized safe work procedures, and training reports. When using accident investigation evidence, remember that the information can exist in a physical or documentary form. It can come from eyewitness accounts or from documentary evidence. The analysis must evaluate sequence of events, extent of damage, human injuries, surface causal factors, hazardous chemical agents, sources of energy, and unsafe behaviors. Consider factors such as horseplay, inadequate training, supervisory ineffectiveness, weak self-inspection processes, poor environmental conditions, and management deficiencies. A good accident analysis should create a *word picture* of the entire event. Refer to photos, charts, graphs, and any other information to better present the complete accident picture. The final analysis report should include detailed recommendations for controlling hazards discovered during the investigation and analysis.

Root Cause Analysis

RCA processes can help *connect* the dots of accident causation by *painting* a picture that includes *beneath the surface* causes. Organizations many times fail to use effective and systematic techniques to identify and correct system root causes. Best guess corrective actions do not address the real causes of accidents. Ineffective quick fix schemes don't change processes to prevent future

TABLE 2.5
Common Causal Factors

Poor supervision

- Lack of proper instructions
- Job and/or safety rules not enforced
- Inadequate PPE, incorrect tools, and improper equipment
- Poor planning, improper job procedures, and rushing the worker

Worker job practices

- Use of shortcuts and/or working too fast
- Incorrect use or failure to use protective equipment
- Horseplay or disregard of established safety rules
- Physical or mental impairment on the job
- Using improper body motion or technique

Unsafe materials, tools, and equipment

- Ineffective machine guarding
- Defective materials and tools
- Improper or poor equipment design
- Using wrong tool or using tool improperly
- Poor preventive maintenance procedures

Unsafe conditions

- Poor lighting or ventilation
- Crowded or poorly planned work areas
- Poor storage, piling, and housekeeping practices
- Lack of exit and egress routes
- Poor environmental conditions such as slippery floors

incidents. RCA focuses on identifying causal factors and not placing blame. A root cause process must involve teams using systematic and systemic methods. The focus must remain on the identification of problems and causal factors that fed or triggered the unwanted event. When analyzing a problem, we must understand what happened before discovering why it happened. Don't overlook causal factors related to procedures, training, quality processes, communications, safety, supervision, and management systems. An effective RCA process lays a foundation for designing and implementing appropriate hazard controls. Root causes always preexist the later discovered surface causes. When root causes go unchecked, surface causes will manifest in the form of an unwanted event. For simplicity reasons, system-related root causes fall into two major classifications. The first class concerns design flaws such as inadequate or missing policies, plans, processes, or procedures that impact conditions and behaviors. The other category, known as operational weaknesses, refer to failures related to implementing or carrying out established policies, plans, processes, or procedures. When discovered and validated, *specific* root causes can provide insight to an entire process or system. The process can also help identify what fed the problem that impacted the system. Finally, RCA provides insight for developing solutions or changes that will improve the organization (Table 2.5).

Accident Reports

When preparing an accident investigation report, use the analysis results to make specific and constructive recommendations. Never make general recommendations just to save time and effort. Use previously drafted sequence of events to describe what happened. Photographs and diagrams may save many words of description. Identify clearly if evidence is based on facts, eyewitness accounts,

or assumptions. State the reasons for any conclusions and follow up with the recommendations. An accident analysis process must consider all known and available information about an event. Clarify any previously reported information and verify any data or facts uncovered during the investigation. Review and consider witness information and employee statements or suggestions.

ORGANIZATIONAL FUNCTIONS THAT SUPPORT ACCIDENT PREVENTION

Interfacing Support Functions

The noninvolvement of staff functions and service components in hazard control can hinder success. Don't ignore a natural interface of hazard control management with other support functions such as facility management, purchasing, and human resource (HR) management. Virtually every department and function of a modern organization contributes in some way to the effectiveness of the hazard control management function. There should be a greater interrelationship among staff and support functions that interface with accident prevention such as personnel, procurement, and maintenance. Too often, these functions operate in parallel tracks with little or no interaction. They must work in harmony to make an impact on preventing accidents and controlling hazards.

Operational and Support Functions

Operational and line elements must remain conscious of their roles in accident prevention in terms of organizational policy, regulations, procedures, safety inspections, and other activities to support the hazard control function. Frequently, technical advances result in acceleration of organizational activities without the provision for accompanying related safeguards by management. Planning, research, budget, and legal functions must interface with accident prevention and hazard control efforts.

Human Resources

As far as practical, the HR function should recruit, evaluate, and place the right person in the right job in terms of physical ability and psychological adaptability. Incorporate into job descriptions specific physical requirements, known hazards, and special abilities required for optimum performance. HR professionals must identify all hazardous occupations and determine the knowledge, skills, abilities, physical requirements, and medical standards required to perform the job in a safe manner. All employees must receive appropriate orientation, training, and education necessary to support safe job accomplishments.

Facility Management

Facility management functions should ensure proper design layout, lighting, heat, and ventilation in work areas. Review specifications for new facilities, major renovations to existing facilities, and any plans for renting or leasing new work or storage areas. Maintenance activities should provide preventive maintenance service to avoid breakdown of equipment and facilities. Coordinate efforts with engineering, purchasing, and safety in reporting obsolete and/or hazardous equipment. Ensure that maximum safety is built into the work environment. It is much more efficient to correct a hazardous situation than to guard it or instruct employees to avoid it (Table 2.6).

Purchasing/Receiving

The organizational purchasing, contracting, or material management functions must consider safety requirements and standards when ordering equipment, tools, and other supplies. With the exception of certain legal requirements, the purchasing function should never attempt to dictate the

TABLE 2.6
Facility Management Hazard Control Issues

- Coordinate implementation of hazard controls during design of all work areas.
- Take appropriate engineering action to eliminate or guard known hazards.
- Develop regular and preventive maintenance schedules for all tools and equipment.
- Implement regular inspections to identify equipment and material-related hazards.
- Take immediate action to eliminate identified hazards and unsafe conditions.
- Ensure the proper design of work areas and the layout of equipment.
- Require each work unit to maintain high housekeeping standards.
- Ensure the installation of proper lighting, ventilation, and environmental controls.

safety-related standards or specifications of equipment, machines, and supplies requisitioned by hazard control or other operational functions. Hazard control managers should inform purchasing personnel about necessary standards, requirements, and safety factors to include in their purchasing specifications. In addition to getting safety features incorporated into specifications, it is essential that the receiving function perform a detailed inspection of the equipment upon delivery. Never accept items that do not meet safety specifications or standards. Ensure the receipt of safety data sheets when accepting hazardous materials. Purchasing functions must follow up and provide information concerning hazardous supplies and equipment.

Employee Health

Occupational health professionals and hazard control managers must coordinate and communicate issues on a continuous basis. Provide prompt emergency treatment of all injuries and illnesses. The coordination of safety and health functions helps workers learn how to protect themselves from hazards. Recommend a multidisciplinary approach to manage health, risks, and costs. Report all work-related incidents of injury and exposure allegations immediately to employee health. Employee health should monitor, manage, or coordinate all workers' compensation injuries, reports on progress, imposition of necessary work restrictions, and return-to-work evaluations. Preemployment placement evaluations should focus on job-related issues with a thorough job analysis as part of the evaluation. If the evaluation indicates no medical causes for performance problems, refer the employee back to management for appropriate administrative action. A preplacement assessment develops a baseline for medical surveillance and helps determine capability of performing essential job functions. The Americans with Disabilities Act (ADA) requires job descriptions for all job offers needing preplacement (postjob offer) physical capacity determinations. Functional capacity evaluations may help in determining job placement and modifications. Essential job functions can determine capability of a prospective employee to perform those functions with or without reasonable accommodations. Assessments may include an update of the occupational and medical histories, biological monitoring, and medical surveillance. Conduct a postexposure assessment following any exposure incident. Determine the extent of exposure and develop measures to prevent it. Rehabilitation involves facilitating the employee's recovery to a preinjury or illness state. Inform occupational health about the rehabilitation of workers with any illnesses or injuries including those not considered work related. The goal of case management is to work with the employee to facilitate a complete and timely recovery (Table 2.7).

Shift Workers

Conduct mandatory education to inform individuals how to better cope with shift work. The human body follows a 24–25 h period called the circadian clock. This internal clock regulates cycles in

TABLE 2.7
Components of the Employee Health Function

- Bloodborne Pathogen Exposure Control Plan (29 CFR 1910.1030)
- Fitness for duty (local policies)
- Personal Protective Equipment (29 CFR 1910.132)
- Eye protection (29 CFR 1910.133)
- Fire safety (NFPA 101, 29 CFR 1910.38, local and state codes)
- TB policy (Centers for Disease Control and Prevention [CDC] guidelines and health department requirements)
- Immunizations (CDC and health department recommendations)
- Radiation safety (29 CFR 1910.1096)
- Reproductive hazards (OSHA, Nuclear Regulatory Commission [NRC], and NIOSH recommendations)
- Confidentiality of medical records (Health Insurance Portability and Accountability Act [HIPAA] and OSHA standards)
- Hazard communication (29 CFR 1910.1200)
- Substance abuse (local policies)
- Work-related injuries (29 CFR 1904) and worker's compensation statutes
- OSHA recordkeeping (29 CFR 1904)
- Hearing protection (29 CFR 1910.95)
- Work-related stress and shift work (NIOSH publications)

body temperature, hormones, heart rate, and other body functions. The desire to sleep for most people occurs during the hours between midnight and 6:00 a.m. Studies indicate that about 20% of night workers fall asleep on the job. Most sleep occurs during the second half of the shift. According to a National Sleep Foundation poll, 65% of all people report that they don't get enough sleep. This translates into more health problems and impaired immune systems. The financial loss to business because of decreased productivity has been estimated at more than 18 billion each year. Studies show higher workplace and vehicular accident rates for shift workers. Many shift workers hold down more than one job. Many times family members don't understand the needs of those working nontraditional shifts. Second- and third-shift workers tend to possess more stress-related problems than those working day shifts (Table 2.8).

WORKERS' COMPENSATION

Workers' compensation laws ensure that employees injured or disabled on the job receive appropriate monetary benefits, eliminating the need for litigation. These laws also provide benefits for dependents of those workers killed because of work-related accidents or illnesses. Some laws also protect employers and fellow workers by limiting the amount an injured employee can recover from an employer and by eliminating the liability of coworkers in most accidents. State workers' compensation statutes establish this framework for most employment. The injury or illness must result from employment. Workers' compensation provides benefits to the injured worker including medical coverage and wages during periods of disability. Employers can obtain coverage through commercial insurance carriers, establishing their own self-insurance program, or by being placed in a state-controlled risk fund. The state or the National Council of Compensation Insurance (NCCI), an independent rating organization, normally determines basic rates paid by employers. Factors affecting rates can include (1) company or fund quoting the coverage, (2) classification code(s) of the employer, (3) payroll amount for the work force covered, and (4) experience rating.

The Federal Employment Compensation Act provides workers' compensation for nonmilitary, federal employees. Many of its provisions remain typical of most workers' compensation laws. Many times awards remain limited to *disability or death* sustained while in the performance of the employee's duties. The act covers medical expenses due to the disability and may require

TABLE 2.8
Shift Work Principles

- Shift differential pay alone does not improve worker morale or performance.
- Provide special orientation sessions for new shift workers.
- Never schedule organizational training after a work shift.
- Conduct job training sessions before or during the scheduled work shift.
- Never schedule shift workers to attend training on their off days.
- Provide mandatory education sessions for all shift workers.
- Provide handouts (with the latest research) on how to improve sleep patterns.
- Encourage workers to share the information with their families.
- Provide flexible scheduling during a crisis and for special occasions.
- Encourage workers to communicate their feelings about the job with supervisors.
- Never promote overtime among shift workers.
- Short naps can help improve worker alertness and productivity.
- Show concern about workers' off-the-job activities such as traveling to and from work.
- Use professionals to help develop effective education and training sessions.
- Encourage workers to seek medical assistance if needed.
- Encourage workers to report sleepiness when operating machines or equipment.

the employee to undergo job retraining. A disabled employee receives two-thirds of his or her normal monthly salary during the disability. The Longshore and Harbor Workers' Compensation Act provides workers' compensation to specified employees of private maritime employers. The Black Lung Benefits Act provides compensation for miners suffering from *black lung* or pneumoconiosis. The act requires liable mine operators to pay disability payments and establishes a fund administered by the Secretary of Labor providing disability payments to miners when mine operators can't pay. The World Health Organization (WHO) defines impairment as any loss or abnormality of psychological, physiologic, or anatomic structures or functions. The American Medical Association (AMA) defines impairment as loss, loss of use, or derangement of any body part, system, or function. WHO defines a disability as any restriction or lack of ability, resulting from an impairment, to perform an activity in the manner of within the range considered normal. Most states require examiners to use the AMA *Guides to the Evaluation of Permanent Impairment* to determine accurate impairment ratings. The AMA guidelines limit the range of impairment values reported by different examiners.

Return-to-Work/Modified Duty Positions

Establishing a realistic return to work function can save organizations financial losses due to fraudulent claims. Any *return-to-work initiative* should accommodate injured workers by modifying jobs to meet their work capabilities. This action permits employees to become productive assets during their recovery. Early return to work options can accelerate an employee's return by addressing the physical, emotional, attitudinal, and environmental factors that otherwise inhibit a prompt return. Senior management must commit to returning injured workers to productive roles. Develop profiles of jobs considered suitable for early return participants. A profile should define the job in terms of overall physical demands, motions required, environmental conditions, the number of times performed each week, and its duration. Conduct a systematic analysis of specific jobs for the purpose of modifying them to accommodate the unique needs of the injured worker. Individuals skilled in ergonomic task analysis, engineering, safety, and biomechanics can help perform the job analysis. Managed care providers can also assist in job modifications. Communicate the availability of early return jobs with care providers, claims adjusters, and the

injured worker. Work with your managed care provider and worker to move them to full production status in their assigned jobs as quickly as possible.

SUBSTANCE ABUSE

Substance use, misuse, abuse, and coping strategies can significantly impact mental health at work. Generally, substance use becomes a problem when an individual loses control over their use and/or continues to use despite experiencing negative consequences. Employers should look for warning signs for employees struggling with substance abuse. Signs of substance abuse can appear similar to those caused by stress, lack of sleep, and physical or mental illness. Identify abuse by establishing preemployment, random, and *for cause* testing. Ensure the development and implementation of a testing policy. Refer and evaluate employees addicted to performance-impairing drugs such as alcohol, narcotics, sedatives, or stimulants to qualified assistance or treatment facilities. Establish an agreement between the organization and the individual to address rehabilitation and random testing upon return to work. Measurable losses attributed to substance abuse can include absenteeism, overtime pay, tardiness, sick leave abuse, health insurance claims, and disability payments. Some of the hidden costs of substance abuse can include low morale, poor performance, equipment damage, diverted supervisory time, and low production quality. Losses can include legal claims, workers' compensation payments, disciplinary actions, security issues, and even dealing drugs in the workplace. Supervisors play the key role in maintaining an effective substance abuse policy (Table 2.9).

ORIENTATION, EDUCATION, AND TRAINING

Orientation relates to the indoctrination of new employees into the organization. Orientation can be defined as the process that informs participants how to find their way within the organization. Usually safety and hazard control topics only make up a portion of any new employee orientation session. Many well-meaning organizations attempt to present detailed safety and hazard control information during new employee orientation sessions. However, attempting to provide too much performance-based safety education during orientation can prove ineffective due to time constraints. Meeting the learning objectives must take precedence over simply documenting an educational session. New employee orientation sessions must address the importance of safety, management's commitment, and worker responsibilities to practice good hazard control principles. Some performance-based OSHA standards require that employees receive more detailed instruction that orientation sessions can provide. Present this information in other education or training sessions. Education refers to the incorporation of knowledge, skills, and attitudes into a person's behavior and includes the connotation of thinking. Education can provide information on topics previously trained. System safety

TABLE 2.9
Signs of Substance Abuse

- Increased absenteeism
- Poor decisions and ineffectiveness on the job
- Poor quantity and/or quality in production
- High accident rates
- Resentment by coworkers who pick up the *slack*
- Poor morale in the department
- Late three times more often than other workers
- Uses three times more sick leave than others
- Five times more likely to file a workers' compensation claim
- Involved in accidents four times more often than other employees

methods use ISD educational and training methods to ensure the competency of individuals working in or supporting operations. We refer loosely to this concept as simply adult education. ISD requires development of competencies before designing educational and training sessions. The sessions presented focus on the competencies both in the classroom and in realistic operational or job settings. Another example of ISD usage occurs in the construction industry that developed *toolbox* safety presentations many years ago to ensure that workers practice safety on the job. Sometimes we use the phrases *job-related training* or *job safety training* to refer to ISD. Training relates to the acquisition of specific skills, while education refers to the incorporation of knowledge, skills, and attitudes into a person's behavior. Consider training as the process of presenting information and techniques that leads to competency of those participating. Conduct hands-on training outside of a classroom if possible unless using realistic simulation processes. Effective training must strive to promote understanding, positively impact worker attitudes, and improve individual performance. Training must facilitate the transfer of knowledge and skills that relate to real-world activities. Many organizations do not dedicate sufficient time, allocate sufficient resources, or require attendance at training and education sessions.

Providing Adequate Sessions

An around-the-clock operation makes the education and training of shift employees even more challenging. Educate and train shift workers prior to or during their shift but never after the shift. Many organizations do not honestly evaluate training and education effectiveness. They maintain attendance or participation documentation. However, this documentation may not document and validate retention or competency. Some professional educators recommend documenting training and education attendance at the conclusion of the session. Suggest using a short quiz or performance assessment to document learning. Consider the use of employee safety meetings to educate workers about on- and off-the-job safety topics. Publish an education and training policy statement to outline goals and objectives. Use various methods such as posters, flyers, bulletins, newsletters, classroom presentations, on-the-job training sessions, professional seminars, safety education fairs, and computer-assisted training to communicate hazard control and safety topics. Some organizations delegate a number of training responsibilities to the individual departments. Other organizations employ a full-time educational coordinator. Large or specialized departments in some organizations, such as laboratories, conduct most of their own training.

Training and Hazard Control

Hazard control managers and training personnel must coordinate education and training objectives to ensure they meet organizational needs. Conduct training for employees transferring to new jobs or work areas. Train those returning from an extended period away from the job and those new to the work force. Schedule training sessions to match the needs of the organization and needs of learners. Always view education and training as organizational functions and never as programs. When implementing an effective hazard control education and training function, consider the following elements: (1) identify needs, (2) develop objectives, (3) determine learning methods, (4) conduct the sessions, (5) evaluate effectiveness, and (6) take steps to improve the process. Training must compliment and supplement other hazard controls and address rules and work practices. Some ways to evaluate training can include the following: (1) student opinions expressed on questionnaires, (2) conducting informal discussions to determine relevance and appropriateness of training, (3) supervisor's observations of individual performance both before and after the training, and (4) documenting reduced injury or accident rates. Revise the content of the session when an evaluation reveals that those attending did not demonstrate the knowledge or competency expected. Recurring sessions should cover on-the-job training and refresher sessions to ensure that employees remain current in worker-related issues, including safety topics. Changes covered might include

updated technology procedures, new government regulations, and improved practice standards. Engineering controls remain the preferred way of preventing accidents involving hazards related to unsafe mechanical and physical hazards. However, education and training serves as the most effective tool in preventing accidents by human causes. Through adequate instruction, people can learn to develop safe attitudes and work practice. Design education and training sessions by using clearly stated goals and objectives that reflect the knowledge and skills needs of people.

Training Methods

Instructional presentations can employ a variety of methods to improve learning. The use of a pretest permits instructors to evaluate the knowledge of participants before the session begins. A pretest can motivate some participants to learn key concepts and principles. Informal discussions and lectures should incorporate time for questions and answers to encourage participation. Demonstration methods permit the instructor to use a hands-on technique to promote the application of knowledge. Training content must directly apply to the hazards, procedures, equipment, and behaviors encountered on the job. People will receive instruction when they understand how they can apply the training to real-world situations. Since people learn in different ways, use a variety of training methods to promote learning. Some methods of education and training include lectures, videos, class discussions, demonstrations, written exercises, small-group exercises, hands-on exercises, and combination methods. Some trainers develop and use games to review critical material, especially in refresher training sessions. Consider ways to validate retention and learning. Methods often used include discussion, written tests and quizzes, trainee demonstrations or presentations, and on-the-job observation. Refer to OSHA booklet *Training Requirements in OSHA Standards and Training Guidelines* (OSHA 2254) for additional information about designing training sessions. Some situations such as a disaster drill permits students to meet training objectives by participating in a realistic scenario such as a disaster exercise. Many organizations use interactive software and other web-based learning opportunities to meet training objectives. Computer-generated and web-based sessions can permit the learner to control the flow of information during the training session.

Many organizations overlook the need to provide informational sheets and handouts to support training requirements and provide future reference information. Multimedia-presented visual aids in today's world can enhance learning. However, simply using computer-generated slides, overhead transparencies, white boards, videos, and flip charts does not guarantee the mastery of training objectives (Table 2.10).

Off-the-Job Safety Education

Organizations should consider presenting off-the-job topics to all employees. Providing sessions that address off-the-job hazard control, safety, and health topics sends the message that the organization

TABLE 2.10
Basic Questions to Ask about Training Sessions

- Did the session cover critical issues or hazards?
- Did the presenter use an appropriate instructional method?
- Did the instructor cover all educational objectives clearly and concretely?
- Did the objectives state acceptable performance expectations of participants?
- Did the session simulate or address real situations?
- Did the participants demonstrate a motivation to learn during the session?
- Did the instructors encourage active participation by all participants?
- Did the presenter ask participants to critique or evaluate the session?

cares about its people. Present information that addresses real-world issues such as summer and winter hazards, holiday safety, and traffic safety topics. Health topics could address eating healthy, the importance of exercise, and managing stress. Other topics to address could include home-related topics such as fire safety and fall prevention. Suggest presenting an off-the-job education on a monthly basis.

Instructional Systems Design

Some organizations with complex systems or processes may benefit by implementing ISD educational and training methodologies. ISD can help organizations identify what an employee should know and what competencies related to hazard control he or she must demonstrate. The ISD approach promotes and supports acceptable performance by an employee or worker. ISD can also identify deficiencies in task knowledge and work competencies. Determine information about hazards and behaviors by conducting system and job tasks analysis. Understanding systems and processes can help hazard control managers validate knowledge and performance requirements of job or task. When preparing to develop an education and training plan on an unfamiliar procedure or system, the JHA provides the foundation for success. Add appropriate content to the plan based on the following: (1) reviewing accident and injury records, (2) requesting workers to describe their job and related hazards, (3) observing and interacting with workers performing their job tasks, and (4) comparing content of other training plans dealing with similar hazards or risks.

PROMOTING SAFETY AND HAZARD CONTROL

Seek ways to promote an interest in hazard control by helping organizational members develop safe work habits and by providing a hazard-free job environment. As addressed previously, make hazard control an organizational function and an operation priority. Organization size, type, and climate can impact hazard control promotional activities. Don't forget to include shift workers in any promotional campaign since their support remains a crucial part of accident prevention efforts. An effective promotional campaign demonstrates management's commitment to hazard control. It also reminds employees to work safely and take ownership of their contributions. Recognition and other incentives can help promote hazard control importance when designed and managed effectively. Provide employees the opportunity to participate in hazard control efforts. Encourage open communication and feedback among all organizational members. Continually stress the organization's commitment to a safe and healthy workplace. Promote the use of workplace safety meetings to keep the lines of communication open and reinforce training concepts. The use of posters doesn't compensate for inadequate hazard control management, broken equipment, unsafe job procedures, poor supervision, or ineffective training. Posters, when used, should communicate a simple straightforward message. Place in well-lighted locations such as lunchrooms, washrooms, entrances, and loading points. Many organizations rotate posters at regular intervals based on potential hazards. A well-designed bulletin or newsletter can still effectively promote objectives of hazard control. An employee-oriented bulletin or newsletter should provide information and recognize accomplishments. A publication written sincerely in a straightforward manner will increase readership. Publications containing personalized articles can grab the reader's attention and prove very effective in promoting safety. Ask for suggestions, articles, feedback, and comments from readers. Develop some features or subjects that will appear on a regular basis. Look for ways to sell and promote the hazard control or safety message. Provide bulletin and newsletters in both print and electronic versions. Many organizations fail to promote or require the use of regular worksite safety meetings. Safety meetings and toolbox talks keep the lines of communication open and reinforce training and education objectives. Supervisory safety meetings can promote safety and also encourage worker involvement in accident prevention efforts. Meetings can motivate individuals to practice safety on the job. They also provide opportunities for employees to make suggestions, help pinpoint problem

areas, and recommend corrective solutions for workplace hazards. Safety meetings provide supervisors an opportunity to address new procedures and equipment acquisitions.

REVIEW EXERCISES

2.1 In your own words, define an accident.
2.2 List three common accident myths.
2.3 Define the concept of *hazard* closing.
2.4 In your opinion, what was the central concept of Heinrich's five-factor accident sequence?
2.5 Explain the basic premise of any multiple causation accident theory.
2.6 Why do some accident prevention professionals challenge the accident pyramid proposed by Heinrich?
2.7 In your opinion, should accident prevention efforts focus more on potential fatal events and less on other hazards?
2.8 What role does human behavior principles play in effective hazard control?
2.9 The text addressed two basic factors that can help create an atmosphere conducive to human error. What other human-related factors could contribute to human error?
2.10 Define an execution error.
2.11 List at least seven *common* unsafe human actions in the workplace.
2.12 Why would good human relations and communications skills help motivate people to act safely?
2.13 Explain the basic premise of accident *deviation* models.
2.14 List at least five ways that organizational leaders can promote employee involvement in hazard control efforts.
2.15 Explain the accident investigation concept of overvaluing causal factors.
2.16 Define in your own words the following basic causal factor categories:
   a. Operational factors
   b. Motivational factors
   c. Organizational factors
2.17 Team RCA should focus on which two fundamental methods to ensure success?
2.18 Why must hazard control managers understand organizational structures and interfacing functions?
2.19 In your own words, describe the roles that HR and purchasing play in supporting organizational accident prevention efforts.
2.20 How do *early return to work* initiatives and case management activities support the employee health function?
2.21 List at least seven key concepts or principles related to shift work that management should consider implementing to improve accident prevention efforts.
2.22 List at least five signs of employee substance abuse.
2.23 Explain the difference between education and training.
2.24 How can effective off-the-job education and training sessions improve employee performance and safety?

3 Leadership and Management

INTRODUCTION

Understanding some of the basic concepts related to effective management and leadership can prove valuable to those working or supporting organizational accident prevention efforts. This chapter provides a brief review of management theory and functions. It also provides a quick overview of key leadership principles that should complement management efforts. Some people think of *leadership* as just another function of management. However, I prefer to view *management* as the key support function of sound leadership. Organizational leaders and those that manage hazard control functions must consider the roles that people play in preventing or contributing to accidents and injuries. Many people view managing as an art that anyone can master with practice. Others view managing as a learned discipline or social science. Good managers seem to demonstrate that managing consists of learning and practice. The word *manager* can also refer to an individual's job or position title. How often do we meet someone with the title of manager, who demonstrates little understanding of even basic management principles? Individuals do not become effective managers because they hold the title or position. Too often, society misuses the term manager much like it also overuses the word *safety*. We tend to use both words out of context or without much thought to their true meanings.

Leading simply refers to taking actions to influence others toward attainment of organizational goals and objectives. Effective leaders understand the importance that human engagement plays in goal accomplishment. Human engagement refers to the concept where individuals personally feel their connection to their position and to organizational success. Human engagement contributes to personal satisfaction that helps increase productivity, morale, and motivation. Some organizations now realize the need for balancing organizational demands with a person's family and other life issues. Individuals when away from the organization serve in a variety of roles including volunteer, caregiver, and parent. Understanding the concept of human engagement helps leaders and hazard control managers better understand the behaviors and reactions of individuals to organizational issues and decisions. Conflicting responsibilities can lead to role misunderstandings and overloads that can impact their support for organizational objectives including hazard control efforts.

LEADERSHIP

Effective leading requires the manager to motivate subordinates, communicate effectively, and effectively use power. To become effective at leading, managers must first understand their subordinates' personalities, values, attitudes, and emotions. Leaders need to identify opportunities to reward personal and team success. Place the emphasis on improving organizational systems and processes instead of blaming individuals. True leaders focus on processes and must learn to educate followers instead of dictating to them. Leaders who use *conditional statements* to encourage others must also listen closely before taking actions. Leaders must promote ownership or *buy in* of hazard control as an organizational value. Encourage creativity to increase responsible actions of those being led. However, leaders must establish and communicate expectations in clear and concise terms. Taking these actions will reduce the need for any future mandates. True leaders learn to trust in their people skills while remaining uncertain about *how* to best meet objectives. Effective leaders learn to look beyond numbers if possible and resist

TABLE 3.1
Concepts Leaders Must Understand

- Character refers to moral or ethical structure of an individual or group.
- Belief refers to the mental act or habit of placing trust in someone or something.
- Value refers to an individual's perception of worth or importance assigned to something.
- Culture reflects the socially accepted behaviors, beliefs, and traditions of a group.
- Attitude refers to an individual's personal state of mind or feeling about something.
- People can perform a job or task and hide their attitude from others.
- Behavior relates to an open manifestation of a person's actions in a given situation.

trying to quantify everything. Leaders must learn to make both tactical and strategic decisions. Leaders must possess a vision of the organization structure and the path that it's traveling. System thinking helps leaders to see the *big picture* or the true organizational cultures that impact failure and success. Formal leaders must become effective ambassadors of the hazard control message (Table 3.1).

Practical Leadership

Effectiveness refers to taking the right actions to achieve a desired or expected outcome. Emotional issues can impact and even *sidetrack* the best hazard control efforts. True leaders must learn to use logic when seeking to reduce accidents and injuries. The appropriateness and quality of decisions at every organizational level can impact hazard control effectiveness. Leaders should understand that repetition acts as the *mother* of learning. Leaders should also consider human learning abilities, including retention of information, when developing orientation, education, and training session. Hazard control promotes the importance of recognizing and identifying unsafe work conditions and behaviors. Fenix stresses the importance of improving *worker awareness* of hazards and exposures encountered on the job. Supervisors should continuously stress the need for improving awareness on the job. High reliable organizations that use system safety methods place a strong emphasis on both task and situational awareness on the job.

When addressing leadership, consider ethics as vital since it provides the foundation of any hazard control management function. Without ethics, hazard control loses its organizational and personal value. *Webster's Collegiate Dictionary* defines ethics as (1) "discipline of dealing with good and bad with moral duty and obligation," and (2) "a set of moral principles or value or a theory or system of moral values." Ethics finds its roots in natural law, religious tenets, parental or family influence, educational experiences, life experiences, cultural norms, and societal expectations. Business ethics refers to the application of the discipline, principles, and ethical theories to the organizational context. We can define business ethics as the "principles and standards that guide behaviors in the business world." Ethical behaviors remain an integral part of conducting business affairs. The three considerations that impact and influence ethical decision making in business include individual difference factors, operational or situational factors, and issue-related factors.

MANAGEMENT

It seems so easy to create and use the phrase "safety management" as if communicating a definitive concept or process. However, safety management can mean different things to different people. The National Safety Management Society defines the term as "… that function which exists to assist all managers in better performing their responsibilities for operational system design and

implementation through either the prediction of management systems deficiencies before errors occur or the identification and correction of management system deficiencies by professional analysis of accidental incidents (performance errors)." This definition stresses the importance of identifying and correcting management-related deficiencies. Many people never think of addressing management deficiencies when referring to the term *safety management*. Poor and inefficient management provides opportunities for accidents to occur. Some individuals also think of management and leadership as synonymous terms. You can manage materials, projects, and processes, but you must lead people. Organizations need all managers and supervisors to provide hazard control leadership to their subordinates. I often made this statement while teaching safety educational sessions, "Good leaders who can't or don't want burdened down with the managerial details must quickly find someone who can help them." I then follow up with this statement, "Good managers who can't lead or don't want to lead need to quickly learn the art of delegating to someone who can." Dealing with too many details can cause operational managers to become overburdened with objectives, goals, and time constraints. Many organizations now use *project management* personnel to oversee the activities of long-term or complex projects. Leaders must move toward meeting established objectives but do so by considering both people and process during the journey. Hazard control management efforts without leadership can easily fail. However, hazard control professionals not using good management techniques can also fail in meeting expectations or objectives. Managers must set an example by following work rules and behavioral expectations established for their subordinates. Organizational members must see management personnel consistently setting a positive example in the area of hazard control. Managers must make practicing safety a priority and lead by example. Managers must learn to help others achieve personnel success while meeting established organizational objectives. People perform better when provided with the proper information, the necessary tools, and the delegated authority to get a job done. People must view themselves as participants in a project and never a pawn of a manager.

Management Theories

Properly employing the functions of management can contribute to the success of every organized enterprise. Traditional management functions include activities such as planning, organizing, coordinating, directing, and controlling. The functions of the management work together in a synergistic process to improve organizational operations including hazard control effectiveness. The evolution of organizational management theories began to take hold in the early 1900s with Frederick Taylor's scientific management theory. Taylor advocated finding the single best way to perform a task and then select the best person to accomplish it.

During the 1930s, Mooney and Reiley proposed a set of standard management principles known as administrative theory. They proposed that a standard approach could apply to all organizations. During the 1940s, Max Weber began to promote his bureaucratic theory based on a hierarchical power structure. Chester Barnard defined organizations as being a system of consciously coordinated activities. Barnard also stressed that senior leaders should create an atmosphere of value and purpose. Alfred Chandler studied large corporations and suggested they would go through some type of evolution to meet their strategy, mission, or function. Lawrence and Lorsch suggested that top leaders delegate authority to lower managers to improve decision-making effectiveness. The need for a better understanding of organizational management led to many proposals, studies, and theories beginning in the 1950s. The emergence of system thinking, which considers all components as interrelated, helped leaders better understand complex processes. The use of system approaches also helped managers better comprehend how a single variable within a process can impact or cause changes in other variables within the same process. Henri Fayol and Frederick Taylor suggested that contingency or situational management could deal with inevitable conflict that would arise within organizations as they became more complex.

Fred Fiedler suggested, in the 1960s and 1970s, the key determinants of a leadership situation depended on the degree to which a subordinate trusted a leader, the formal authority held by a leader, and degree of structure of a job task.

Peter Drucker

Drucker proposed during the 1970s the concept of decentralization for large organizations. Drucker suggested creating different organizational divisions that would operate simultaneously. He also suggested that some division would operate independently. This would permit organizations to diverse by allowing dynamic but flexible operations. However, he also believed that this divisional independence would hinder the integration and coordination of organizational activities. Today, many large corporations and companies must address the reality of Drucker's foresight about decentralization. You can't operate a traditional or centralized hazard control function in an organization that operates in a decentralized manner.

Classic Management Theory

The classic theory of management proposed by McGregor can play an important role in hazard control and can help prevent accidents within some organizations depending on organizational structure. Theory "X" or the traditional management approach develops mandatory rules and policies enforced by the organization. Theory X can work in centralized bureaucratic and *line* organizations. Theory "Y" on the other hand promotes worker involvement and participation in the functions of the organization. A good example of a Theory "Y" approach would be to include nonsupervisory hourly employees on the facility hazard control committee. Managers should look for ways to motivate, educate, and encourage workers to work safely. Theory "Y" approaches would work better in decentralized organizational environments.

Motivation–Hygiene Theory

In the late 1950s, Frederick Herzberg promoted his motivation–hygiene theory of leadership. The theory proposed that people require different things to motivate and satisfy their needs. Herzberg proposed that some factors contributed to job satisfaction but other factors did not. He also noted that some factors served as a source of dissatisfaction when not present. However, dissatisfying factors did not function as motivators. Motivating factors go to the very root and nature of an individual's job or position. Hygiene-related factors do little to motivate people but can cause great dissatisfaction when not provided or present. Job security could serve as a motivating hygiene factor, while recognition would result in motivating the individual. Organizational hazard control could serve as a hygiene factor in organizations that view accident prevention as just another program. However, hazard control could serve as motivator in organizations that view accident prevention as an integral part of every job, task, or process.

Managerial Grid

Robert Blake and Jane Mouton in the 1960s created the managerial grid to plot the degree that a manager focuses on people or job accomplishment. The grid considers a manager's concern for the people that do the job and his or her concern for the job itself. The grid employs an axis to plot managerial concerns for job completion versus concerns for the needs of people. Blake and Mouton defined the following five basic managerial styles. When using the managerial grid, consider the process as only a starting place for seeking a better understanding of management commitment categories. To perform at their highest level, hazard control managers must develop a good understanding of basic management and leadership concepts.

Management Theory S

William C. Pope in his excellent book entitled *Managing for Performance Perfection: The Changing Emphasis* presents several principles of system safety management or Theory "S." Pope's Theory "S" supports organizational performance and quality objectives by stressing the need for direct human involvement in hazard control functions. Hazard control functions must discover and document poor performance to demonstrate that the costs associated with errors do not result in too great of an expense to the margin of profit. Pope believed that management should control the behavior of any system. He proposed that shifting this responsibility, to assign personal blame, did not correct the human or interpersonal situations that permitted a mishap to occur repeatedly. Administering any system, to avoid flaws, required adapting the system to its environment. This adaptation ensured management of the safest possible performance of both human and material resources. Pope suggested that three-*system*-generated flaws or causal factors exist in all organizational mishaps. He referred to the flaws as biological or human, physical or property, and social or management. He believed that correcting flaws in one system and not addressing the other two systems can increase the potential for additional mishaps. Management must take responsibility for the flaws in all three systems.

Theory Z

Proposed by Professor William Ouchi, Theory "Z" addresses long-term job security, consensual decision making, slow promotion opportunity, and individual responsibility within a group context. Theory "Z" breaks away from McGregor's Theory "Y" that focuses on employer–employee relationships. Theory "Z" changes the level to include entire organizational structure. Theory "Z" characterizes values, beliefs, and objectives as similar to *clannish* cultures. The theory places an emphasis on the socialization of group members to achieve personal and group objectives. Organizations can retain some components of a bureaucracy including authority delegation and evaluation of performance. Some view Theory "Z" as suggesting that common cultural values promote increased organizational commitment among employees.

Knowledge Management

The concept of *knowledge management* goes beyond the concept of informational technology. Many organizations manage information but neglect to manage knowledge. Managing knowledge requires the identification, analysis, and understanding of all operational processes. Knowledge provides no organization value unless the information is relevant, available, and disseminated to end users. The failure to communicate accident and hazard information can result in poor analysis of hazards or accident experience. Each organizational process, department, or function must contribute information about accidents, hazards, and unsafe behaviors. This aggregate knowledge provides the basis for determining appropriate hazard controls, the need for training or education, or required innovations to improve performance (Table 3.2).

DECISION MAKING

People employ management concepts to help them make good decisions. Managers must constantly evaluate alternatives and make decisions regarding a wide range of matters. Decision making involves uncertainty and risk. Many decision makers possess varying degrees of risk aversion when making decisions. Decision making may require evaluating information and data generated by qualitative and quantitative analyses. Decision making must rely not only on rational judgments but factors such as decision-maker personality, peer pressures, organizational situations, and a host of other issues. Management *icon* Peter Drucker identified several key decision-making practices

TABLE 3.2
Tips for Improving Organizational Knowledge Management

- Identify the knowledge that the organization already possesses.
- Determine the kinds of knowledge that the organization needs.
- Evaluate how knowledge can add value to organizational effectiveness.
- Create processes to help the organization to achieve objectives.
- Maintain and effectively use knowledge assets to improve the organization.

that successful executives used. Leaders should consider the following questions before making decisions. The first question simply says, what needs accomplishment? The second question seeks to find out, "what's best for the organization?" When a decision maker gets the answers, he or she can then proceed with developing a plan of action. Decision makers must take responsibility for their actions. True decision makers use the team pronouns such as *we* and never the self-gratifying pronoun *I*.

Management by Exception

Management by exception (MBE) enables managers to quickly make common day-to-day decisions. MBE would prove inappropriate for decisions requiring significant deviation from established practices, standards, or expectations. Managers of today can easily use MBE decision-making principles because of their immediate access to electronically provided sources of information. Provide busy managers only with sufficient information about a situation for them to make a decision.

The use of MBE concepts can encourage subordinates to use judgment in deciding which situations or concerns managers need to know. MBE motivates subordinates to work within established controls and reduce the number of insignificant decisions made by managers. MBE helps direct a manager's attention to issues, challenges, or problems that seriously impact organizational success. Never waste time and effort by focusing on those parts of the organization that run smoothly.

FUNCTIONS OF MANAGEMENT

Planning

Proper planning can help any organized enterprise to successfully meet objectives and attain goals. The function of planning focuses on developing a course action and setting organization direction as necessary to achieve desired outcomes. Planning requires that managers learn to make good decisions. Tactical organizational planning refers to creating and developing short-term or specific ways to implement strategic or long-term goals. Strategic planning must identify long-range opportunities and threats. When developing tactical and strategic plans, effective managers must understand the strengths and weaknesses of their organization. Planning provides the foundation to ensure the success of all functions of management. Effective planning must consider issues related to properly utilizing human and other material resources. Effective planning must seek to avoid confusion, uncertainty, and human emotion hindrances to goal accomplishment. Leaders must also consider organizational culture and climate during planning sessions.

Directing

Managers must effectively supervise others and attempt to motivate them to achieve success in pursuit of organizational objectives. The function and art of directing people must use effective

communication and human relation skills. Directing remains the fundamental aspect of all effective management. Leadership plays an important role in directing because it can encourage and motivate others to succeed. Directing also requires overseeing the work of others including providing them guidance and incentive.

Organizing

Managers must organize the workforce and materials in an efficient manner. Organizing includes designing the structure and aligning the activities of the organization. Organizing can also include what some refer to as the *staffing function* of management. Organizing focuses on people, activities, and other functions operating at high levels of effectiveness and efficiency. Organizing can involve designing jobs and tasks to maximize operational performance. Organizing must also consider using material and financial resources as required to ensure action plans lead to goal attainment. The art of organizing requires the use of good coordination to *connect the dots* of organizational dysfunction that would otherwise hinder goal accomplishment. Organizing efforts must identify and classify the many activities necessary to ensure success. Organizing also must address requirements related to the assignment of duties, delegation of authority, creation of responsibility, and obtaining approval or consensus.

Controlling

Controlling involves the processes related to ensuring operational activities adhere to organizational policies, procedures, and directives. Managers at all levels must learn to recognize and report deviations from plans or objectives. Controlling also includes taking necessary actions to correct performance and actions that deviate from standards and expectations. Performance standards can address financial issues such as revenue, costs, or profits. Controlling can also consider other quality or production concerns such as defects or customer complaints. The controlling function must also attempt to predict substandard deviations and accomplishments before occurrence. Poor controlling functions can hinder goal accomplishment.

Coordinating

Coordinating goes beyond simple communication and feedback processes. Coordinating seeks to attain consensus among interested or relevant parties about an action or objective. Managers must learn to harmonize procedures and activities performed by various functions, departments, leaders, and subordinates to ensure the organization moves forward with agreement and understanding. Coordinating, by nature, must bring functions, cultures, and groups together for the common good of the organization. Coordinating focuses on unifying goal attainment efforts. Coordinating, the hidden force, binds together other management functions. For example, directing requires coordination because of a need for rapport between a superior and subordinate.

OTHER MANAGEMENT CONCERNS

Staffing

Many business and management professionals now include *staffing* as a key function of management. Staffing deals with organizational structures and ensures the maintenance of a proper level of manning. Some organizations consider staffing as vital because of increased technology, wide diversity, and complexity of modern organizations. Staffing must consider issues such as recruitment, screening methods, assessment, proper classification, and effective assigning of people to organizational positions and departments.

Project Management

Project management involves applying leadership principles and management concepts to a transition, phase, or temporary endeavor requiring great attention to detail. This type of management can trace its roots to construction and other complex undertakings. Trained managers address and coordinate all the details related to the myriad of activities of a *given* project. Many project managers possess some experience in addressing quality, risk, and hazard control issues. When properly addressing these issues, projects can progress as planned and also meet budgetary or resource expectations. Most project managers use a *structured problem-solving approach* to address the risk and hazard control–related issues. Hazard control personnel should coordinate with the project manager issues such as objectives, scope, time frames, costs, regulatory issues, and required performance measures.

Psychological Safety

Workplace-related psychological safety demonstrates itself when employees feel unable to put themselves on the line, ask questions, seek feedback, report problems, or propose a new idea without fearing negative consequences to themselves, their jobs, or their career. A psychologically safe and healthy workplace actively promotes emotional well-being among employees while taking all reasonable steps to minimize threats to employee mental health.

Crisis Management

The study of crisis management originated with the large-scale industrial and environmental disasters in the 1980s. Three elements common to most definitions of crisis include determining threats to the organization, planning for the elements of surprise, and making decisions in short time frames. The fourth element relates to addressing the need for change. When change does not take place, some could view the event as a failure or incident. Crisis management uses response methods that address both the reality and perception of crises. Organizations should develop guidance to help define what constitutes a crisis and what triggers would require immediate response.

ORGANIZATIONAL DYNAMICS

Traditional Organizational Structure

Traditional organizational *structure* follows two basic patterns. The first structure referred to as a line organization permitted top management to maintain complete control with a clearly defined chain of command. This basic line structure works well in small companies with the owner or top manager functioning at the top of the organizational structure. Everyone understands the clear *lines* of distinction between the owner or manager and subordinates. A line-and-staff organization combines the line organization with appropriate staff departments that provide support and advice to the line functions of the organization. Many medium and large organizations use the line-and-staff structure with multiple layers of staff managers supporting overall operations. An advantage of the line-and-staff organizational structure relates to the availability of technical and managerial functions. The organization incorporates these needed staff and support positions into the formal chain of command. However, conflict can arise between line and staff personnel, creating disruptions within the organization. This conflict can at times impact the effectiveness of the hazard control management function. Hazard control managers must remain focused on identifying and correcting the causes of accidents regardless of the organizational structure. However, they must understand that organizational structure can hinder accident prevention efforts. Organizational leaders must integrate the function of hazard into the organizational management structure with clearly defined

responsibility and authority. Top management must focus on identifying and correcting operational and staff management–related deficiencies that could hinder hazard control efforts. The organizational structure must consider developing processes that help identify and analyze system deficiencies that contribute to accidents. Leaders must ensure that support functions such HR, facility management, and purchasing receive information about their management deficiencies that could impact hazard control. Consider the following scenario: an HR department mistakenly assigned a new employee to a hazardous job position without properly screening or evaluating the person's qualifications. This could contribute to an accident or mishap. Senior leaders of staff and departments must understand their roles and responsibilities related to hazard control. Many organizational structures permit and even unknowingly encourage support or staff department managers to create their own *little dynasty*. This can result in the self-coronation of *turf kings and queens*. Once crowned, these rulers may not see the need to coordinate or communicate important issues with other functions.

Organizational Culture

Organizational culture consists and exists based on assumptions held by a particular group. These assumptions can include a mix of values, beliefs, meanings, and expectations held in common by its members. Cultures can determine acceptable behaviors and problem-solving processes. Organizational trust refers to the positive and productive social processes existing within the workplace. Trust can encourage group members to engage in cooperative and expected organizational behaviors. Trust also provides the foundation for demonstrating commitment and loyalty. For example, an organization with a safety and health-focused culture enhances the well-being, job satisfaction, and organizational commitment of all members. A culture with social support systems can enhance member's well-being by providing a positive work environment for those dealing with depression or anxiety. The established culture *sets the tone* for an organization. Negative cultures can even hinder the effectiveness of the best plans and policies. Unhealthy cultures create stressful environments that can lower employee well-being and impact organizational productivity (Table 3.3).

Covert and Overt Cultures

Many times, senior managers fail to acknowledge the existence of the covert, informal, and hidden cultures. They incorrectly hold the belief that the established overt, formal, or open culture drives organizational success and productivity. They also fail to acknowledge the tremendous influence of hidden cultures on organizational behaviors. Why do these hidden cultures exist? They exist to meet the needs of its members. Failing to acknowledge these hidden cultures can hinder an organization's ability to change or improve the formal culture. The actual climate, not the established structure,

TABLE 3.3
Elements for Creating Safety Cultures

- Positive perception of teamwork.
- Safe behaviors exist as the norm.
- Job satisfaction.
- Perception of senior management effectiveness.
- Recognizing the reality of job-related stress.
- Adequacy of supervision, education, and training.
- Opportunities for effective organizational learning.
- Nonpunitive response to error by leaders.

exerts the most influence on organizational performance. Hidden cultures can also support a very effective organizational communication process known as the grapevine. The grapevine serves as the informal and confidential communication network that quickly develops within any organization to supplement the formal channels. The actual function of the grapevine will vary depending on the organization. For example, it could communicate information inappropriate for formal channels. The grapevine can carry both good and bad organizational news. The grapevine in some instances serves as a medium for translating top management information into more understandable terms. The grapevine also serves as a source of communication redundancy to supplement formal channels. When formal communication channels become unreliable, the grapevine can quickly operate as the more trusted communication system.

Some organizations use socialization processes to educate new members about the organization's cultures. Socialization can occur in both formal and informal culture arenas. The socialization process will determine which culture, formal or informal, will exert the most influence on an individual. Organizational members then must decide to remain or leave the organization. Many that stay may experience isolation. Leading culture change requires a sound understanding of organizational behaviors, attitudes, expectations, and perceptions. Changing the organizational culture must also impact the behaviors, attitudes, and perceptions of all organizational members. Leaders must use all available sources to communicate the *change* message. Change can have both a negative and positive impact on leaders as well. Change can dethrone the turf kings and queens. However, it can encourage development of teamwork and continuous improvement processes.

When leading change within any organization—never forget the importance of communication and feedback throughout the entire journey. Most people naturally resist change that causes organizations to change very slowly. First-level change deals with people, structure, policies, and procedures. Second-level change deals with complex systems, cultures, and processes. Many people now view change as an inherent and integral part of organizational life. Some new trends in organizational dynamics emerged during recent years. These emerging trends can create conflict and concern for organizational leaders and members. The trends can create both opportunities and threats in the minds of people. Any change creates tensions that leaders must address to prevent unwanted or dysfunctional change results. Many organizations now operate on a global scale with increased competition. These organizations also must embrace economic interdependence and increased collaboration. This globalization results in a wide range of consumer needs and preferences.

Change does not occur just because a top manager writes a memo and declares it done. Organizational change must consider how to best transform the organization from within. When leaders communicate need and intent to change, they must provide information to address issues such as behaviors and expectations. Communicate the reasons for change so that everyone understands. Provide guidance and leadership action to ensure change happens. Before change can occur in large organizations, leaders must acknowledge the existence and influence of hidden or covert cultures operating in the organization. Always articulate how change will impact all organizational members and operational functions. When educating others about change, provide sessions that focus on real situations. Work to change or shift the culture before implementing other innovations or interventions. Not to do so would provide no supporting foundation for the innovations or interventions. Leaders must promote trust and ensure the involvement of organizational members in decision-making processes. Provide team members with the opportunity to voice concerns or make suggestions that would help build trust. Encourage team members to express some kind of choice and allow them flexibility to make decisions related to their job tasks. Migrating decision making permits individuals with the appropriate expertise, education, or experience, regardless of rank or position, to make an informed decision.

When changes in work sites, processes, materials, and equipment occur, hazard can emerge. During any change process, hazard surveillance and self-inspections must become frequent.

Organizations should develop an enhanced hazard review process when undertaking major changes in processes, systems, or operations. Maintain sound coordination and communication systems among all parties involved in the change process.

Change may require revising existing JHAs, reviewing standard operating practices evaluating lockout methods, and assessing PPE requirements. Change-related hazard analyses can prove cost-effective in terms of preventing accidents, injuries, and other organizational losses. Individuals respond differently to change. Some organizational members may require additional time to adapt and accept the change.

EFFECTIVE SPEAKING AND WRITING

Healthcare safety and hazard control managers must learn to understand the communicative process and demonstrate their ability to speak and write effectively. Communication consists of the sender, the message, and the audience. For successful communication, the audience must not only get the message but must interpret the message in the sender's intended way. Communication refers to the purposeful act or instance of transmitting information using verbal expressions or written messages. To function effectively, all leaders and managers need to know how to effectively communicate with all organizational members. Managers and leaders must understand the different communication channels available. Downward communication involves more than passing information to subordinates. It can involve managing the tone of the message and effectively demonstrating skill in delegation. When communicating upward, tone becomes more crucial along with timing, strategy, and audience adaptation. A sender wants to transmit an idea to a receiver through using signs capable of perception by another person.

Communication

Communication refers to the sharing or exchanging of thought by oral, written, or nonverbal means. Communication signs can include the printed or spoken word, a gesture, a handshake, or a facial expression. The receiver takes those signs, interprets them, and then reacts with feedback or simply ignores the message. When communicating, a sender encodes a message using some tangible sign. A sign may consist of anything seen, heard, felt, tasted, or smelled. The receiver decodes the message to comprehend its meaning. The meaning of the message can differ since both the sender and receiver can assign their own meaning. Each individual's unique set of experiences can function as a perceptual *filter*. The filter blends the education, upbringing, and life experiences of the perceiver. Leaders must learn to use effective communication to provide vision and direction to others. Motivating, inspiring, and persuading others to work together require effective communication skills. Miscommunication can result in expensive mistakes, organizational embarrassment, and in some cases, accidents or even death. Today, communication effectiveness can suffer from too much information. Around-the-clock media coverage, e-mails, and web-based informational sources make it difficult to filter the valuable information needed to accomplish our goals and objectives. We must learn to communicate with clarity and focus. Failure to communicate relates to answering the wrong question, answering only part of the question, and adding irrelevant information. Many communicators answer the question but provide unnecessary feedback information.

Communication Barriers

Communication barriers often also called noise or static can complicate the communication process. While unavoidable, both the sender and receiver must work to minimize them. Interpersonal communication barriers can arise within the realm of either the sender or receiver. If an individual holds a bias against the topic under discussion, anything said in the conversation can affect perception.

TABLE 3.4
FOCUS Principles of Effective Writing and Speaking

- Focused: Address the issue, the whole issue, and nothing but the issue.
- Organized: Systematically present your information and ideas.
- Clear: Communicate with clarity and make each word count.
- Understanding: Know your audience and its expectations.
- Supported: Use logic and support to make your point.

Source: Adapted from U.S. Air Force Manual: Tongue and Quill.

Organizational barriers can occur because of interactions taking place within another larger work unit. The serial transmission effect takes place when a message travels along the chain of command path. As it moves from one level to the next, it changes to reflect the person who passed it on. By the time a message travels from bottom to the top of the chain, it changes and not likely recognized by the person who initiated it. Nonverbal communication occurs when information exchanges through nonlinguistic signs. Many consider *body language* as synonymous with nonverbal communication. Body language provides a rich source of information during interpersonal communication. The gestures that people make during an interview can emphasize or contradict what he or she says. Posture and eye contact can indicate respect and careful attention (Table 3.4).

Effective Writing

When preparing to communicate using written correspondence, organize information using a logical and systematic process. This helps the recipients to understand the message without reading it over and over. When communicating in a clear manner, place emphasis on the rules of language including proper spelling and correctly pronouncing words. Good communicators also learn how to assemble and punctuate sentences. Effective communicators never hide their ideas or information in a jungle of unnecessary verbiage. Use of incorrect language can cripple credibility and limit acceptance of ideas. Developing strong language skills requires commitment. Many writers and speakers cripple their attempt at communication by using bureaucratic jargon, big words, and too much passive voice. Good writers and speakers want to inform or persuade their audience. Building credibility with the targeted audience requires the use of support and logic. Nothing can cripple a clearly written and correctly punctuated correspondence quicker than a fractured fact or a distorted argument. However, properly using logic remains a challenge for many individuals to master since it challenges the mind's ability to think in the abstract. Never attempt to hide intellectual shortcomings with verbal overdose. Communicators need to consider a seven-step approach that will support communication success. Good communication requires preparation, and the first four steps lay the groundwork for the drafting process (Table 3.5).

Purpose for Writing

Too many writers launch into a project without a clear understanding of their purpose or audience. Carefully analyzing your purpose helps answer the question, the whole question, and nothing but the question. Take time to understand your audience and consider their current knowledge, interest, and motives. Abraham Lincoln said it well, "Truth is generally the best vindication against slander." Support your communication with information relevant to your point. Do your homework to get educated about your communication topic.

TABLE 3.5
Seven Steps for Effective Communication

- Analyze purpose and audience.
- Research your topic.
- Support your ideas.
- Organize and outline.
- Draft.
- Edit.
- Get feedback and approval.

Source: Adapted from U.S. Air Force Manual: Tongue and Quill.

Persuasive Writing

Since communication involves persuasion, use information that supports a logical argument. People use logic to make decisions and solve problems. Before starting to write or speak, organize your thoughts and develop a presentation outline. Good communicators organize their information logically and lead their audience from point to point. Audiences tune out speakers or writers who ramble without any logical pattern. Organize the presentation to help the audiences better understand the point. The first four steps of the FOCUS process apply to both writing and speaking. Mastering the first four steps will make the actual drafting process less painful and more efficient. Make your point quickly, organize the paragraphs to lead the reader, and use proper transitions to guide them. Write clear and direct sentences that cut through the jargon.

Editing

Good writers resist the laziness of overusing the passive voice. Select the right words and summarize your message in a concluding paragraph. Remember the inevitability of criticism and judgment. Learn to critically evaluate and correct your own writing. Learn the two most critical aspects of the editing process. Know what to edit and how to edit. The *how to edit* poses the biggest challenge to most writers. Writers should begin the editing by looking at the message as a whole and then work down to details such as spelling and punctuation. Most individuals demonstrate a limited ability to criticize their own work. Sometimes engaging someone else can help writers see how to improve or strengthen their communication. Never let pride or fear of criticism hinder objective and helpful criticism.

Writing a Report

An effective report should include a brief summary, introduction, findings, conclusion, and recommendations. The summary should include a very brief digest of the report sections. The introduction should include the need for the report and who wrote it. The main part should contain the findings with a discussion and analysis of each finding. The conclusions and recommendations should contain statements for corrective actions including alternatives or options. Writing a report to encourage hazard control decision making or management actions can help senior leaders address important organizational issues.

REVIEW EXERCISES

3.1 Explain in your own words how the *grapevine* can impact an organization and its members.
3.2 Why must leaders understand and promote human engagement in organizational activities, goals, and objectives?
3.3 What reasons can you give that would support the author's view that effective management serves best as a function of leadership?
3.4 What reasons can you give that would support the assertion that *leaders need to educate more and dictate less*?
3.5 Explain in your own words the difference between effectiveness and efficiency.
3.6 Describe what role ethics must play in the practice of hazard control.
3.7 In your opinion, what aspect of "Theory S" would contribute most to organizational accident prevention efforts?
3.8 Why should leaders understand the difference between effective knowledge management and information management?
3.9 List and define five traditional functions of management.
3.10 Define organizational culture and then explain the key difference between overt and covert cultures.
3.11 Why would effective oral and written communication skills prove important to the success of a hazard control manager? How could the lack of communication skills impact hazard control efforts?

4 Federal Agencies, Standards Organizations, and Voluntary Associations

FEDERAL LAW

The US Code (U.S.C.) consists of a compilation of laws in force from 1789 to the present. As prima facie or presumed to law, it does not include repealed or expired acts. The Federal Register (FR) publication system established on July 26, 1935, provides the official legal information service of the US government. It functions under the authority of the Administrative Committee of the Federal Register (ACFR). The FR operates through a statutory partnership with National Archives' Office of the Federal Register (OFR) and the US Government Printing Office (GPO). The ACFR delegates its day-to-day authority to the director of the OFR. The OFR administers programs under the Federal Register Act (44 U.S.C. Ch.15), the GPO Electronic Information Access Enhancement Act (44 U.S.C. 4101), the Freedom of Information Act (5 U.S.C.551 et seq.), and other public information laws of the United States. The daily *FR* posted on the GPO's Federal Digital System serves as the official daily publication for rules, proposed rules, and notices of federal agencies and organizations including executive orders and other presidential documents.

An amendment to the act in 1937 established the CFR. The CFR serves as the codification source for the general and permanent rules published previously in the *FR*. Users may access the CFR free of charge as on the Federal Digital System maintained by the US GPO. The CFR contains 50 titles with each title assigned to specific agencies that issue regulations pertaining to broad subject areas. The CFR permits the arrangement of official text of agency regulations or standards into a single publication. This provides a comprehensive and convenient reference for anyone needing to access federal general and permanent regulations. The CFR works with the FR, which provides updates on a daily basis to keep the CFR current. A full set of the CFR consists of approximately 200 volumes with revision occurring annually on quarterly basis as follows:

- Titles 1–16 as of January 1
- Titles 17–27 as of April 1
- Titles 28–41 as of July 1
- Titles 42–50 as of October 1

The Administrative Procedure Act was passed in 1945 (5 U.S.C. 551) and added several provisions to the FR system. The act gave the public, in most instances, the right to participate in the rule-making process by commenting on proposed standards. Informing the public about proposed rule-making actions remains the primary purpose of the FR. Governmental agencies can promulgate standards using the administrative law process. Most federal agencies publish a regulatory agenda in the FR to inform the public of proposed or expected actions (Table 4.1).

OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION

The OSH Act and standards issued by OSHA apply to every private employer with one or more employees except those covered by other federal legislation. Under the act, employers have the

TABLE 4.1
Selected CFR Titles

- Title 10, Energy and Radiation (NRC)
- Title 21, Food and Drugs (FDA)
- Title 29, Labor (OSHA)
- Title 40, Environmental Protection (EPA)
- Title 42, Health and Human Services (NIOSH, CMS)
- Title 44, Emergency Management (FEMA)
- Title 49, Transportation (DOT)

general duty of providing their workers employment and a place of employment free from recognized hazards to safety and health and must comply with OSHA standards. When OSHA compliance officers discover hazards, employers can receive citations listing alleged violations including proposed penalties and abatement periods. Employers may contest these before the independent Occupational Safety and Health Review Commission (OSHRC). Employees must comply with standards and with job safety and health rules and regulations applying to their own conduct. Employees or their representatives have the right to file a complaint with OSHA requesting a workplace inspection. OSHA can withhold complainants' names from the employer. Employees have the right, on request, to be advised of OSHA actions regarding their complaint. They also possess the right for an informal review to be made of any OSHA decision not to inspect a workplace. Employees also may attend the employer's informal conference with OSHA to discuss any issues raised by inspection, citation, and notice of proposed penalty or abatement period. In developing new or amended standards, OSHA invites full participation by employers and employees.

Summary of General Duties

5(a)(1)—Each employer must provide each employee a place of employment free from recognized hazards that could cause or likely to cause death or serious physical harm to employees.

5(a)(2)—Each employer must comply with occupational safety and health standards promulgated under the OSH Act.

5(b)—Each employee must comply with occupational safety and health standards and rules, regulations, and orders issued pursuant to this act as applicable to his or her actions and conduct (Table 4.2).

Every workplace must display the OSHA poster (Pub 3165) or the state plan equivalent. The poster explains worker rights to a safe workplace and how to file a complaint. Place the poster where

TABLE 4.2
Types of OSHA Standards

- General Industry Standards, 29 CFR 1910
- Standards for Shipyard Employment, 29 CFR 1915
- Marine Terminals Standards, 29 CFR 1917
- Long Shoring Standards, 29 CFR 1918
- Construction Standards, 29 CFR 1926

employees will see it. You can order one free copy from OSHA or download a copy from the agency website at www.osha.gov. OSHA uses special criteria to conduct a programmed inspection. Criteria may include injury rates, death rates, exposure to toxic substances, or a high amount of lost workdays for the industry. Another nonprogrammed inspection can occur when an employee makes a formal complaint to OSHA regarding a possible unsafe working condition or imminent danger at the workplace. If the inspector does not have a warrant, employers do not have to provide access to the facility under the Fourth Amendment. OSHA regulations require employers to report deaths on the job within 8 h. The agency then investigates the circumstances of the death, usually on-site, to determine the cause of death and if violations of the OSH Act occurred. If the agency determines that the employer failed to follow safety and health requirements, it issues citations and proposed civil penalties. OSHA bases proposed penalties on the statutory factors of employer size, gravity of violation, good faith of the employer, and the history of previous violations. OSHA penalties do not correspond to or reflect the value of a worker's life or the cost of an injury or illness. OSHA instructs compliance officers to check the OSHA 300 Log and other documents to determine occupational health hazard trends. Inspectors can check healthcare facility safety records and NRC radioisotope or radiation source licenses.

OSHA can refer a willful citation resulting a fatality to the Justice Department for consideration for criminal prosecution. Any criminal prosecution by the Department of Justice (DOJ) does not impact OSHA authority to issue civil citations and penalties. OSHA can use criminal referral as an enforcement tool. However, most cases involving willful citations do not merit criminal prosecution.

Priorities

Imminent danger situations receive top priority. An imminent danger refers to any condition with reasonable certainty that a danger exists that could cause immediate death or serious physical harm. If an imminent danger exists, the compliance officer will ask the employer to voluntarily abate the hazard and to remove endangered employees from exposure. Should the employer refuse, OSHA will apply to the nearest federal district court for legal action to correct the situation. OSHA's second priority involves investigation of fatalities and catastrophes resulting in hospitalization of three or more employees. Employees retain a right to request an OSHA inspection when placed in imminent danger from a hazard or whenever there is a violation of an OSHA standard that threatens physical harm. If the employee so requests, OSHA will withhold the employee's name from the employer. OSHA establishes inspection priorities aimed at specific high-hazard industries, occupations, or health hazards. Establishments cited for alleged serious violations may undergo a reinspection to determine whether the hazards are corrected. OSHA regulations require employers to report deaths on the job within 8 h. Employers may call their local office or the agency's toll-free number of 800-321-6742. The agency investigates the circumstances of the death, usually on-site, to determine the cause of death and if violations of the OSH Act occurred. OSHA makes exceptions when the situation falls outside of the agency's jurisdiction.

Citations

After the compliance officer reports the findings, the area director determines which citations warrant formal issuance and which penalties require assessment. An *other than serious* violation addresses issues that would not normally cause death or serious physical harm. OSHA can issue a serious violation if substantial probability exist that death or serious physical harm could result. The employer knew or should have known situation or hazard. OSHA cites imminent dangerous citations as serious violations. A willful violation refers to a situation that the employer intentionally and knowingly committed. The employer either knows that the operation constitutes a violation or is aware that a hazardous condition existed but made no reasonable effort to eliminate it. A repeat violation can address any standard, regulation, rule, or order where, upon reinspection, another

violation of the previously cited section is found. Failure to correct any violations may bring civil penalties for every day, the violation continues beyond the prescribed abatement date. Falsifying records, reports, or applications can bring a fine and/or 6 months in jail upon conviction. Assaulting a compliance officer, or otherwise resisting, opposing, intimidating, or interfering with a compliance officer in the performance of his or her duties, is a criminal offense.

State-Approved Plans

States and jurisdictions can operate their own occupational safety and health plans with OSHA approval. State plans must establish standards that meet federal requirements. Approved state plans must extend their coverage to state and local government workers. Alliances enable organizations committed to workplace safety and health to collaborate with OSHA to prevent injuries and illnesses in the workplace. OSHA and its allies work together to reach out to, educate, and lead the nation's employers and their employees in improving and advancing workplace safety and health.

Recordkeeping (29 CFR 1904)

Congress directed the Secretary of Labor through Section 8(c)(2) of the OSH Act to prescribe regulations requiring employers to maintain accurate records and periodic reports on work-related deaths, injuries, and illnesses that do not involve medical treatment, loss of consciousness, restriction of work or motion, or transfer to another job. The act requires OSHA to develop and maintain the effective collection, compilation, and analysis of occupational safety statistics. Under 29 CFR 1904, Recording and Reporting Occupational Injuries and Illnesses, employers are required to record information on the occurrence of injuries and illnesses in their workplaces. The employer must record work-related injuries and illnesses that meet one or more of published recording criteria. OSHA rules found in 29 CFR part 1904 require all employers under OSHA jurisdiction with 11 or more employees to keep OSHA injury and illness records, unless the establishment is classified in a specific low-hazard retail, service, finance, insurance, or real estate industry. Employers with 10 or fewer employees must keep OSHA injury and illness records if OSHA or the Bureau of Labor Statistics (BLS) informs them in writing that they must keep records under 29 CFR 1904.41.

Recording Work-Related Injuries and Illnesses

The OSHA Log of Work-Related Injuries and Illnesses (Form 300) is used to document and classify work-related injuries and illnesses. The log also documents the extent and severity of each case. Employers use the log to record specific details about what happened and how it happened. The summary (Form 300A) shows totals for the year in each category. At the end of the year, post the summary in a visible location to make employees aware of the injuries and illnesses occurring in the workplace. Employers must keep a log for each establishment or site. If an employer operates more than one establishment, each location must keep a separate log and summary. Keep all logs for 5 years.

Medical Treatment

Medical treatment includes managing and caring for a patient for the purpose of combating disease or disorder. Do not consider the following as medical treatments and do not record them: (1) visits to a doctor or healthcare professional solely for observation or counseling; (2) diagnostic procedures, including administering prescription medications used solely for diagnostic purposes; and (3) any procedure labeled as first aid.

Restricted Work

Restricted work activity occurs when an employer or healthcare professional recommends that the worker can't do routine functions of his or her job or for a full workday. Count the number of calendar days the employee was on restricted work activity or was away from work as a result of the recordable injury or illness. Do not count the day on which the injury or illness occurred in this number. Begin counting days from the day after the incident occurs. If a single injury or illness involved both days away from work and days of restricted work activity, enter the total number of days for each. You may stop counting days of restricted work activity or days away from work once the total of either or the combination of both reaches 180 days.

Classifying Injuries

An injury is a wound or damage to the body resulting from an event in the work environment. Examples include cuts, punctures, lacerations, abrasions, fractures, bruises, contusions, chipped teeth, amputations, insect bites, electrocution, or thermal, chemical, electrical, or radiation burns. Classify sprains and strain injuries to muscles, joints, and connective tissues as injuries when they result from a slip, trip, fall, or other similar accidents.

Classifying Illnesses

OSHA considers skin diseases as illnesses caused by exposure to chemicals, plants, or other hazardous substances. OSHA defines respiratory conditions or illnesses as breathing-related problems associated with pneumonitis, pharyngitis, rhinitis, farmer's lung, beryllium disease, tuberculosis, occupational asthma, reactive airways dysfunction syndrome, chronic obstructive pulmonary disease, and hypersensitivity. Examples can include heatstroke, hypothermia, decompression sickness, effects of ionizing radiation, exposure to ultraviolet (UV) rays, anthrax, and bloodborne pathogen diseases.

Posting the Summary

Post the summary OSHA Form 300A only (not the log) by February 1 of the year following the year covered by the form. Keep it posted until April 30 of that year. Retain the log and summary for 5 years following the year to which they pertain. Do not send the completed forms to OSHA unless specifically asked to do so.

Form 301 Injury and Illness Incident Report

Employers may use the OSHA 301 or an equivalent form that documents the same information. Some state workers compensation, insurance, or other reports may be acceptable substitutes, as long as they provide the same information as the OSHA 301.

Access to Employee Exposure and Medical Records (29 CFR1910.1020)

Employees potentially exposed to toxic substances or harmful physical agents in the workplace possess the right to access relevant exposure and medical records. Access includes current workers, former employees, and employees assigned or transferred to work involving toxic substances or harmful physical agents. Designated employee representatives may access employee medical or exposure records and analyses created from those records only in very specific circumstances. Designated employee representatives include any individual or organization employee with written authorization to exercise a right of access. Access gives the right to examine or copy medical and

exposure records. Employees have the right to access records- and analyses-based work concerns. Employers must permit access free of charge and within a reasonable period of time. Employees can access in one of three ways: (1) employer may provide the employee a copy of the document, (2) employer may provide facilities for employees to copy the document, or (3) the employer may loan a copy to the employee to copy off site.

OSHA Whistle-Blowing Responsibilities

The OSH Act provides for a wide range of substantive and procedural rights for employees and representatives of employees. The act recognizes that effective implementation and achievement of its goals depend on active and orderly participation of employees or their representatives. Section 11(c) of the act prohibits any person from discharging or retaliating against any employee because he or she exercised rights under the act. These rights include complaining to OSHA and seeking an inspection, participating in an inspection, and participating or testifying in any proceeding related to an inspection. OSHA also administers the whistle-blowing provisions of other statutes, protecting employees who report violations of various airline, commercial motor carrier, consumer product, environmental, financial reform, healthcare reform, nuclear, pipeline, public transportation agency, railroad, maritime, and securities laws. A person filing a complaint of discrimination or retaliation must show that he or she engaged in protected activity, the employer knew about that activity, the employer subjected him or her to an adverse action, and the protected activity contributed to the adverse action. Define adverse action as any action that would dissuade a reasonable employee from engaging in protected activity. Depending upon the circumstances of the case, *adverse action* can include the following: (1) firing or laying off, (2) blacklisting, (3) demoting, (4) denying overtime or promotion, (5) disciplining, (6) denial of benefits, (7) failure to hire or rehire, (8) intimidation, (9) making threats, (10) reassignment affecting prospects for promotion, and (11) reducing pay or hours (Table 4.3).

OSHA Management Guidelines

Published in the FR 54 (16), 3904-3916, January 26, 1989, these voluntary guidelines apply to all places of employment covered by OSHA. The guidelines identify four general elements critical to the development of a successful safety and health management system:

- Management leadership and employee involvement
- Workplace analysis
- Hazard prevention and control
- Safety and health training

Occupational Safety and Health Review Commission

The OSHRC is an independent federal agency created to decide contests of citations or penalties resulting from OSHA inspections of American workplaces. The review commission, therefore, functions as an administrative court, with established procedures for conducting hearings, receiving evidence, and rendering decisions by its administrative law judges (ALJs). OSHRC functions as a three-member board appointed by the president and confirmed by the senate. OSHRC adjudicates cases brought by OSHA and contested by the employer or employees. The commission may conduct investigations and can uphold, change, or dismiss OSHA findings. The federal appeal court can review rulings handed down by OSHRC. Refer to the Rules of Procedures found in 29 CFR 2200. The burden of proof rests with the government attorney.

TABLE 4.3
Whistle-Blower Provisional Statutes Enforced by OSHA

1. Section 11(c) of the Occupational Safety and Health Act, 29 U.S.C. §660
2. Surface Transportation Assistance Act (STAA), 49 U.S.C. §31105
3. Asbestos Hazard Emergency Response Act (AHERA), 15 U.S.C. §2651
4. International Safe Container Act (ISCA), 46 U.S.C. §80507
5. Safe Drinking Water Act (SDWA), 42 U.S.C. §300j-9(i)
6. Federal Water Pollution Control Act (FWPCA), 33 U.S.C. §1367
7. Toxic Substances Control Act (TSCA), 15 U.S.C. §2622
8. Solid Waste Disposal Act (SWDA), 42 U.S.C. §6971
9. Clean Air Act (CAA), 42 U.S.C. §7622
10. Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 U.S.C. §9610
11. Energy Reorganization Act (ERA), 42 U.S.C. §5851
12. Wendell H. Ford Aviation Investment and Reform Act for the 21st Century (AIR21), 49 U.S.C. §42121
13. Sarbanes–Oxley Act (SOX), 18 U.S.C.A. §1514 and Amendments to SOX, enacted July 21, 2010—Sections 922 and 929A of the Dodd–Frank Act (DFA)
14. Pipeline Safety Improvement Act (PSIA), 49 U.S.C. §60129
15. Federal Railroad Safety Act (FRSA), 49 U.S.C. §20109
16. National Transit Systems Security Act (NTSSA), 6 U.S.C. §1142
17. Consumer Product Safety Improvement Act (CPSIA), 15 U.S.C. §2087
18. Section 1558 of the Affordable Care Act (ACA), P.L. 111-148
19. Consumer Financial Protection Act of 2010 (CFPA), Section 1057 of the Dodd–Frank Wall Street Reform and Consumer Protection Act of 2010, 12 U.S.C.A. §5567
20. Seaman's Protection Act, 46 U.S.C. §2114 (SPA), as amended by Section 611 of the Coast Guard Authorization Act of 2010, P.L. 111-281
21. Section 402 of the FDA Food Safety Modernization Act (FSMA), P.L. 111-353 Regulations

Source: OSHA Website. Accessed April 15, 2013.

ENVIRONMENTAL PROTECTION AGENCY

The Environmental Protection Agency (EPA) was created in 1970 to protect the environment and exercise control over release of harmful substances that could threaten public health. Many EPA rules define which substances are considered hazardous to human health and/or pose a threat to the environment. The EPA or state-approved agencies provide guidance for handling hazardous materials, regulate the operation of waste disposal sites, and establish procedures for dealing with environmental incidents such as leaks or spills. The EPA publishes informative guides to assist risk managers in understanding and complying with a number of environmental laws and regulations. CFR Title 40 contains the EPA's environmental standards and rules.

Resource Conservation and Recovery Act

The Resource Conservation and Recovery Act (RCRA) serves as the EPA's main statutory weapon. The act created a *cradle-to-grave* management system for current and future wastes, while the EPA authorizes cleanup of released hazardous substances. Some statutes apply to specific issues and limit the amount of wastes introduced into the air, waterways, oceans, and drinking water. Other statutes directly limit the production, rather than the release, of chemical substances and products that may contribute to the nation's wastes. The RCRA protects human health and the environment from the dangers of hazardous waste. RCRA authorizes control over the management of wastes from the moment of generation until final disposal. The RCRA was passed in 1976 as an amendment

TABLE 4.4
RCRA Waste Generator Classifications

- Large quantity generators (over 1000 kg/month)
- Small quantity generators (100 to 1000 kg/month)
- Conditionally exempt generators (less than 100 kg/month) with no more than 1 kg acutely hazardous waste

TABLE 4.5
Key RCRA Regulatory Generator Requirements

- Identify and label all wastes and notify the EPA of hazardous waste operations.
- Maintain secure storage areas, keep records, and train waste handlers.
- Use permitted treatment, storage, and disposal facilities.

to the Solid Waste Disposal Act. General RCRA objectives include (1) protection of human health and the environment, (2) reduction of waste and conservation of natural resources and energy, and (3) reduction and elimination hazardous waste generation (Tables 4.4 and 4.5).

RCRA was amended in 1984 through passage of the Hazardous and Solid Waste Amendment. This action enabled the EPA to regulate UST to better control and prevent leaks. RCRA Subtitle C regulates tanks with hazardous wastes. Facilities with underground tanks should take action to ensure piping does not fail, control corrosion of tanks and piping, and prevent spills and overflows. Refer to 40 CFR Part 280 for a listing of tanks excluded from regulation.

Comprehensive Environmental Response, Compensation, and Liability Act

The law intended to remedy the mistakes in past hazardous waste management. CERCLA authorized a number of government actions to remedy the conditions or the effects of a release. CERCLA, as originally enacted in 1980, authorized a 5-year plan by the federal government to perform cleanup activities. CERCLA authorized EPA to identify those sites where the release of hazardous substances had occurred or might occur and posed a serious threat to human health, welfare, or the environment. The parties responsible for the releases were required to fund the cleanup actions.

Superfund Amendments and Reauthorization Act of 1986

Superfund Amendments and Reauthorization Act (SARA) established new standards and schedules for site cleanup and also created new methods for informing the public of risks from hazardous substances in the community and for preparing communities for hazardous substance emergencies. Under Public Law (P.L.) 99-499, SARA specified new requirements for state and local governments. It also added provisions for the private sector related to hazardous chemicals. The Emergency Planning and Community Right-To-Know Act specifically require states to establish a State Emergency Response Commission (SERC). The SERC must designate emergency planning districts within the state. The SERC appoints a Local Emergency Planning Committee (LEPC) for each district. SERC and LEPC responsibilities include implementing various planning provisions of Title III and serve as points of contact for the community right-to-know reporting requirements. SARA Title III requires that the local committees must include, at a minimum, representatives from the following groups: state and local officials, law enforcement, civil defense, firefighting,

environmental, hospital, media, first aid, health, transportation, and facility owners or operators subject to the emergency planning requirements.

Clean Air Act

The Clean Air Act (CAA) was passed to limit the emission of pollutants into the atmosphere; it protects human health and the environment from the effects of airborne pollution. The EPA established National Ambient Air Quality Standards (NAAQS) for several substances. The NAAQS provide the public some protection from toxic air pollutants. Primary responsibility for meeting the requirements of the CAA rests with each state. States must submit plans for achieving NAAQS. Under Section 112 of the CAA, the EPA possesses authority to designate hazardous air pollutants and set national emission standards for hazardous air pollutants. Common air pollutants include (1) ozone, (2) nitrogen dioxide, (3) carbon monoxide, (4) particulate matter, (5) sulfur dioxide, and (6) other sources including metal refineries, solvent usage, and manufacture of lead batteries. Air emissions from incinerators regulated by RCRA must also comply with ambient air standards and emission limitations published under the provisions of CAA. Extraction of pollutants from air emissions under CAA controls such as scrubbers can create hazardous wastes or sludge containing such wastes. Disposal of incinerator materials must also comply with the RCRA.

Clean Water Act

The Clean Water Act (CWA) of 1977 strengthened and renamed the Federal Water Pollution Control Act of 1972. The act contains several major provisions including the establishment of the National Pollutant Discharge Elimination Systems (NPDES) Permit Program to permit discharges into the nation's waterways. Any direct discharges into surface water required a NPDES permit. An indirect discharge means that the waste is first sent to a publicly owned treatment works and then discharged pursuant to a permit. Handle sludge resulting from wastewater treatment as RCRA waste and dispose of at an RCRA facility if deemed hazardous. The act requires regulation of certain industrial and municipal storm water discharges under the NPDES permit system.

Federal Insecticide, Fungicide, and Rodenticide Act

Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) was passed in 1947 and administered by the US Department of Agriculture. The EPA became responsible for the act in 1970. A 1972 amendment included provisions to protect public health and the environment. FIFRA controls risks of pesticides through a registration system. EPA can refuse to register a pesticide or to limit its use if evidence indicates a threat to humans and the environment. All pesticides and general disinfectants used in healthcare facilities must hold EPA registration.

Toxic Substances Control Act

Toxic Substances Control Act (TSCA) was enacted in 1976 to help control the risk of substances not regulated as drugs, food additives, cosmetics, or pesticides. Under this law, the EPA can regulate the manufacture, use, and distribution of chemical substances. TSCA mandates that manufacturers notify the EPA prior to producing any new chemical substance. The EPA ensures the testing of all chemicals to determine risks to humans. The TSCA also allows the EPA to regulate polychlorinated biphenyls (PCBs) under 40 CFR 761.

DEPARTMENT OF TRANSPORTATION

The Department of Transportation (DOT) was established by an Act of Congress on October 15, 1966. The mission focuses on ensuring a fast, safe, efficient, accessible, and convenient transportation system that meets vital national interests. The DOT secretary oversees the formulation of national transportation policy and promotes intermodal transportation. Other responsibilities range

from negotiation and implementation of international transportation agreements, assuring the fitness of US airlines, enforcing airline consumer protection regulations, and issuance of regulations to prevent alcohol and illegal drug misuse in transportation systems to preparing transportation legislation.

Federal Motor Carrier Safety Administration

The Federal Motor Carrier Safety Administration (FMCSA) was established as a separate administration within the US DOT on January 1, 2000, pursuant to the Motor Carrier Safety Improvement Act of 1999. The FMCSA seeks to reduce crashes, injuries, fatalities, and property loss involving large trucks and buses by regulating the workers involved. FMCSA develops and enforces data-driven regulations that balance motor carrier safety with industry efficiency. The administration issues motor carrier numbers to *for hire interstate motor carriers* who transport passengers, property, and hazardous materials. It also targets educational messages to carriers, commercial drivers, and the public. FMCSA enforces hazardous material regulations to ensure the safe and secure transportation of hazardous materials.

NUCLEAR REGULATORY COMMISSION

This independent agency, established by the Energy Reorganization Act of 1974, regulates civilian use of nuclear materials. NRC employs a staff of 3000 employees with two-thirds working at the Rockville, Maryland, headquarters location. NRC staffs four regional offices and assigns resident inspector offices at each commercial nuclear power plant and some fuel cycle locations. Headed by a five-member commission, the NRC regulates by-product, source, and special nuclear materials to ensure adequate public health and safety and common defense and security and protects the environment. The NRC adopts and enforces standards for the department of nuclear medicine in healthcare facilities. Some states have agreements with the government to assume these regulatory responsibilities. NRC issues 5-year licenses to qualified healthcare organizations that follow prescribed safety precautions and standards. Types of regulated facilities include (1) nuclear power plants, (2) departments of nuclear medicine at hospitals, (3) academic activities at educational institutions, (4) research work in scientific organizations, and (5) industrial applications such as gauges and testing equipment.

DEPARTMENT OF HEALTH AND HUMAN SERVICES

The Department of Health and Human Services (DHHS) spends almost a quarter of all federal outlays and administers more grant dollars than all other federal agencies combined. DHHS works closely with state and local governments since many DHHS-funded services come from state or county agencies or through private sector grantees. DHHS responsibilities include 11 operating divisions. Key agencies under DHHS control include (1) CDC, (2) Centers for Medicare and Medicaid Services (CMS), (3) National Institutes of Health (NIH), and (4) Food and Drug Administration (FDA).

National Institute for Occupational Safety and Health

NIOSH conducts research and makes recommendations that help prevent work-related injury and illness. NIOSH, established by the OSH Act of 1970, operates under the administrative control of CDC. Although NIOSH and OSHA were created by the same Act of Congress, they operate as distinct agencies with separate responsibilities. However, NIOSH and OSHA often work together toward the common goal of protecting worker safety and health. NIOSH publishes educational resources and guidelines on a number of healthcare- and hospital-related topics.

Centers for Disease Control and Prevention

The CDC, located in Atlanta, Georgia, is an agency of the DHHS. It works to protect the health of the American people by tracking, monitoring, preventing, and researching disease. It is also responsible for surveillance and investigation of infectious disease in healthcare facilities. The CDC conducts research and publishes results in its Morbidity and Mortality Weekly Report. This weekly publication provides healthcare facilities with timely information on topics such as infection control, isolation procedures, bloodborne pathogens, tuberculosis management, infectious waste disposal recommendations, and how to protect workers. CDC performs many of the administrative functions for the Agency for Toxic Substances and Disease Registry (ATSDR), a sister agency of the CDC, and is one of eight federal public health agencies within the DHHS. CDC seeks to accomplish its mission by working with partners throughout the nation and world to monitor health, detect and investigate health problems, conduct research to enhance prevention, develop and advocate sound public health policies, implement prevention strategies, promote healthy behaviors, foster safe and healthful environments, and provide leadership and training. CDC develops and sustains many vital partnerships with public and private entities that improve service to the American people.

Food and Drug Administration

The FDA created by the Appropriation Act of 1931 operates under the auspices of the DHHS. FDA is responsible for protecting the public health by assuring the safety, efficacy, and security of human and veterinary drugs, biological products, medical devices, our nation's food supply, cosmetics, and products that emit radiation. FDA advances public health by helping to speed innovations that make medicines more effective, safer, and more affordable and by helping the public get the accurate, science-based information they need to use medicines and foods to maintain and improve their health. FDA possesses the responsibility for regulating the manufacturing, marketing, and distribution of tobacco products to protect the public health and to reduce tobacco use by minors. FDA plays a significant role in the nation's counterterrorism capability. FDA fulfills this responsibility by ensuring the security of the food supply and by fostering development of medical products to respond to deliberate and naturally emerging public health threats. The FDA ensures the safety of food, human and veterinary drugs, biological products, medical devices, cosmetics, and any electronic products that emit radiation. The FDA oversees biologic product manufacturing and the safety of the nation's blood supply. The FDA also conducts research to establish product standards and develop improved testing methods. The FDA sets standards for drug approvals and over the counter and prescription drug labeling/manufacturing standards. The FDA oversees the labeling and safety of all food products (except meat and poultry) and bottled water. The FDA grants premarket approval of new devices, establishes manufacturing and performance standards, and tracks device malfunctioning and serious adverse reaction events. The FDA develops radiation safety performance standards for microwave ovens, television receivers, diagnostic x-ray equipment, cabinet x-ray systems, laser products, ultrasonic therapy equipment, mercury vapor lamps, and sunlamps. The FDA also accredits and inspects mammography facilities. In 2007, the president signed into law the Food and Drug Administration Amendments Act. The revised law represented a very significant addition to FDA authority. Among the many components of the law are the Prescription Drug User Fee Act (PDUFA) and the Medical Device User Fee and Modernization Act (MDUFMA).

Agency for Healthcare Research and Quality

The agency serves as the health services research arm of the DHHS. The agency provides a major source of funding and technical assistance for health services research and research training at leading universities and other institutions. The agency is a science partner, working with the public and private sectors to build the knowledge base for what works and does not work in health

and healthcare and to translate this knowledge into everyday practice and policymaking. Health services research examines how people get access to healthcare, how much care costs, and what happens to patients as a result of this care. The main goals of health services research include identifying the most effective ways to organize, manage, finance, and deliver high-quality care; reduce medical errors; and improve patient safety. The agency's research findings help practitioners diagnose and treat patients more effectively. A computerized clinical information system developed with the agency's support now helps healthcare professionals determine the most appropriate timing for giving antibiotics to surgical patients. A national clearing house gives clinicians, health plans, and healthcare delivery systems a web-based mechanism for obtaining detailed objective on clinical practice. The agency complements the biomedical research mission of its sister agency, the NIH. The agency specializes in healthcare research including quality improvement and patient safety.

National Institutes of Health

The agency operates 27 centers and serves as one of the world's foremost medical research organizations. NIH pursues fundamental knowledge about the nature and behavior of living systems and the application of that knowledge to extend healthy life and reduce the burdens of illness and disability. The NIH supports the health of the nation by conducting and supporting health-related research. The agency places emphasis on developing, maintaining, and renewing scientific evidence that will improve the nation's capability to prevent disease.

Agency for Toxic Substances and Disease Registry

The mission of the ATSDR helps prevent exposure and adverse human health effects and diminished quality of life associated with exposure to hazardous substances from waste sites, unplanned releases, and other sources of pollution present in the environment. Congress directs ATSDR to perform specific functions concerning the effect on public health of hazardous substances in the environment. These functions include public health assessments of waste sites, health consultations concerning specific hazardous substances, applied research in support of public health assessments, information development and dissemination, and education and training concerning hazardous substances.

Health Resources Services Administration

The Health Resources Services Administration (HRSA) seeks to improve and expand access to quality healthcare for all. The agency employs about 2000 individuals in the nation's capital and 10 regional offices. Considered as the access agency of the DHHS, the administration assures the availability of quality healthcare to low-income, uninsured, isolated, vulnerable, and special needs populations. HRSA seeks to eliminate barriers to care and health disparities. It also works to assure quality of care, improve public health, and improve healthcare systems.

Assistant Secretary for Preparedness and Response

The Assistant Secretary for Preparedness and Response (ASPR), formerly known as the Office of Public Health Emergency Preparedness, was created under the Pandemic and All Hazards Preparedness Act in the wake of Hurricane Katrina. The office leads the nation in preventing, preparing for, and responding to the adverse health effects of public health emergencies and disasters. ASPR focuses on preparedness planning and response; building federal emergency medical operational capabilities; countermeasures research, advance development, and procurement; and grants to strengthen the capabilities of hospitals and healthcare systems in public health emergencies and

medical disasters. The office provides federal support, including medical professionals through ASPR's National Disaster Medical System, to augment state and local capabilities during an emergency. Under the Pandemic and All Hazards Preparedness Act, DHHS serves as the lead agency for the National Response Framework (NRF) for Emergency Support Function (ESF) 8.

Centers for Medicare and Medicaid Services

The CMS operate 10 field offices that were reorganized in February 2007. The agency moved from a geography-based structure to consortia with key responsibilities focusing on survey and quality improvement. The agency also publishes guidelines governing long-term nursing facilities. The guidelines emphasize resident's rights and quality of care. The Omnibus Budget Reconciliation Act (OBRA) of 1987 gave the CMS the power to regulate facilities receiving federal funds. The Medicare Modernization Act or MMA became a law in December 2003 and added outpatient prescription drug benefits to Medicare.

DEPARTMENT OF HOMELAND SECURITY

The creation of the department was one of the most significant transformation of the US government since 1947, when Harry S. Truman merged the various branches of the US Armed Forces into the Department of Defense (DOD). Department of Homeland Security (DHS) represents a similar consolidation, both in style and substance. In the aftermath of the terrorist attacks on September 11, 2001, the president decided that 22 previously disparate domestic agencies needed consolidation under a single department to protect the nation against threats to the homeland. The new department's first priority was to protect the nation against further terrorist attacks. Component agencies will analyze threats and intelligence, guard our borders and airports, protect our critical infrastructure, and coordinate the response of our nation for future emergencies.

Emergency Preparedness and Response

This directorate will oversee domestic disaster preparedness training and coordinate government disaster response. It coordinates the following agencies and resources: (1) Federal Emergency Management Agency (FEMA), (2) Strategic National Stockpile, (3) National Disaster Medical System, (4) DOE Nuclear Incident Response Team, (5) DOJ Domestic Emergency Support Teams, and (6) FBI National Domestic Preparedness Office.

Science and Technology

This directorate seeks to utilize all scientific and technological advantages when securing the homeland. The following assets help meet the DHS mission: (1) DOE CBRN Countermeasures Programs, (2) Environmental Measurements Laboratory of DOE, (3) National BW Defense Analysis Center of DOD, and (4) Plum Island Animal Disease Center of the Department of Agriculture.

Information Analysis and Infrastructure Protection

This directorate will analyze intelligence and information from other agencies (including the CIA, FBI, DIA, and NSA) involving threats to homeland security and evaluate vulnerabilities in the nation's infrastructure. It coordinates the following: (1) Critical Infrastructure Assurance Office of the Department of Commerce, (2) the GSA Federal Computer Incident Response Center, (3) DOD National Communications System, (4) the FBI National Infrastructure Protection Center, and (5) the DOE Energy Security and Assurance Program.

Federal Emergency Management Agency

The agency, a former independent agency, became part of the new DHS in March 2003. FEMA goals include responding to, planning for, recovering from, and mitigating disasters. FEMA maintains headquarters in Washington, DC, with regional and area offices across the country including the Mount Weather Emergency Operations Center and the FEMA training center in Emmetsburg, Maryland. Often FEMA works in partnership with other organizations serving as part of the nation's emergency management system. FEMA coordinates assistance to areas hit by catastrophic events or natural disasters. FEMA works with local governments, industries, and response agencies to coordinate emergency planning activities within a geographic area or region.

Fire Administration

As an entity of the DHS's FEMA, United States Fire Administration (USFA) provides national leadership to foster a solid foundation for our fire and emergency services stakeholders in prevention, preparedness, and response. Congress passed P.L. 93-498, the Federal Fire Prevention and Control Act, in 1974. The law established the USFA and its National Fire Academy (NFA). USFA efforts to prevent and mitigate consequences of fires focus on four areas. The first focuses on developing and delivering fire prevention and safety education in partnership with other federal agencies. USFA promotes professional development of the fire and emergency response community. USFA also works with the public and private groups to promote and improve fire prevention and life safety through research, testing, and evaluation. Finally, the agency assists state and local entities in collecting, analyzing, and disseminating data on the occurrence, the control, and the consequences of all types of fires. The NFA supports state and local training organizations to fulfill their obligation to the career and volunteer fire and emergency services.

US Coast Guard

The US Coast Guard serves one of the five armed forces of the United States and the only military organization within the DHS. The Coast Guard protects the maritime economy and the environment, defends our maritime borders, and saves those in peril. Working with the DOD, DHS, and DOJ as well as other partners, the Coast Guard seizes tons of cocaine bound toward the United States via the transit zone. It also provides waterside security and escorts for nearly 500 military freight conveyances supporting US military operations. The Coast Guard enforces laws that ensure safety on coastal, intracoastal, and inland navigable waterways. It operates the National Response Center that responds to reports of chemical or oil spills in navigable water ways. The service also oversees environmental cleanup activities on navigable waterways.

INSTITUTE OF MEDICINE

The Institute of Medicine (IOM) serves as adviser to the nation for health improvement. As an independent, scientific adviser, the IOM strives to provide advice that is unbiased, based on evidence, and grounded in science. The mission of the IOM embraces the health of people everywhere. The institute is a part of the National Academies for science-based advice on matters of biomedical science, medicine, and health. It is a nonprofit organization that provides a vital service by working outside the framework of government to ensure scientifically informed analysis and independent guidance. The institute serves as adviser to the nation to improve health. The institute provides evidence-based and authoritative information/advice concerning health and science to policymakers, professionals, and leaders in every sector of society. Committees of volunteer scientists serve without compensation. Each report produced by committees goes through a review and evaluation process. The review is conducted by a panel of experts that remain unknown to the committee.

The institute's work centers principally on committee reports or studies on subjects ranging from quality of medical care to medical errors. The majority of the studies and other activities receive funds from the federal government. Other studies can be initiated by private industry, foundations, state or local governments, and the institute.

AMERICANS WITH DISABILITIES ACT

The act contains five titles that define the rights of disabled individuals and the responsibilities of employers, government agencies, and telecommunications companies and privately owned public facilities. The EEOC technical manual defines a disability as physical or mental impairment that greatly limits one or more major life activities. These major life activities include, but not limited to, walking, hearing, seeing, speaking, learning, breathing, working, caring for oneself, or performing manual tasks. A reasonable accommodation or a modification or adjustment of a job allows a qualified individual with a disability the same opportunity to perform the job as an individual without a disability. Accomplish this by (1) making a facility accessible; (2) changing jobs or work schedules; (3) modifying equipment, tools, policies or training procedures; and (4) providing qualified readers or interpreters. Determine undue hardship on a case by case basis considering if the accommodation is unduly costly, extensive, substantial, disruptive, or fundamentally change the nature or operation of the business.

Title I Employment

Title I does not allow discrimination against individuals with disabilities in a workplace with 15 or more employees. Employers can't ask about disabilities or require a medical history survey or conduct a medical examination until after making an offer of employment. Title I also requires employers to provide reasonable accommodations to qualified individuals with disabilities and to provide the same employment opportunities as nondisabled persons. This law does not require employers to hire unqualified disabled individuals. However, an employer may not use an individual's disability to disqualify or deny him or her any employment activities.

Title II Public Services

Title II covers all services, activities, and employment conducted by government agencies. The majority of Title II is directed at government agencies that provide public transportation. It requires that new buses, rail cars, taxis, or other types of vehicles purchased or leased by government agencies must be accessible to disabled individuals.

Title III Public Accommodation and Services Operated by Private Entities

Title III requires anyone who owns leases or operates a public business to comply with the provisions of this title. In addition, privately owned buses, vans, and cars used for public transportation must also comply with these provisions. Contact the DOT for additional information. Title III contains three specific areas. The first provision requires public businesses to change all policies, procedures, or practices that deny, exclude, segregate, or treat persons with disabilities differently. The second provision requires that all services and accommodations offered by a business be the same for disabled and nondisabled patrons. The third provision requires businesses to remove all architectural, communication, and transportation barriers deemed as easily removable.

Title IV Telecommunications

This title requires phone companies to provide relay stations for hearing- or speech-impaired individuals to businesses or employers with voice-only phones. This does not require employers to buy

Telecommunication Devices for the Deaf (TDD), unless needed for a reasonable accommodation. Employers or businesses that receive TDD phone calls will need to train employees on how to handle such situations.

Title V Miscellaneous

This title contains only two provisions that may impact an employer or public business. The first part encourages disputing parties to settle their differences outside of a court room. The second part allows state and local laws equal to or greater than the ADA to take precedence. This part of the title should encourage you to research state and local laws to find out what you must comply with.

BUREAU OF LABOR STATISTICS

In September 2010, the BLS completed a major revision to the Occupational Injury and Illness Classification System (OIICS). The OIICS is used in the Census of Fatal Occupational Injuries (CFOI) and the Survey of Occupational Injuries and Illnesses (SOII) to code various circumstances of the individual injury or illness reported. OIICS provides a structure to classify the nature of the injury and part of body affected, source and secondary source of the injury, and event or exposure that precipitated the injury. The new version, OIICS 2.0, constitutes the first comprehensive revision to the OIICS since its creation in December 1992. Major changes included arranging the *event* categories according to an order of precedence to facilitate coding when multiple event codes apply. The change modified the definition and rules for selection of source and secondary source. BLS also restructured code categories to provide an appropriate level of detail for injury and illness prevention.

ACCREDITATION ORGANIZATIONS

Joint Commission

The most well known of the accrediting bodies, the Joint Commission, impacts the operation of most hospitals and a good number of other healthcare organizations including nursing homes and surgery centers. The Joint Commission operates as an independent, not-for-profit organization, governed by a board that includes physicians, nurses, and consumers. The mission to continuously improve safety and quality care through accreditation supports performance improvement in healthcare organizations. The Joint Commission sets the standards to measure many aspects of patient care and quality. To maintain and earn accreditation, a healthcare organization must undergo an extensive on-site review by a team of surveyors, at least once every 3 years. The review helps evaluate the organization's performance in areas that affect patient care. Organizations must provide a safe, functional, supportive, and effective environment for patients, staff, visitors, and contractors. Effective safety management provides guidance to achieve quality patient care, good outcomes, and continuous improvement. Some key environment and care requirements include performing long-range and continuous planning by organizational leaders to ensure space requirements, proper equipment, and necessary resources remain available to support services offered. The planning and designing of the environment must be consistent with the organizational mission to support proper care considering the patient's physical condition/health, cultural background, age, and cognitive abilities. Organizations must educate staff on their roles in the EOC in safely, sensitively, and effectively supporting patient care. Organizations must also educate staff on physical requirements processes for monitoring, maintaining, and reporting on the organization's EOC. Other requirements include developing standards to measure staff and organizational performance in managing and improving the EOC and establishing an effective information, collection, and evaluation system (ICES). Environment and care standards do not prescribe any particular safety-related structure.

The standards don't address the specific type of safety committee or a specific individual to serve safety officer. An organization with multiple sites may develop separate management plans for each location or choose to use a single comprehensive set of plans. The organization must address specific risks and unique conditions at each site. The five written management EOC functional areas include (1) safety management, (2) security management, (3) hazardous materials and waste management, (4) medical equipment management, and (5) utilities management. Emergency management and life safety are now stand-alone standards.

EOC Management

EOC management plans provide guidance for taking action to minimize risk and hazards. The six key functional areas are safety, security, hazardous materials and waste, fire safety, medical equipment, and utilities. The organization can decide the format of the plan. The plan could exist as a set of plans, one for each functional area. Organizations could also develop a single document that covers all functional areas. The use of annexes, attachments, and action plans can provide details for the six functional areas. Maintaining a systematic approach, when developing plans, permits organizational members to better use the document or documents. Management plans must contain content that addresses performance objectives, compliance requirements, and performance evaluation specifics. Create a cross-checking process to document compliance with stricter regulatory requirements, other accreditation standards, and rules mandated by any authority with jurisdiction. The organization must identify risks and implement processes to minimize adverse impacts on buildings, grounds, equipment, occupants, and internal physical safety systems. Accomplish the following actions:

- Develop a written plan to address the management of the care environment.
- Senior leaders designating persons to coordinate safety functions.
- Designate persons to intervene in events threatening life, health, or property.
- Review general safety policies as often as necessary but at least every 3 years.
- Respond to product safety recalls by taking appropriate actions.
- Ensure proper maintenance of all facility grounds and equipment.
- Conduct periodic evaluations to assess safety effectiveness.
- Assess staff knowledge behaviors during period environmental tours.
- Identify new or altered tasks that could pose risks in construction areas.
- Evaluate areas with changes in services to identify improvement opportunities.
- Conduct environmental tours at least every 6 months in all patient areas.
- Conduct environmental tours at least annually in nonpatient areas.

American Osteopathic Association

The association represents more than 47,000 osteopathic physicians, promotes public health, encourages scientific research, and serves as the primary certifying body for osteopath doctors. The association serves as the accrediting agency for all osteopathic medical schools and healthcare facilities including acute care hospitals. The osteopathic accreditation was developed in 1945. This enabled the association to assure that osteopathic students received their training through rotating internships and residencies in facilities that provided a high quality of patient care. The association also has deeming authority to accredit laboratories within accredited hospitals under the Clinical Laboratory Improvement Amendments (CLIA) of 1988. The association developed accreditation requirements for ambulatory care, surgery, mental health, substance abuse, and physical rehabilitation medicine facilities. The Healthcare Facilities Accreditation Program (HFAP) meets or exceeds the standards required by CMS to provide accreditation to all hospitals, ambulatory care/surgical facilities, mental health facilities, physical rehabilitation facilities, clinical laboratories, critical access hospitals, and stroke centers. HFAP's surveying process and standards benefit from oversight

by a wide range of medical professionals, including both allopathic and osteopathic disciplines. HFAP accreditation requirements are clearly tied to the corresponding Medicare conditions of participation. Base successful accreditation on the facility's ability to correct deficiencies. Surveyors must possess experience and understand the many aspects of a healthcare facility and help make the survey process more realistic and educational. If a deficiency is identified, surveyors are able to draw from their experience and offer feasible solutions, usually on the spot. HFAP accreditation also is recognized by the federal government, state departments of public health, insurance carriers, and managed care organizations. Healthcare facilities seeking accreditation must comply with all the requirements listed in the latest edition of *Accreditation Requirements for Healthcare Facilities*.

DNV National Integrated Accreditation for Healthcare Organizations

National Integrated Accreditation for Healthcare Organizations (NIAHO) is designed from the ground up to drive quality transformation into the core processes of running a hospital. NIAHO helps healthcare organizations meet their national accreditation obligations and achieve ISO 9001 compliance. NIAHOSM compresses the survey cycle from every 3 years to annually, thereby ensuring continual quality improvement. Det Norske Veritas (DNV)'s goal is to offer healthcare organizations and companies a new alternative to hospital accreditation. DNV was established in 1864 as an independent foundation with a purpose to safeguard life, property, and the environment. Increasing patient safety and reducing errors in healthcare is an important part of that purpose. DNV issues ISO certificates to healthcare facilities worldwide, including hospitals, outpatient clinics, diagnostic centers, laboratories, nursing homes, and home care centers.

The facility must take actions to ensure patient safety, provide areas for diagnosis and treatment, and services to meet the needs of the community. Organizations must maintain the condition of the physical plant and overall hospital environment to ensure the safety and well-being of patients, visitors, and staff. The hospital must maintain adequate facilities for its services. Locate diagnostic and therapeutic facilities to ensure the safety of patients. Maintain facilities, supplies, and equipment at an acceptable level to ensure safety and quality. Determine the extent and complexity of facilities by evaluating the services offered. The organization must implement processes to maintain a safe environment for the organization's patients, staff, and visitors. The organization must use documented process, policies, and procedures to define how unfavorable occurrences, incidents, or impairments impact the facility's infrastructure. Key accreditation functional areas include life safety, safety, security, hazardous material/waste, emergency management, medical equipment, and utilities management. Organizations must evaluate their physical environment management systems at least annually. Measure occurrences, incidents, or impairments and analyze to identify any patterns or trends.

Accreditation Canada

Accreditation Canada is a not-for-profit, independent organization that provides health organizations with an external peer review to assess the quality of their services based on standards of excellence. Accreditation Canada, accredited by the International Society for Quality in Health Care (ISQua), fosters quality in health services across Canada and internationally. Accreditation Canada's first survey with ISQua occurred in 1998. Three surveyors spent a week at Accreditation Canada interviewing teams and reviewing self-assessments and evidence. Accreditation Canada achieved three separate accreditation awards from ISQua—for the organization, the standards, and the surveyor. Accreditation Canada's clients include regional health authorities, hospitals, and community-based services. The organization uses more than 600 surveyors or peer reviewers. These experienced professionals come from accredited health facilities. They are physicians, nurses, health executives, administrators, occupational therapists, laboratory scientists, respiratory therapists, psychologists, social workers, and addiction counselors. Accreditation standards are developed in close consultation with healthcare experts. The survey features customized processes geared to organizational

priorities, comprehensive performance measures, and automated tools for efficient data exchange. Patient safety is an integral component of the accreditation process. Complying with Accreditation Canada standards and Required Organizational Practices reduces the potential for adverse events occurring within healthcare and service organizations. Accreditation standards assess governance, risk management, leadership, infection prevention and control, and medication management, as well as services in over 30 sectors, including acute care, home care, rehabilitation, community and public health, labs and blood banks, and diagnostic imaging.

Commission on Accreditation of Rehabilitation Facilities

The Commission on Accreditation of Rehabilitation Facilities (CARF) serves as an independent not-for-profit organization that provides accreditation in the human services field with the focus on the areas of rehabilitation, employment, child and family, and aging services. The survey is a consultative process rather than an inspection. The survey team works with the provider to improve service resources and outcomes. CARF develops standards through a series of leadership panels, national advisory committees, focus groups, and field reviews. The standards development process provides opportunities for persons receiving services and other stakeholders to participate in developing CARF standards. A 3-year accreditation, the highest level of accreditation, demonstrates substantial fulfillment of the CARF standards. A 1-year accreditation indicates existence of deficiencies in relation to the provider's conformance to the CARF standards, yet there is evidence of the provider's capability and commitment to correct the deficiencies or make progress toward their correction. Provisional accreditation indicates that a provider still functions at the level of a 1-year accreditation.

College of American Pathologists Laboratory Accreditation

The college serves as the principal organization of board-certified pathologists and serves and represents the interest of patients, pathologists, and the public by fostering excellence in the practice of pathology and laboratory medicine. The college is the world's largest association composed exclusively of pathologists and is widely considered the leader in providing quality improvement to laboratories around the world. CAP products include resources designed specifically for pathologists and laboratory professionals. CAP accreditation improves the quality of clinical laboratory services through voluntary participation, professional peer review, education, and compliance. Upon successful completion of the inspection process, the laboratory is awarded CAP accreditation and becomes part of an exclusive group of more than 6000 laboratories worldwide that meet the highest standards of excellence. CAP utilizes working and experienced laboratory professionals in their peer review process. This approach provides a laboratory with inspectors who bring firsthand knowledge of the most current laboratory techniques and processes. The college serves the broadest patient population by accommodating the full spectrum of laboratory disciplines under one accreditation process. No other accreditation process provides such a comprehensive offering. An accredited laboratory helps assure the facility meets federal requirements. CAP accreditation provides a laboratory with the assurance of meeting the highest standards of practice. The accreditation cycle includes the following:

- The lab submits an application request form with a deposit.
- CAP forwards application and checklists to the lab.
- The lab completes the application and reviews the checklists.
- CAP receives and reviews the application.
- An inspection team is assigned.
- A mutually acceptable date is set for the inspection.
- A team of inspectors arrives on the designated date.
- The team conducts a thorough inspection using checklists as guides.
- The team meets with the lab for a summation conference to review findings.

- The inspectors leave a copy of the final summation report.
- The lab corrects any deficiencies and provides documentation for the CAP.
- The lab is accredited for a 2-year cycle but conducts a self-inspection at the 1-year mark.

VOLUNTARY STANDARDS ORGANIZATIONS

American Conference of Governmental Industrial Hygienists

The independent *National Conference of Governmental Industrial Hygienists (NCGIH)* convened on June 27, 1938, in Washington, DC. In 1946, the organization changed its name to the *American Conference of Governmental Industrial Hygienists (ACGIH).* In September 2000, conference members approved an amendment of the bylaws to permit members, not government or academic employees, greater voting rights and the opportunity to serve on the ACGIH® Board. The amendment set new member categories, including the organizational member category. Today, nine committees focus their energies on a range of topics: agricultural safety and health, air sampling instruments, bioaerosols, biological exposure indices, industrial ventilation, international, and small business. ACGIH publishes threshold limit values for chemical substances (TLVs®-CS) and threshold limit values for physical agents (TLVs®-PA). The list of TLVs includes 642 chemical substances and physical agents, as well as 47 biological exposure indices (BEIs®). ACGIH offers approximately 400 publication titles addressing industrial hygiene, environment, safety/health, toxicology, medical, hazardous materials/waste, indoor air quality, physical agents, ergonomics, distance learning, and computer resources.

American National Standards Institute

The organization was founded in 1918 to consolidate voluntary standards. The ANSI is a federation of more than 1500 professional, trade, governmental, industrial, labor, and consumer organizations. It publishes national consensus standards developed by various technical, professional, trade, and consumer organizations. ANSI also serves as the coordinating agency for safety standards adopted for international implementation. ANSI represents the United States as a member of the International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC). OSHA adopts many ANSI standards. ANSI-accredited standards committees develop any of the safety-related ANSI standards. ANSI provides members access to more than 9000 standards from around the world and publishes specifications for protective eyewear including safety glasses and goggles, hard hats, safety shoes, fall-protection equipment, eyewash stations, and emergency shower equipment.

American Society of Heating, Refrigerating, and Air-Conditioning Engineers

The American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) is an international organization that advances the effective use of heating, ventilating, air-conditioning, and refrigeration standards. ASHRAE serves as the foremost source of technical and educational information and the primary provider of opportunity for professional growth in the arts and sciences of heating, ventilating, air-conditioning, and refrigerating (HVAC&R). Through its membership, ASHRAE writes standards that set uniform methods of testing and rating of equipment. It also establishes accepted practices for the HVAC&R industry worldwide including publishing standards on the design of energy-efficient buildings and ventilation.

American Society of Mechanical Engineers

The American Society of Mechanical Engineers (ASME) is a not-for-profit membership organization that enables collaboration, knowledge sharing, career enrichment, and skills development

across all engineering disciplines, toward a goal of helping the global engineering community develop solutions to benefit lives and livelihoods. Founded in 1880 by a small group of leading industrialists, ASME grew through the decades to include more than 120,000 members in over 150 countries. ASME codes and standards, publications, conferences, and continuing education provide a foundation for advancing technical knowledge. ASME serves as the essential resource for mechanical engineers and other technical professionals throughout the world for solutions that benefit humankind.

ASTM International

The American Society for Testing and Materials (ASTM) is the world's largest source of voluntary consensus standards, with research done by more than 30,000 members. ASTM publishes more than 8000 standards annually with categories such as medical devices, occupational safety and health, environmental effects, energy, and security systems. The standards address six major categories of information including (1) classification information on materials grouped together by characteristics, (2) practices and procedures detailing how to accomplish a process or function, (3) testing methods for specific products or materials, (4) guides to provide directional procedures, (5) precise information about material specifications, and (6) terminology or a compilation of definitions and terms.

Compressed Gas Association

The Compressed Gas Association (CGA) is dedicated to the development and promotion of safety standards and safe practices in the industrial gas industry. CGA develops technical and safety standards for the compressed gas industry. Members work together through a committee system to develop technical specifications, safety standards, and educational materials and to promote compliance with regulations and standards in the workplace. Member companies represent manufacturers, distributors, suppliers, and transporters of gases, cryogenic liquids, and related products. The CGA publishes more than 100 technical standards. The association publishes the Handbook of Compressed Gases, which is widely used and sets forth the recognized safe methods for handling, storing, and transporting industrial gases.

Factory Mutual Research Corporation

The Factory Mutual Research Corporation (FM) is a nationally recognized testing laboratory and approval organization recognized by OSHA. FM was established to focus on industrial loss control. It also does third-party testing on fire extinguishing equipment, sprinklers, building materials, and smoke detectors. FM lists approved equipment, materials, and other services in its annual 500-page guide. Manufacturers can display a special symbol on approved items to inform users and buyers that the product or piece of equipment meets approval of an independent laboratory. OSHA recognizes the FM lab a certification organization.

International Electrotechnical Commission

The IEC is the leading global organization that prepares and publishes international standards for all electrical, electronic, and related technologies. It also supports associated general disciplines such as terminology and symbols, electromagnetic compatibility, measurement, performance, dependability, design, development, safety, and the environment. IEC standards provide industry and users with the framework for economies of design, greater product and service quality, more interoperability, and better production and delivery efficiency. Using IEC standards for certification at the national level ensures that a manufactured product meets international standards.

National Council on Radiation Protection and Measurements

The National Council on Radiation Protection and Measurements (NCRP) works to promote the importance of radiation protection and measurements. The council, established to represent all of the national radiological organizations in the United States on a collective basis, focuses on the science of radiation protection. The International X-Ray and Radium Protection Committee, created in July 1928, evolved into the International Commission on Radiological Protection. The NCRP originally operated as an informal association of scientists seeking to make available information and recommendations on radiation protection and measurements. The NCRP was reorganized and chartered by the US Congress in 1964 as the NCRPM.

National Fire Protection Association

The National Fire Protection Association (NFPA) serves as the world's leading advocate of fire prevention and publishes about 300 safety codes and standards. NFPA influence is present in every building, process, service, design, and installation. NFPA encourages the broadest possible participation in its consensus code development process. NFPA relies on more than 6000 volunteers from diverse professional backgrounds to serve on over 200 technical code and standard development committees. NFPA code development processes are accredited by the ANSI. Some examples of NFPA codes relevant to healthcare include NFPA 70, National Electrical Code®, NFPA 99 Healthcare Facilities, and NFPA 101, Life Safety Code®. NFPA offers excellent education and training that addresses the latest fire and life safety requirements, technologies, and practices. NFPA also administers several professional certifications including Certified Fire Protection Specialist, Certified Fire Inspector, and Certified Fire Plans Examiner. NFPA also develops dozens of texts, guides, and other materials to assist firefighters and first responders.

NSF International

NSF International founded in 1944 is known for the development of standards, product testing, and certification services in the area of public health safety. Technical resources include physical and performance testing facilities and analytical chemistry and microbiology laboratories. NSF International, known as The Public Health and Safety Company™, operates as a not-for-profit, nongovernmental organization. NSF is the world leader in standards development, product certification, education, and risk management for public health and safety. NSF standards focuses issues related to public health, safety, and protection of the environment. NSF develops national standards, provides learning opportunities, and provides third-party conformity assessment services while representing the interests of all stakeholders. NSF is widely recognized for its scientific and technical expertise in the health and environmental sciences. Its professional staff includes engineers, chemists, toxicologists, and environmental health professionals with broad experience both in public and private organizations.

Safety Equipment Institute

The Safety Equipment Institute (SEI), a private nonprofit organization established in 1981, administers nongovernmental, third-party certifications of a broad range of safety equipment and products. SEI certification is voluntary and available to any manufacturer of safety and protective equipment. Certifications include ongoing product testing and quality assurance audits. SEI conducts product testing in accordance with consensus, governmental, or other standards.

Underwriters Laboratories

This nonprofit organization maintains laboratories for the examination and testing of systems, devices, and material to ensure compliance with safety and health standards. Underwriters

Laboratories (UL) inspects or tests more than 70,000 products each year, including firefighting equipment, lockout/tagout supplies, lighting fixtures, and flammable liquid storage containers. UL certification only pertains to the area of safety and does not involve performance testing. UL issues more than 500 standards, with many being adopted by ANSI. UL publishes directories of companies whose products meet or exceed criteria outlined in appropriate standards.

ASSOCIATIONS AND OTHER ORGANIZATIONS

AIA Academy of Architecture for Health

The American Institute of Architects (AIA) serves as a professional membership association for licensed architects, emerging professionals, and allied partners. With nearly 300 state and local chapters, the AIA serves as the voice of the architecture profession and a resource for its members. The AIA Academy of Architecture for Health (AAH) is an AIA knowledge community for architects who practice in the field of healthcare design. The mission of the AAH is to "improve both the quality of health care design and the design of healthy communities by developing, documenting, and disseminating knowledge; educating design practitioners and other related constituencies; advancing the practice of architecture; and affiliating and advocating with others that share these priorities."

American Dental Hygienists' Association

The American Dental Hygienists' Association (ADHA) was formed in 1923 to develop communication and mutual cooperation among dental hygienists. Today, ADHA is the largest national organization representing the professional interests of the more than 150,000 registered dental hygienists (RDHs) in the United States. The association strives to advance the art and science of dental hygiene by ensuring access to quality oral healthcare. The association promotes the advancement of dental hygiene education. It interacts with other health professions, consumer groups, and health workforce agencies. ADAA provides continuing education to dental assistants through home study courses, professional journals, and local, state, and national meetings with educational agendas. It encourages education, registration, and certification for dental assisting professionals while providing a network of personal services for its members.

American Health Care Association

The American Health Care Association (AHCA) operates as a nonprofit federation of affiliated state health organizations, together representing nearly 12,000 nonprofit- and for-profit-assisted living, nursing facility, developmentally disabled, and subacute care providers that care for more than 1.5 million elderly and disabled individuals nationally. The association represents the long-term care community to the nation at large and to government, business leaders, and the general public. It also serves as a force for change within the long-term care field, providing information, education, and administrative tools that enhance quality at every level. At its Washington, DC, headquarters, the association maintains legislative, regulatory, and public affairs, as well as member services staffs that work both internally and externally to assist the interests of government and the general public, as well as member providers.

American Hospital Association

The American Hospital Association (AHA) is the national organization that represents and serves all types of hospitals, healthcare networks, and their patients and communities. Close to 5,000 hospitals, healthcare systems, networks, other providers of care, and 37,000 individual members

come together to form the AHA. Advocacy efforts include the legislative and executive branches and include the legislative and regulatory arenas. Founded in 1898, the AHA provides education for healthcare leaders and is a source of information on healthcare issues and trends.

American Society of Healthcare Engineering

The American Society of Healthcare Engineering (ASHE) promotes healthcare safety, emergency preparedness, engineering, and security issues. The society also promotes healthcare education through professional development seminars and conferences. Monthly publication of technical documents keeps members informed on the latest changes and developments related to healthcare engineering and facility management. The society's more than 100 publications and innovative software help members meet new challenges. The society provides advice on a number of operational concerns including the following:

- Facilities management
- Plant design and engineering
- Building maintenance and support services
- Environmental and waste management
- Safety and security
- Clinical engineering

American Society of Healthcare Risk Management

Established in 1980, the American Society for Healthcare Risk Management (ASHRM) is a personal membership group of the AHA with more than 4400 members representing healthcare, insurance, law, and other related professions. The society promotes effective and innovative risk management strategies and professional leadership through education, recognition, advocacy, publications, networking, and interactions with leading healthcare organizations and government agencies. The society initiatives focus on developing and implementing safe and effective patient care practices, the preservation of financial resources, and the maintenance of safe working environments.

American Association of Occupational Health Nurses

The American Association of Occupational Health Nurses (AAOHN) serves the largest group of healthcare professionals in the workplace. The vision is to create a positive economic impact through worker health and well-being leading to optimal performance. AAOHN is dedicated to advancing and maximizing the health, safety, and productivity of domestic and global workforces by providing education, research, public policy, and practice resources for occupational and environmental health nurses. The mission of AAOHN is to advance the profession of occupational and environmental health nursing through five pillars: (1) education and research, (2) professional practice/ethics, (3) communications, (4) governmental issues, and (5) establish alliances. Values include reflecting strategic and forward thinking while promoting excellence for the association and the profession and conducting business and interpersonal action ethically, honestly, and with respect. AAOHN also seeks to provide stewardship of fiscal responsibility to reflect credibility, accountability, and respect.

American Association of Safety Councils

In September 2000, a group of 20 plus executives and volunteers representing independent safety councils across the United States gathered in Atlanta, Georgia, to identify needs and share ideas. The result of this meeting was the formation of the American Association of Safety Councils

(AASC). The purpose of AASC was to pool information and resources to better address the safety and health issues facing businesses, communities, and individuals. AASC was formed as a charitable nonprofit 501(C)(3) entity organized and managed by volunteers from the charter member councils. The power of the AASC lies with its many members. The mission is to be an international association of safety council professionals whose mission is the enhancement of safety and health. AASC strives to gain recognition as the premier safety organization for educating, communicating, and promoting safety and health.

American Chemistry Council

The American Chemistry Council represents the companies that make the products that make modern life possible, while working to protect the environment, public health, and the security of our nation. Founded in 1872, the council supports research and initiatives that serve communities and customers. Member companies must commit to establish goals and guidelines that go beyond federal safety and environmental regulatory standards. The American Chemistry Council's mission is to deliver business value to its members through exceptional advocacy based on enhanced member performance, high-quality scientific research, communications, effective participation in the political process, and a commitment to sustainable development through member contributions to economic, environmental, and societal progress.

American Industrial Hygiene Association®

The American Industrial Hygiene Association (AIHA) is one of the largest international associations serving the needs of occupational and environmental health and safety professionals practicing industrial hygiene in industry, government, labor, academic institutions, and independent organizations. The association is devoted to achieving and maintaining the highest professional standards for all members. The association coordinates with the American Board of Industrial Hygiene to promote certification of industrial hygienists. Comprehensive education keeps occupational and environmental health professionals current in the field of industrial hygiene. The association operates several highly recognized laboratory accreditations based on the highest international standards. These accreditations help ensure the quality of the data used in making critical worker protection decisions. Founded in 1939, AIHA operates as a nonprofit organization with 73 local sections.

American Public Health Association

The American Public Health Association (APHA), the oldest and most diverse organization of public health professionals in the world, works to protect all Americans, their families, and their communities from serious but preventable health threats. APHA builds a collective voice for public health, working to ensure access to healthcare, protect funding for core public health services, and eliminate health disparities, among a myriad of other issues. The association produces the peer-reviewed *American Journal of Public Health* and the award-winning newspaper, *The Nation's Health*. APHA is an association of individuals and organizations working to improve the public's health and to achieve equity in health status for all. It promotes the scientific and professional foundation of public health practices and policy, advocates the conditions for a healthy global society, emphasizes prevention, and enhances the ability of members to promote and protect environmental and community health.

ASIS International

ASIS operates as the largest organization for security professionals. ASIS works to increase the effectiveness and productivity of security professionals through education. ASIS advocates the role

and value of the security management profession to businesses, the media, governmental entities, and the general public. ASIS publishes the security industry's magazine, Security Management.

American Society of Safety Engineers

The society was founded in October 1911 as the United Society of Casualty Inspectors. This nonprofit organization is the only organization of individual safety professionals. It works to promote the safety profession and foster the professional development of its members. The American Society of Safety Engineers (ASSE) plays an important role in the development of safety standards. The society continues to expand its focus in the United States and also operates chapters in the Middle East and Great Britain. A 25-member board of directors that includes 13 regional vice presidents guides the ASSE. The society operates 138 chapters to promote, establish, and maintain standards for the safety profession.

American Welding Society

The American Welding Society (AWS) was founded in 1919 as a multifaceted, nonprofit organization with a goal to advance the science, technology, and application of welding and related disciplines. AWS continues to lead the way in supporting welding education and technology development to ensure a strong, competitive, and exciting way of life for all Americans. The mission of the AWS is to advance the science, technology, and application of welding and allied processes, including brazing, soldering, and thermal spraying.

Association of Healthcare Environment

The Association of Healthcare Environment (AHE) is the premier professional membership society for healthcare environmental services, housekeeping, waste management, textile care professionals, and related support services disciplines. AHE provides education, recognition for personal and professional achievements, national networking, as well as affiliation and collaboration with the AHS on public policy and advocacy issues related to healthcare environmental services. AHE serves as the association of choice for healthcare environmental services and textile care professionals. It is a recognized resource and catalyst in the general and regulatory communities. AHE will strive to exceed its members' expectations by providing strong leadership and progressive thinking in the face of a changing healthcare field. AHE provides the following member benefits:

- Educational materials that can increase an individual's knowledge and skills
- Leadership that is accessible and responsible to the needs of the members
- Opportunities to network with peers on a national level
- Recognition for personal and professional achievements
- Collaboration with the AHA and other organizations on public policy and advocacy issues relating to environmental services

Association of Occupational Health Professionals

The association works to define employee health issues and serve as a leading advocate for occupational health professionals serving in healthcare organizations. The board uses monthly conference calls to coordinate positions on hot topics and strategic initiatives. The association participates in governmental affairs and meets with OSHA, NIOSH, and congressional representatives to address association positions. The association sponsors an annual national conference where members meet to share, network, and attend professional education sessions. OSHA and the association recently entered into an alliance to promote worker health and safety in healthcare workshop.

Canadian Centre for Occupational Health and Safety

The vision of the Canadian Centre for Occupational Health and Safety (CCOHS) is the elimination of work-related illnesses and injuries. The center strives to provide credible and relevant tools and resources to improve workplace health and safety. Established in 1978, CCOHS promotes the total well-being of physical, psychosocial, and mental health of working Canadians. CCOHS provides information, training, education, management systems, and solutions to support health, safety, and wellness efforts. As a not-for-profit organization, CCOHS is governed by a council—representing government, employers, and labor organizations. CCOHS places strong emphasis on helping organizations raise awareness, assess risks, and implement prevention controls.

CHEMTREC

CHEMTREC, established in 1971 by the chemical industry, provides a public service hotline for emergency responders needing information and assistance for emergency incidents involving chemicals or hazardous materials. Registration with CHEMTREC authorizes shippers of hazardous materials the right to portray the CHEMTREC phone numbers on their shipping documents, material safety data sheets, and hazard communications labels. The portrayal of the CHEMTREC phone numbers helps registrants to comply with DOT regulation 49 CFR 172.604. DOT requires shippers of hazardous materials to provide a 24 h emergency telephone number on shipping documents. CHEMTREC operates around the clock and is staffed by trained and experienced emergency service specialists.

ECRI

This nonprofit health services research agency works to improve the safety, quality, and cost-effectiveness of healthcare. It is widely recognized as one of the world's leading independent organizations committed to advancing the quality of healthcare. The agency focuses on healthcare technology, risk, quality, and environmental management. The agency provides information services and technical assistance to more than 5000 hospitals, healthcare organizations, ministries of health, government and planning agencies, voluntary sector organizations, associations, and accrediting agencies around the world. ECRI maintains over 30 databases, publications, information systems, and technical assistance services that set the standard for the healthcare community. The agency provides alerts related to technology hazards and the results of medical product or technology assessments.

Facility Guidelines Institute

The Facility Guidelines Institute (FGI) is a nonprofit organization that was established in 1998 to provide leadership and continuity to the development and publication of the Guidelines for Design and Construction of Health Care Facilities. FGI functions as a contractual, fund-raising, and coordinating entity for the quad-annual guidelines revision process, supporting the work of the independent Health Guidelines Revision Committee in its goal to update and improve the content of the guidelines document to encourage its adoption and use. FGI uses revenue from sales of the guidelines document to support the revision process and to fund research that can inform the guidelines development process.

Health Physics Society

The society was formed in 1956 as a scientific organization of professionals who specialize in radiation safety. Its mission is to support its members in the practice of their profession and to promote excellence in the science and practice of radiation safety. Today, its nearly 6000 members represent all scientific and technical areas related to radiation safety including academia, government,

medicine, research and development, analytical services, consulting, and industry in all 50 states and the District of Columbia. The society is an independent nonprofit scientific organization and, as such, is not affiliated with any government or industrial organization or private entity. The society promotes education and training opportunities along with conferences and meetings.

Human Factors and Ergonomics Society

The society advocates systematic use of such knowledge to achieve compatibility in the design of interactive systems of people, machines, and environments to ensure their effectiveness, safety, and ease of performance. The society encourages appropriate education and training for those entering the human factors profession and for those who conceive, design, develop, manufacture, test, manage, and participate in systems. The purpose inherent in human factors research and application is to contribute to overall human well-being. The bimonthly journal *Human Factors* presents original papers of scientific merit that contribute to the understanding of human factors and advance the systematic consideration of human factors. It features articles on methodology and procedures, literature reviews, technical research results of broad scope, articles on research applications, and papers of general professional interest. The society publishes a quarterly magazine, *Ergonomics in Design*.

Institute of Hazardous Materials Management

The Institute of Hazardous Materials Management (IHMM) is a not-for-profit organization founded in 1984 to protect the environment and the public's health, safety, and security through the administration of credentials recognizing professionals who have demonstrated a high level of knowledge, expertise, and excellence in the management of hazardous materials. More than 15,000 homeland security, environmental protection, engineering, health sciences, transportation, and public safety professionals possess the Certified Hazardous Materials Manager (CHMM) credential. IHMM also administers a Certified Hazardous Materials Practitioner (CHMP) credential and the Hazardous Materials Manager-in-Training (HMMT) program. The purpose of IHMM is to develop and promote professional standards for certification and to administer credible certification opportunities for individuals who practice in disciplines involving the general management of hazardous materials and related areas.

International Association of Nanotechnology

The International Association of Nanotechnology (IANT) is a nonprofit organization with the goals of fostering scientific research and business development in the area of nanoscience and nanotechnology for the benefit of society. The association fosters friendship, equality, and cooperation among its members around the world. IANT does not endorse nor support any applications that uses and misuses the advanced technology for destructive purposes. As the leading organization, IANT is working on the road map and the framework of the emerging technology worldwide, including address various issues relating to nanotechnology.

International Organization for Standardization

Known as ISO, the organization publishes international standards that address topics such as agriculture, construction, mechanical engineering, medical devices, and information technology. ISO functions using a network of the national standards institutes of 163 countries, one member per country, with a Central Secretariat in Geneva, Switzerland, that coordinates the entire system. ISO is a nongovernmental organization that forms a bridge between the public and private sectors. Many of its member institutes function as part of the governmental structure of their

countries or are mandated by their government. Other member connections to the private sector work with national partnerships or industry associations. ISO promotes consensus on solutions that meet both the requirements of business and the broader needs of society. ISO objectives focus on activities that help ensure products, systems, machinery, and devices work well and safely.

International System Safety Society

The society is a nonprofit organization that promotes safety during the conceptual design phase and continues through development, fabrication, testing, production, use, and ultimate disposal of system or product. The system safety concept is based on the application of systems engineering and management to the process of hazard control, safety, and risk analysis. These functions help identify, assess, and correct associated hazards during designing or modifying systems, products, or services. Before production, construction, or operation, accident potential is eliminated or reduced by eliminating or controlling associated hazards. The system safety profession draws from a broad range of engineering, behavioral, scientific, legal, and managerial skills. The society is international and draws members throughout the world and is affiliated with major corporations and educational institutions.

National Board of Boiler and Pressure Vessel Inspectors

The board was created in 1919 to promote greater safety to life and property through uniformity in the construction, installation, repair, maintenance, and inspection of pressure equipment. The National Board membership oversees adherence to laws, rules, and regulations relating to boilers and pressure vessels. The National Board members serve as the chief boiler inspectors representing most states and all provinces of North America, as well as many major cities in the United States. The National Board's functions include (1) promoting safety and educating the public and government officials on the need for manufacturing, maintenance, and repair standards, (2) offering comprehensive training in the form of continuing education for both inspectors and pressure equipment professionals, (3) enabling a qualified inspection process by commissioning inspectors through a comprehensive examination administered by the National Board, and (4) setting worldwide industry standards for pressure relief devices and other appurtenances through operation of an international pressure relief testing laboratory. The Board investigates pressure equipment accidents and issues involving code compliance. The Board develops installation, inspection, repair, and alteration standards for the National Board Inspection Code. The National Board Inspection Code, adopted by cities, states, Canadian provinces, and federal regulatory agencies, addresses in-service inspection repairs and alterations of boilers and pressure vessels.

National Restaurant Association

The National Restaurant Association (NRA) serves more than 380,000 businesses including restaurants, suppliers, educators, and nonprofit organizations. The members of the NRA come from every corner of the restaurant and hospitality industry. Members come from chef-owned restaurants, family restaurant chains, quick service franchisees, contract food services, and all other segments of the industry. One key objective of NRA is to increase food and alcohol safety and security in the restaurant industry. NRA also strives to promote increasing restaurant nutrition information availability and consumer awareness. Another objective is to improve water and energy usage and other sustainability practices in the restaurant industry. NRA is governed by a volunteer board of directors and led by a president and chief executive officer. A major association activity is the preparation and distribution of educational materials including self-inspection guidelines on general safety concerns, OSHA requirements, and fire protection.

National Safety Council

The National Safety Council (NSC) is the world's largest organization that devotes its entire efforts to safety promotion and accident prevention. The council is the largest nongovernmental and not-for-profit organization promoting safety in the United States. It oversees the activities of local safety councils, which work under the leadership of local citizens, industrial interests, responsible official agencies, and other important groups. Each council is self-supporting and its goal is to reduce accidents and injuries through prevention training. Over the years, increased injury and death rates in the homes and communities resulted in the council expanding its focus to include community safety.

Society for Chemical Hazard Communication

The Society for Chemical Hazard Communication (SCHC) is a professional society committed to serving chemical hazard communication professionals and to promoting knowledge and awareness in all areas of chemical hazard communication. Areas covered include worker safety, domestic and international regulatory compliance, toxicology, environmental toxicology, and risk analysis. Members represent industrial, consumer, and specialty chemical companies, pharmaceutical firms, manufacturers, distributors and importers, government agencies, universities, and consultants. SCHC holds conferences each year in the fall and spring. Meetings feature regulatory hazard communication updates, expert speakers from domestic or international chemical agencies, and valuable opportunities for business networking. Professional development courses offer an excellent opportunity to develop the expertise needed to operate in the chemical, regulatory, and hazard communication industry.

World Health Organization

WHO is the directing and coordinating authority for health issues addressed by the United Nations. It is responsible for providing leadership on global health matters, shaping the health research agenda, setting norms and standards, articulating evidence-based policy options, providing technical support to countries, and monitoring and assessing health trends. The organization is headquartered in Geneva, Switzerland. In addition to medical doctors, public health specialists, scientists, and epidemiologists, the staff includes people trained to manage administrative, financial, and information systems, as well as experts in the fields of health statistics, economics, and emergency relief.

REVIEW EXERCISES

4.1 What does the federal government use to announce proposed administrative law regulations and standards?

4.2 Explain the purpose of the CFR.

4.3 List the type of standards published in the following CFR references:
- 29 CFR 1910
- 29 CFR 1915
- 29 CFR 1917
- 29 CFR 1918
- 29 CFR 1926
- 29 CFR 1904

4.4 How long must employers covered by the OSH Act maintain their OSHA 300 Logs?

4.5 Explain in your own words the key difference between an OSHA-defined injury and illness.

4.6 List the four general elements of the OSHA Management Guidelines.

4.7 Describe the purpose and operation of the OSHRC.

4.8 Describe the purpose of following environmental laws:
- RCRA
- CERCLA
- SARA
- CWA
- TSCA

4.9 List four key agencies operating under the auspices of the DHHS.

4.10 What is the mission of the NIOSH?

4.11 In your own words, describe the creation and purpose of the DHS.

4.12 What is the mission of the DHS' Information Analysis and Infrastructure Protection Directorate? To coordinate emergency planning activities within a geographic area or region.

4.13 What three organizations possess legal *deemed status* to conduct hospital accreditation surveys?

4.14 What type of facilities does CARF accredit?

4.15 Describe the types of voluntary standards issued or developed by the following organizations:
- ACGIH
- ASHRAE
- ASTM International
- CGA
- NSF International
- SEI

4.16 Describe how the ASHE promotes healthcare safety.

4.17 Describe the mission of ASIS International.

5 Facility Safety

INTRODUCTION

Hazards of all types can exist in healthcare facilities and organizations must take steps to identify and control these hazards. Conducting periodic tours, inspections, and surveys can help identify and control hazards. Organizations with established safety cultures can rely on staff vigilance to help identify hazards and help prevent accidents. Healthcare supervisors must also focus on correcting unsafe acts and behaviors. Facility personnel at all levels should learn to observe hazards and behaviors that could contribute to accidents. Senior leads should stress the importance of job safety education and training. Supervisors should communicate the need for personal involvement in safety and hazard control efforts.

NFPA 99 became a code with the release of the 2012 Edition. The updated version now includes a chapter about categories of risk, new requirements on emergency management, a chapter addressing facility security, and information-related technology and communication systems. NFPA 99-2012 also includes updated information on medical gas and vacuum systems. NFPA 99C will no longer exist as a stand-alone document. The content now appears in NFPA 99, Chapters 1 through 5.

FACILITY GUIDELINES INSTITUTE

Facility Guidelines Institute (FGI) is a nonprofit organization that was established in 1998 to provide leadership and continuity to the development and publication of the *Guidelines for Design and Construction of Health Care Facilities.* FGI functions as a contractual, fundraising, and coordinating entity for the quadannual *Guidelines* revision process, supporting the work of the independent Health Guidelines Revision Committee in its goal to update and improve the content of the *Guidelines* document to encourage its adoption and use. The 2014 *Guidelines* documents were produced with the participation of more than 200 experts in planning, design and construction, and operation of hospitals, outpatient facilities, and residential health, care, and support facilities as well as health and residential care providers. The *Guidelines* revision cycle brings together some of the best minds in our business and through a formal consensus process develops a series of minimum design and construction standards for adoption by federal, state, and private enforcing authorities. So, although called guidelines, the standards contained in the two documents are truly considered the *standard of care* for new construction and major renovation projects. The 2014 *Guidelines* will require a safety risk assessment (SRA) that includes an overarching risk identification process, with considerations for infection control, patient handling, falls, medication safety, psychiatric injury, immobility, and security. Read this article to learn more about what this means for your health-care facility project. The 2014 FGI *Guidelines for Design and Construction of Hospitals and Outpatient Facilities* includes new requirements for assessing medication safety risks and identifying and designing medication safety zones to help health-care organizations address the high rate of medication errors in health-care today.

ADMINISTRATIVE AREA SAFETY

Many healthcare organizations overlook the administrative areas during safety surveys. These areas contain a number of hazards including lifting, climbing, repetitive motions, tripping, and electrical. Office areas can also experience workplace violence in locations such as admissions, emergency departments, gift shops, patient affairs, and business offices.

SLIP, TRIP, AND FALL PREVENTION

OSHA 29 CFR 1910.22, Walking/Working Surfaces, and ANSI A1264.2-2006, Provision for the Slip Resistance on Walking/Working Surfaces, provide guidance on preventing slips, trips, and falls. Safety personnel must identify, evaluate, and correct any hazards that could contribute to these types of events. Educate staff members about the causal and behavioral aspects of fall prevention efforts. Establish procedures to analyze trends related to slip and fall incidents. Slip, trip, and fall incidents can frequently result in serious disabling injuries. Slips and falls can result in lost workdays, reduced productivity, expensive worker compensation claims, and diminished ability to care for patients. In 2009, the BLS reported a hospital incidence rate of 38.2 per 10,000 employees for same level slips, trips, and falls. The 2009 rate was 90% greater than the average rate for all other private industries combined. These events resulted most often in sprains, strains, dislocations, and tears for healthcare personnel. Contaminants on the floor contribute to most healthcare facility slip, trip, and fall incidents. Implementing effective housekeeping procedures, conducting proper floor cleaning, using walk-off mats, posting safety signs, and requiring the wearing of slip-resistant shoes minimize the risk of slipping. Many slip and trip hazards exist in food preparation and service areas, decontamination areas, near soap dispensers, at drinking fountains, and at building entrances. Encourage personnel to cover, clean, and promptly report all spills or floor hazards. Hang or place spill cleanup materials, paper towel holders, and pop-up tent wet floor signs in convenient locations throughout the healthcare facility. Use water-absorbent and flat beveled edge walk-off mats at all locations water, ice, or soap may drip onto floors. Provide umbrella bags near entrances. Use proper cleaning procedures and ensure that cleaning products meet floor surface requirements. Mix cleaning products according to manufacturer directions and in the proper locations. Prevent entry into wet areas and use highly visible caution signs to inform employees and visitors of the hazard. Ensure the use of wet floor signs of 34–36 in. in height to ensure greater visibility. Rope or block off areas during floor cleaning, stripping, and waxing operations. Use barrier products or caution tape to prevent people from entering areas undergoing cleaning. Remove floor signs immediately once the floor dries. Wet floor signs can create familiar hazards if not removed. Ensure the proper alignment of all water pipes, floor drains, and down spouts. Use yellow safety warning paint to create visual cues to highlight changes in walkway elevations. Replace smooth flooring materials in areas normally exposed to water, grease, and particulate matter with rougher surfaced flooring when renovating or replacing floor surfaces. Identify and correct outside walking areas with hazards such as protruding structures, holes, rocks, and other types of debris that could contribute to falls.

Never use concrete wheel stops in parking lots since they pose great tripping hazards. Develop procedures that direct the prompt removal of ice and snow from parking lots, garages, and sidewalks. Place labeled bins filled with ice-melting materials and scoops that anyone can use immediately on icy patches. Provide SDS and instructions for handling all ice-melting chemicals.

Poor Lighting, Stairs, and Handrails

Proper lighting allows individuals to see their surroundings and notice any unsafe conditions. Install lights in poorly lit areas and always use lights with the appropriate brightness. Proper construction and maintenance of stairs and handrails can reduce tripping hazards. Poorly designed stairs can lead to missteps and can cause trips and falls. Paint surfaces with "safety yellow or other highly contrasted paint." Consider taping or highlighting the edge steps to provide guidance related to a change in elevation. Keep stairs free of ice, snow, water, and other slippery contaminants. Ensure the installation of adequate lighting in all stairwells. Evaluate the need to install handrails at locations with less than four steps, locations such as employee shuttle bus stops, building entrances, or conference theaters. Use handrails of 34–38 in. as measured from the stepping surface. Handrails must extend the full length of the stairs and extend 12 in. at the

top. For stairs greater than 44 in. wide, install two handrails. For stairs less than 44 in. wide, provide one handrail on the right side of the descending stairway.

Hazard Identification and Reporting

Conduct regular walking tours using a well-written slip, trip, and fall prevention checklist to guide the identification of hazards. Correct all identified hazards immediately. Educate all healthcare facility on how to recognize slip, trip, and fall hazards. Encourage facility personnel to participate in developing slip and fall prevention strategies.

Review facility historical accident and injury records to assist in identifying slip, trip, and fall hazards. Establish written housekeeping procedures and require everyone including patient care staff to immediately report spills and other floor hazards. Incorporate slip, trip, and fall prevention education into recurring safety training. Conduct awareness campaigns to educate employees about the risk of slips, trips, and falls. Provide feedback on the actions taken to prevent slip, trip, and fall injuries.

Static Coefficient of Friction

Static coefficient of friction (SCOF) relates to the traction between a person's foot or shoe sole and the walking surface. We can define SCOF as the relative force that resists the tendency of the shoe or foot to slide along a walkway surface. ADA recommends a minimum of 0.6 on level walking surfaces and 0.8 on ramps. OSHA requires an SCOF 0.5 in all areas. Slip resistance relates to a combination of factors including type of surface, and care and maintenance procedures with the presence of foreign materials between the foot/shoe sole and the walking surface. The AIA's Academy of Architecture for Healthcare states that "floor materials shall be readily cleanable and appropriate for each location." Install water-resistant floors in all food preparation areas and in locations containing baths or showers.

Healthcare facilities must conform to a certain *standard of care* for flooring and protect people from unreasonable risks. Failure to conform to a reasonable standard of care can create liability issues. Negligence can involve any reasonable, close, or contributing causal factor as related top conduct and an injury. Proximate cause relates to actual loss or damage experienced by another as the result of an event (Table 5.1).

SAFETY SIGNS, COLORS, AND MARKING REQUIREMENTS

OSHA Standard 29CFR1910.145 addresses accident prevention signs and tags. These specifications apply to the design, application, and use of signs/symbols used to prevent accidental injuries or property damage. These specifications do not cover plant bulletin boards, safety posters, or

TABLE 5.1
Factors to Consider When Selecting New Flooring Materials

- Performance factors in wet and dry conditions.
- Consider durability of a surface as important in high traffic areas.
- Abrasion resistance simply means how long will the surface retain its slip resistance.
- Establish maintenance and care procedures to meet manufacturer specifications.
- Impact-resistant flooring also considers the weight of heavy loads.
- Make appearance important but not as crucial as safety.
- Most modern flooring will retain a good appearance if maintained properly.
- Life cycle costs include expenses beyond the cost of flooring, installation, and maintenance.

any signs designed for streets, highways, railroads, or marine applications. OSHA standards do not address sign design for danger, caution, and safety instruction signs except for purpose and colors. OSHA requires signs designed with rounded or blunt corners and must be free from sharp edges, burrs, splinters, or other sharp projections. The ends or heads of fastening devices cannot create a hazard. The size of the sign, height and width of the letters, and viewing distances must meet ANSI Z535.2 requirements. Ensure that signs contain concise and easy to read wording. Use letters large enough to meet determined intended viewing distances. Place signs in locations to ensure individuals can take action to avoid the hazard. Use legible signs that do not cause distraction or create a hazard. Never place signs on moveable objects or adjacent to moveable objects such as doors and windows. If necessary, equip signs with emergency or battery-operated illumination. OSHA Standard 29 CFR 1910.144 requires the use of red to mark fire protection equipment and apparatus. Use red danger markings for safety cans or other portable containers of flammable liquids, excluding shipping containers. Red safety cans must contain some additional clearly visible identification either in the form of a yellow band around the can or the name of the contents conspicuously stenciled or painted on the can in accordance with 1910.1200. OSHA mandates the use of yellow as basic color for designating caution. Use yellow for the marking of physical hazards such as striking against, stumbling, falling, and getting caught in-between (Tables 5.2 through 5.5).

ELEVATORS AND ESCALATORS

Consider elevators and escalators as pathways that need maintenance. Keep these locations well lit, in good working order, and free of trash and debris. Unlevel flooring hazards can exist when

TABLE 5.2
ANSI Standards on Color Codes and Signs

- Z353.1 Color Codes for Safety Signs
- Z353.2 Environmental and Facility Safety Signs
- Z353.3 Safety Symbols
- Z353.4 Product Safety Signs and Labels
- Z353.5 Temporary Hazard Signs

TABLE 5.3
OSHA Classifications of Signs

- Danger signs: indicates immediate danger and that special precautions are necessary. OSHA also specifies the use of red, black, and white colors for danger signs to meet the requirements of ANSI Z53.1.
- Caution signs: warns against potential hazards or caution against unsafe practices. OSHA specifies that caution signs possess a yellow background black panel and yellow letters. All letters used against the yellow background shall be black. The colors must meet requirements of ANSI Z53.1.
- Safety instruction signs: use when there exists a need for general instructions and suggestions relative to safety measures. OSHA specifies that the standard color for safety instruction signs shall be a white background, green panel, and white letters. Any letters used on the white background shall be black. The colors must meet requirements of ANSI Z53.1.

TABLE 5.4
Signs Classified by ANSI Z535.2-2002

- DANGER: indicates immediately hazardous situations that could result in death or serious injury. Use only in extreme situations.
- WARNING: indicates potentially hazardous situations that could result in death or serious injury.
- CAUTION: indicates potentially hazardous situations that may result in minor or moderate injury. Use caution signs to alert individual about unsafe practices.
- NOTICE: indicates policy positions that relate directly or indirectly to the safety of personnel or protection of property.
- GENERAL SAFETY: indicates general instructions relative to safe work practices, reminders of proper procedures, and the location of safety equipment.
- FIRE SAFETY: indicates locations of emergency fire-fighting equipment.
- DIRECTIONAL ARROW SIGNS
- SPECIAL SIGNS

TABLE 5.5
OSHA/ANSI Requirements for Marking Hazards

- Compressed gas cylinders (29 CFR 1910.253). Label the contents of the cylinder—either by the chemical or trade name—use stenciling or stamping on the shoulder of the cylinder.
- Confined spaces (29 CFR 1910.146). Identify all workplace confined spaces and use danger signs or other effective means of identifying their locations and the dangers they pose.
- Eyewash/shower stations (ANSI Z358.2-2004). Identify the locations of eyewashes and showers facilities.
- Hazardous chemicals (29 CFR 1910.1200). Ensure that containers contain appropriate labels and warnings.
- Hazardous waste (40 CFR Part 262). Facilities accumulating hazardous waste on site must label containers as *Hazardous Waste* and include the accumulation start date. Label transport to meet DOT requirements.
- High voltage (29 CFR 1910.305). Permanently mark high voltage on the outside covers of pull and junction boxes.
- Ladders (29 CFR 1910.25). Mark defective ladders taken out of service as *Dangerous—Do Not Use*.
- Lockout/tag out (29 CFR 1910.147). Standardize lockout and tag-out devices within a facility in terms of size, color, shape, print, and format. Tag-out devices also need to warn against hazardous conditions of energized equipment. Appropriate legends on the tag-out devices include: Do Not Start, Do Not Open, Do Not Operate, Do Not Close, and Do Not Energize.
- Machine guarding—Radial Saws (29 CFR 1910.213). Mark the direction of rotation on the hood. Additionally, place a permanent label, at least 1½ in. by ¾ in. at the rear of the guard that reads *Danger: Do not rip or plough from this end*.
- Permanent aisles and passageways (29 CFR 1910.176). Allow sufficient clearances for mechanical equipment handling, loading docks, and doorways. Clearly mark such passageways. Use striped or solid floor tapes to mark off such areas. The color of tape used depends on degree of hazard.
- Pipe markings (ANSI/ASME A13.1). ANSI requires marking of pipes using legend indicating the name of the contents and arrows showing the direction of flow of the material. Use a color in combination with the legend to identify the characteristic hazards of the contents. Apply labels on or near valves, flanges, branches, changes in direction, and wherever pipes pass through walls.
- Radiation hazards (29 CFR 1910.96). Post signs or labels bearing the radiation caution symbol in radiation areas and on containers of radioactive material. These sign or labels require specific wording depending on the situation.
- Respirator storage (29 CFR 1910.134). Clearly identify storage compartments for respirators at workstations and those used for emergencies.
- Storage rooms for flammable and combustible materials (29 CFR 1910.106). Mark an aisle at least 3 ft wide in every inside storage room.

entering and exiting elevators. If the elevator doors start to close, there exists the potential for a hand, leg, or piece of clothing to get caught. Elevators contain moving parts and must undergo regular service. Maintenance includes lubrication of moving parts and repairing or replacing faulty or nonoperating components. Use temporary signs, barriers, and operator-control covers during maintenance operations. The ASME along with ANSI publishes ASME/ANSI A17.1 Safety Code for Elevators and Escalators. Standard A17.2 serves as the guide for inspecting elevators, and Standard A17.3 addresses the code requirements for existing elevators. Local and state jurisdictions enforce code rules through their established inspection procedures. Safety violations can result in fines and shutting of the equipment down. Like elevators, escalators require service on a regular basis to remain safe. Maintenance includes lubrication of moving parts and repairing or replacing faulty or nonoperating components. Use temporary signs, barrier, and operator-control covers to prevent unauthorized escalator use during maintenance operations. Qualified inspectors from local or state agencies conduct escalator inspections. Many inspectors belong to the National Association of Elevator Safety Authorities (NAESA) and some possess the qualified elevator inspectors (QEI) certification.

LADDER SAFETY

OSHA publishes guidelines for portable ladders, along with tips for proper ladder usage. OSHA Standard 29 CFR 1910.25 addresses wood ladders and OSHA Standard 29 CFR 1910.26 addresses metal ladders.

OSHA standards do not address fiberglass ladders. For specific information on ladders, refer to OSHA general industry standards at 29 CFR 1910.21-68 and for construction standards at 29 CFR 1926.1053. ANSI consensus standards on portable ladders include ANSI A14.1-2000, Wood Ladders, ANSI A14.2-2000 Metal Ladders, and ANSI A14.5-2000 Reinforced Plastic Ladders. These standards detail specifications on the various materials, construction requirements, test requirements, usage guidelines, and labeling or marking requirements. Mark ladders with the following information: size, type, maximum length, number of sections as appropriate, highest standing level, total length of sections as applicable, model number, manufacturer's name, manufacturer's location, and date of manufacture. Provide usage guidelines and other warning statements on the ladders in specific locations depending on ladder type. According to ANSI A14.1-2000, inspect a ladder before each use. Ensure that ladders contain firm and unbroken rungs with braces fastened securely. Keep ropes, pulleys, and other moving parts in good working order. Keep the feet of a ladder level when positioned solidly on the ground. Ensure that the legs on a stepladder can spread fully and lock into position. Place ladders at a 75° angle.

SCAFFOLDING (29 CFR 1910.22, 23, 28)

Ensure the inspection of all platforms or scaffolds by the supervisor before use. All elevated platforms must contain a standard guardrail securely fastened to a stationary object. The floor under an elevated platform must withstand a working load of 75 lb/ft^2. Adhere to the manufacturer's instructions and safety warnings. Inspect the equipment before use for damage or deterioration. Inspect erected scaffolds regularly to ensure safe conditions. Provide adequate sills and posts and use base plates. Anchor wall scaffolds securely between structure and scaffold. Use caution when working near power lines and never work closer than 10 ft to any electrical power lines. Use adjusting screws instead of blocking to adjust for uneven grades. Equip all planked areas with proper guard rails and toe boards. Never ride rolling scaffolding or leave materials on the platform when moving it. Do not extend adjusting screws over 12 in. Prohibit working platform height from exceeding four times the smallest base dimension unless guyed or stabilized. Never overload a scaffold and do not use ladders or makeshift devices on top of scaffolds. Ensure the soundness of all scaffolding footing and

anchorage. Scaffold must also support the maximum intended load. Never use unstable objects such as barrels, boxes, or bricks to support scaffolds or working planks.

FALL PROTECTION

OSHA general industry standards require fall protection for employees working at elevations of 4 ft or more. OSHA construction standards mandate a 6-foot requirement. OSHA addresses general industry standards for fall protection in 29 CFR 1910.23 and 29 CFR 1910.132(a). OSHA recommends establishing designated areas for employees not working at the edge of a roof. Consider a designated area as a section of a walking or working surface with an erected perimeter line so that employees within the area can receive a warning when approaching a fall hazard. When working on roofs without guardrails, never get within 10 ft of the roof edge unless you are securely attached to a securely anchored rope or line for fall protection. Never work on any roof when wind speed exceeds 20 mph. Some key elements of industrial roof fall protection include the following:

- Limit access to the roof through a roof permit system.
- Ensure that employees can recognize, evaluate, and control roof top fall hazards.
- Perform a hazard analysis prior to each roof entry.
- Monitor all processes and make improvements as necessary.

When performing inspections, maintenance, and repairs at an unprotected edges, provide conventional fall protection methods such as guardrails, safety nets, and personal fall arrest systems. In some situations, it may be possible to perform the work from the ground using ladders or articulated aerial lifts. Refer 29 CFR 1910.23(a)(4) for OSHA to skylight protection requirements. OSHA requires that skylights be guarded by a screen or by a fixed standard railing. Skylight screens must be capable of withstanding a load of at least 200 lb applied perpendicularly at any one area on the screen. They must also be constructed and mounted so they will not deflect downward sufficiently to break the glass below them under ordinary loads or impacts.

Healthcare organizations must monitor contractor activities and point out any uncontrolled hazards. Contractors must address and control all hazards. Some employers incorrectly assume that contractors who work at heights possess knowledge of OSHA fall protection requirements. Contractor safety can be addressed by a prequalification process that allows only contractors with demonstrated skills to bid on projects involving work at heights.

ANSI Z359.1: Safety Requirements for Fall Arrest Systems, Subsystems, and Components

The standard pertains to new performance requirements for fall protection equipment used in the general industry. ANSI standards primarily focus on the general industry on product performance. This relates to snap hook and *carabiner* gate strength requirements used on fall arrest and positioning devices. The new standard increases the gate strength of snap hooks and *carabiners* to 3600 lb.

ANSI Z359.2: Minimum Requirements for a Comprehensive Managed Fall Protection

The standard identifies the responsibility of the employer adherence to the following:

- Scope, purpose, application, exceptions, and interpretations
- Controlling fall hazards through identification, evaluation, and elimination
- Providing proper training to employees exposed to fall hazards

- Ensuring proper use of fall protection systems and rescue systems
- Implementing safe rescue procedures

ANSI Z359.3: Safety Requirements for Positioning and Travel Restraint Systems

The standard contains five sections and covers the following:

- Scope, purpose, application, exceptions, and interpretations
- Definitions
- Design requirements to include positioning systems, travel restraint systems, rope adjusters, positioning and travel restraint lanyards, full-body harnesses, positioning harnesses, and hardware
- Qualification testing to include test equipment and test specimens, as well as qualification tests
- Marking and instructions to include general and specific marking requirements, as well as general and specific instruction requirements

ANSI Z359.4: Safety Requirements for Assisted Rescue and Self-Rescue Systems, Subsystems, and Components

The standard covers the following:

- System requirements, component and element requirements, and corrosion protection
- Qualification, component, constituent, and element testing
- Inspection, maintenance, and storage
- Equipment selection, rigging, use, and training

TOOL SAFETY

Organizations must take steps to identify and help people avoid tool-related hazards. In the process of removing or avoiding the hazards, workers must learn to recognize the hazards associated with the different types of tools and the safety precautions necessary to prevent those hazards. Employees using hand and power tools can experience hazards such as falling, flying, abrasive, and splashing objects. Other exposures can include harmful dusts, fumes, mists, vapors, or gases (Table 5.6).

Hand tools may include anything from axes to wrenches. The greatest hazards posed by hand tools result from misuse and improper maintenance. The employer and workers must take actions to keep tools and equipment in good working order. Employers should caution employees to keep saw blades, knives, and other tools away from aisle areas and other employees working in close proximity. The use of appropriate PPE can help protect workers against tool hazards.

TABLE 5.6
Basic Tool Safety Rules

- Keep all tools in good condition with regular maintenance.
- Select and only use the right tool for the job.
- Examine each tool for damage before use.
- Operate according to the manufacturer's instructions.
- Provide and use the proper protective equipment.

Power tool comes in a variety of types based on the power source they use. Power tools can include those powered by electric, pneumatic, liquid fuel, hydraulic, and powder-actuated sources. Never carry a tool by the cord or hose and never yank the cord or the hose to disconnect it. Keep cords and hoses away from heat, oil, and sharp edges. Disconnect tools when not in use, before servicing, and when changing accessories such as blades, bits, and cutters. Keep all observers at a safe distance away from the work area. Secure work with clamps or a vise, freeing both hands to operate the tool. Avoid accidental starting. Workers should never hold a finger on the switch button while carrying a plugged-in tool. Follow instructions in the user's manual for lubricating and changing accessories. Prohibit the wear of loose clothing, ties, or jewelry that can get caught in moving parts. Remove from service-damaged portable electric tools and tag *Do Not Use*.

Safeguard hazardous moving parts such as belts, gears, shafts, pulleys, sprockets, spindles, drums, fly wheels, and chains. Take precautions against reciprocating, rotating, or moving parts of equipment if exposed. Never remove safety guards when using a tool. Use only hand-held powered tools equipped with a momentary contact *on–off* control switches. Some tools also may contain a lock-on control that turns off with a single motion of the same finger or fingers that turn it on.

Key hazards of electric-powered tools include burns and slight shocks that can lead to injuries or heart failure. To protect users from shock, tools must contain a three-wire cord with a proper ground. Tools can also contain double insulation or powered by a low-voltage isolation transformer. Operate electric tools within their design limitations. Recommend use of gloves and safety footwear when using electric tools. Never use electric tools in damp or wet locations. Keep work areas well lighted.

Pneumatic tools, powered by compressed air, can include chippers, drills, hammers, and sanders.

Key hazards include getting hit by a tool attachment or by a fastener used with the tool. Recommend use of eye and face protection when working with pneumatic tools. Working with noisy tools such as jackhammers requires proper and effective use of hearing protection. When using pneumatic tools, ensure secure fastening to the hose to prevent them from becoming disconnected. A short wire or positive locking device attached to the air hose can serve as an added safeguard. A safety clip or retainer can prevent attachments such as chisels on a chipping hammer from being unintentionally shot from the barrel.

Powder-actuated tools operate like a loaded gun. Treat them with respect and take precautions. Specially trained employees should operate these tools. Never use these tools in an explosive or flammable atmosphere. Before using, inspect the tools to determine cleanliness and ensure that moving parts operate freely and the barrel contains no obstructions. Never point the tool at someone else. Always load the tool immediately before using. Never leave a loaded tool unattended. Tools must operate until pressed against the work surface with a force of at least 5 lb greater than the total weight of the tool. If a powder-actuated tool misfires, the employee should wait at least 30 s and fire again. If it still will not fire, the user should wait another 30 s before removing the faulty cartridge. Place the bad cartridge in water. Wear appropriate eye and face protection when using a powder-actuated tool.

When using hydraulic power tools, use approved fire-resistant fluids that will retain operating characteristics at the most extreme temperatures. Never exceed the manufacturer's recommended safe operating pressure for hoses, valves, pipes, filters, and other fittings. Ensure that all lever and ratchet jacks, screw jacks, and hydraulic jacks contain a device that stops them from jacking up too high. Mark the manufacturer's load limit in a prominent place on the jack. Never use a jack to support a lifted load.

MACHINE GUARDING (29 CFR 1910.212)

Machine safeguards protect workers from preventable injuries. Safeguard any machine part, function, or process that may cause injury. A wide variety of mechanical motions and actions can create hazards to the worker. Hazards can include rotating members, reciprocating arms, moving belts,

meshing gears, cutting teeth, and parts that impact or shear. These different types of hazardous mechanical motions and actions can occur in varying combinations in most machines. The basic types of hazardous mechanical motions and actions include the motions of rotating, reciprocating, and transverse operations. Hazardous actions can include cutting, punching, shearing, and bending operations. Rotating motion can pose danger. Smooth and slowly rotating shafts can grip clothing and can force an arm or hand into a dangerous position. Examples of dangerous rotating mechanisms that pose risks include couplings, cams, clutches, flywheels, shaft ends, spindles, meshing gears, and horizontal or vertical shafting operations. Danger can increase when projections such as set screws, bolts, or projecting keys become exposed on rotating parts.

Dangerous moving parts in three basic areas require safeguarding:

- The point of operation refers to any point where a person performs at tasks such as cutting, shaping, boring, or forming of stock.
- Power transmission apparatus functions as the part of the mechanical system that transmits energy to the part of the machine performing the work. These components include flywheels, pulleys, belts, connecting rods, couplings, cams, spindles, chains, cranks, and gears.
- Other moving parts can include reciprocating, rotating, and transverse moving parts. It can also include feed mechanisms and auxiliary parts of the machine.

Requirements for Safeguards

The safeguards must prevent hands, arms, and any other part of a worker's body from making contact with dangerous moving parts. A good safeguarding system eliminates the possibility of the operator or another worker placing parts of their bodies near hazardous moving parts. A safeguard that a worker can easily remove or make ineffective provides no protection. Use guards and safety devices made of durable materials that will withstand conditions of normal use. Securely attach safeguards to the machine and ensure that the guard prevents objects from falling into moving parts. Never install a safeguard that becomes a hazard of its own such as a shear point, a jagged edge, or an unfinished surface. Ensure that safeguards do not impede a worker from performing the job quickly and comfortably. Proper safeguarding can actually enhance efficiency since it can relieve the worker's apprehensions about injury (Table 5.7).

ABRASIVE WHEEL GRINDER SAFETY (29 CFR 1910.215 AND .243)

OSHA Standard 29 CFR 1910.243 addresses portable abrasive wheels and 29 CFR 1910.215 covers fixed abrasive wheel grinders. The abrasive wheel grinder remains one of the most common pieces of machinery used in healthcare maintenance. These useful machines, used to remove metal from flat and cylindrical surfaces, come in two types. Bench or pedestal grinders remain

TABLE 5.7
Hierarchy of Guarding

- Design out or eliminate the hazard.
- Physically *engineer out* the exposure to the hazard.
- Guard the hazard.
- Require PPE.
- Use warning devices or make the danger *manifest*.
- Use warning signs.
- Use safe working practices and procedures.

in a stationary location. Portable abrasive tools can go anywhere in the facility. Some abrasive wheels permit only exposed flat sides for grinding. Other machines permit grinding on the circumference of the wheel. Some grinders may also contain a wire brush or buffing wheel attachments. Some workers using abrasive wheel grinders may not understand the hazards. Guarding remains the key safety feature of grinders. Use only fixed and portable abrasive wheels containing safety guards. OSHA defines a guard as an enclosure designed to restrain the pieces of the grinding wheel and furnish all possible protection in the event of a broken wheel. OSHA requires an adjustable guard to protect operators as the wheel diameter gets smaller. Before mounting an abrasive wheel, inspect and then test to ensure that the wheel contains no cracks. To prevent the wheel from cracking, ensure that it fits freely on the spindle. Never grind the side of the wheel unless designed for that purpose and does not jam work onto the wheel. Never stand in front of the wheel when the grinder starts. Hold the material with hands away from the wheel and work rest. Wear eye protection or a face shield. Never wear gloves or hold material with a rag. Use jigs or fixtures to hold frequently ground pieces and vise grips or channel locks to hold pieces not frequently grounded. Provide appropriate glass shields and ensure that all guards attach correctly and securely. The face of the wheel should be clean with no foreign material, chips, or nicks. Grinders should never demonstrate excessive vibration when in use. Maintain the adjustable tongue ¼ in. or less from the wheel and secure. Ensure that the work rest remains ⅛ in. or less from the wheel. PPE should include the following:

- Safety eyeglasses with side shields or a full-face shield.
- Dust mask to prevent dust inhalation.
- Hearing protection.
- Never wear loose clothing.
- Scarves, loose hair, and dangling jewelry create hazards.

COMPRESSED AIR SAFETY

The lightest pressure of compressed air on your skin can cause blood vessels to break and result in a hemorrhage. It can cause your eardrums to burst and damage your eyes, which can be beyond repair. If you put compressed air into your body, it can make your internal organs explode and can cause a very painful death. Never use compressed air to blow dirt, chips, or dust from clothing. Maintain air compressors strictly in accordance with the manufacturer's instructions. The maximum working pressure of compressed air lines shall be identified in psi. Never use compressed air where particles can be accelerated by the air stream. Do not use compressed air to clean machinery or parts unless absolutely necessary. Never use a compressed air line without a pressure regulator for reducing the pressure. Keep the hose length between tool housing and the air source as short as possible. Ensure that the hose is in good condition before you use the compressed air. Replace any torn, cracked, or bent hose before use. Keep the hose off of the floor where it could cause tripping hazards. Compressed air should never make contact with a person's skin. When cleaning with compressed air, wear safety goggles or a full-face shield. The OSHA compressed air safety guidelines state that the air pressure must not to exceed 30 psi. Never use compressed air to clean your clothes of debris.

ELECTRICAL SAFETY (29 CFR SUBPART S)

OSHA now considers the NEC or NFPA/ANSI 70 as a national consensus standard. Article 517 of NFPA 70 contains special electrical requirements for healthcare facilities. Refer to 29 CFR 1926.401-449 for OSHA construction-related electrical requirements. In addition, state and local regulations may apply. Electricians and maintenance personnel must understand the OSHA electrical safety standards published in 29 CFR 1910.301–399. Electrical installations and utilization

equipment must follow the requirements of the NFPA/ANSI 70. NFPA 70 applies to every replacement, installation, or utilization of electrical equipment. Supervisors must inspect work areas for possible electrical hazards. Electrical current travels through electrical conductors and we can measure its pressure as volts. You can measure resistance to the flow of electricity using ohms and that can vary widely. Resistance determination considers the nature of the substance itself, the length and area of the substance, and the temperature of the substance. Some materials, like metal, offer very little resistance and become conductors very easily. Other substances, such as porcelain and dry wood, offer high resistance. Insulators prevent the flow of electricity. Water that contains impurities such as salts and acids make a ready conductor. Electricity travels in closed circuits and follows its normal route through a conductor. Electrical equipment can cause shock, electrocution, and catastrophic property damage due to fire or explosion risks. Electrical fires in healthcare facilities many times result from short circuits, overheating equipment, and failure of current safety devices. Explosions may occur when flammable liquids, gases, and dusts interact with ignition sources generated by electrical equipment.

Grounding

Grounding refers to a conductive connection. Ground the frames of all electrical equipment regardless of voltage. Ground exposed noncurrent-carrying metal parts of electrical equipment that may become energized under abnormal conditions. Cover all electrical outlets, switches, and junction boxes. Provide ground fault circuit interrupters (GFCI) for all 120 V, single phase, 15 and 20 A receptacle outlets. The OSHA Standard 29 CFR 1910, Subpart S, covers two types of grounds. The grounded neutral conductor normally the white or gray protects machines, tools, and insulation against damage. This additional ground offers enhanced protection for the worker by providing another path from the machine or tool through which the current flows into the ground. This protects the worker should the metal frame of the tool become accidentally energized. The resulting heavy surge of current will activate the circuit protection devices and open the circuit.

Circuit Protection Devices

Circuit protection devices limit or shut off the flow of electricity in the event of a ground fault overload or short circuit in the wiring system. Consider fuses and circuit breakers as overcurrent devices that automatically open or break when the amount of current becomes excessive. Fuses and circuit breakers primarily protect equipment and conductors. GFCI shut off electrical power immediately by comparing the amount of current going to the equipment and the amount returning along the circuit conductors. Use in wet locations and construction areas. Employers must ensure that workers understand safety-related work practices. Workers whose jobs require them to work constantly and directly with electricity must use required PPE. Equipment may consist of rubber insulating gloves, hood, sleeves, line hose, and protective helmet. Workers should always use tools designed to withstand voltage and stresses of electricity (Table 5.8).

Work Practices

Use safety-related work practice to help prevent electrical shock or injuries. Keep workers away from energized equipment or circuits. Train qualified personnel on the correct procedures to use when working on energized equipment or circuits. Prior to using or performing maintenance on electrical equipment, first determine the safety of equipment location. Look for damp and wet hazards, high temperatures, and flammable liquids and gases. Ensure that current and safety devices such as fuses, breakers, and GFCI are working correctly. Check power cords and plugs for defects. Look for cuts in the insulation that expose bare wires. Determine the location of any emergency shutoff switch before using a piece of equipment.

TABLE 5.8
Unsafe Grounded Equipment Situations

- Three-wire plugs attached to two-wire cords
- Grounding prongs bent or cut off
- Ungrounded appliances resting on metal surfaces
- Extension cords or improper grounding
- Cords molded into plugs not properly wired
- Ungrounded multiple plug strips often found in office areas and nurse stations

Ensure that sufficient space exists around the electrical equipment or circuit in order to maintain or operate it safely. Personnel must remove personal metal jewelry. De-energize electrical equipment before testing or repairing in accordance with the OSHA Lockout Tag-out Standard 29 CFR 1910.147. If de-energizing electrical equipment or circuits increases the potential of an electrical hazard or requires troubleshooting, use appropriate tools and PPE as mandated by the situation.

Electrical Shock

Shock normally occurs when a person contacts both wires of an electrical circuit, comes into contact with one wire of an energized circuit and the ground, or makes contact with a *hot* metallic energized part when in contact with the ground. Several factors impact the severity of shock including the (1) amount of current (amperes) flowing through the body, (2) path of the current through the body, (3) length of time the person remain in the circuit, (4) phase of the heart cycle when the shock occurs, and (5) general health of the person involved. Severe shock can cause falls, cuts, burns, and broken bones. Three types of burns can result from shocks. Electrical burns result from current flowing through tissue or bone. Thermal burns occur when the skin comes into contact with the hot surfaces of overheated conductors or other energized parts. Electrical arc burns result from high temperatures occurring near the body (Table 5.9).

TABLE 5.9
Electrical-Related Standards

- NFPA 70 National Electric Code®—The NEC addresses many of the electrical requirements for healthcare facilities including installation requirements, incoming power lines, and voltage, noise, and frequency topics. The code also addresses transformers, distribution lines, conduit, wiring systems, junction boxes, and panel boards.
- NFPA 70B, Recommended Practice for Electrical Equipment Maintenance.
- NFPA 70E Standard on Electrical Safety Requirements for Workplaces—Provides safety guidance for those working with electrical systems within the facility. OSHA recently announced that the agency plans to adopt the standard in the 29 CFR 1910.
- NFPA 72, Fire Alarm Code—Provides power supply requirements for fire alarm systems.
- NFPA 110 Standard on Emergency and Standby Power Systems—Addresses general topics regarding installation, lighting, testing, and transfer switches.
- NFPA 111 Standard on Stored Electrical Energy Emergency and Standby Power Systems—Covers general topics such as installation requirements, light, acceptance testing, and transfer switches.
- OSHA 29 CFR 1910.147, Control of Hazardous Energy (Lockout/Tag-out Requirements).
- OSHA 29 CFR 1910 Subpart S, Electrical/Safeguarding Employees in Their Workplaces—OSHA continues to write citations for healthcare facilities failing to comply with Sections 303, 304, and 305 of the standard which includes wiring designs and methods.
- OSHA 29 CFR 1926.401-449, Construction Electrical Requirements.

PAINTING OPERATIONS (29 CFR 1926.20, 29 CFR 1926.21, 29 CFR 1910.132-138)

Painting and paint removal present hazards requiring effective controls. Hazards include exposure to toxic materials and flammable or explosive mists, particulates, and vapors. Inhalation of mists and vapors from paints, solvents, thinners, cleaning chemicals, strippers, and epoxies can pose a serious hazard. Injury and illness severity depends upon the agent's toxic characteristics, exposure amount, and method of exposure. Control potential physical and health hazards by using appropriate work procedures, hazard controls, facility design, protective clothing, and safe equipment. Pressure equipment used in painting operations can pose hazards because of the compressed air. Inspect ladders, scaffolds, and other equipment prior to use. Conduct paint mixing in designated, adequately ventilated rooms constructed of fire-resistant materials. Prohibit all sources of ignition in mixing areas. All electrical fixtures or equipment in or within 20 ft of designated paint preparation areas shall meet the requirements of the NFPA/ANSI 70. Good housekeeping provides the foundation for safe operations in paint shops. Place solvent or paint-soiled rags in approved self-closing metal containers plainly marked to indicate the contents. Personnel engaged in painting operations must refer to SDS to get information about properties and hazards of the solvents used. Skin contact with solvents may cause dermatitis, ranging in severity from a simple irritation to actual damage to the skin. Personnel engaged in painting and paint removal must wear protective clothing, respiratory devices if required, and appropriate face, eye, and hand protection. Require the use of eye or face protection during scraping or paint preparation. Change clothing as needed to minimize body contamination.

CONTROL OF HAZARDOUS ENERGY (29 CFR 1910.147)

Lockout procedures exist to render inoperative electrical systems, pumps, pipelines, valves, and any other systems that could energize while employees work. The OSHA Standard 29 CFR 1910.147 places four basic requirements on employers with worker engaged in service or maintenance functions: (1) written procedures for lockout/tag out, (2) training of employees, (3) accountability of engaged employees, and (4) administrative controls. Before beginning service or maintenance, ensure accomplishment of the proper steps according to the specific provisions of the employer's energy control procedure. Designate lockout employees to work on any de-energized machinery. All employees must learn to respect lockout and tag-out devices. Mandate that the person who applied these devices is the only authorized individual that can remove them. Training must ensure that employees understand the purpose, function, and restrictions of the energy control procedures.

Authorized Employees

Employers must provide training specific to the needs of authorized, affected, and other employees. Consider authorized employees as those responsible for implementing the energy control procedures or performing the service or maintenance activities. They need the knowledge and skills necessary for the safe application, use, and removal of energy isolating devices. They also need training in the following areas: (1) hazardous energy source recognition, (2) type and magnitude of the hazardous energy sources in the workplace, (3) energy control procedures, and (4) means or methods to isolate and control the energy sources. Describe affected employees as machine operators and others working in areas near those accomplishing service or maintenance tasks. These employees do not service or maintain machinery or perform lockout/tag-out activities.

Affected Employees

Affected employees must receive training on the purpose and use of energy control procedures. These employees must (1) recognize the use energy control procedures, (2) understand the purpose

of the procedure, (3) never tamper with lockout/tag-out devices, and (4) use equipment under lockout or that contains tag. Other employees working or near energy control areas must receive instructions about the energy control procedures. This includes education about the prohibition of removing a lockout or tag-out device and attempting to restart, reenergize, or operate the machinery. The employer must provide initial training before starting service/maintenance activities and must provide training as necessary. In addition, the employer must certify that the training of all employees is covered by the standard. The certification must contain each employee's name and dates of training. Employers must provide retraining for all authorized and affected employees and a change occurs in the following: (1) job assignments, (2) machinery or processes, (3) presence of a new hazard, and (4) revised energy control procedures.

Periodic Inspection and Reviews

Inspections ensure that employees understand their responsibilities under the procedure and can implement energy control procedures properly. Employers must ensure that an authorized inspector, not involved in the particular control procedure under evaluation, determines the following: (1) employees followed correct steps in the energy control procedures, (2) employees know their responsibilities, and (3) the procedure used to provide necessary protections. For lockout procedures, the periodic inspection must include a review of each authorized employee's responsibilities. The inspector's review can extend to affected employees. The employer must certify that the designated inspectors perform periodic inspections. The certification must specify the following: (1) machine or equipment on which the energy control procedure was used, (2) date of the inspection, (3) names of employees included in the inspection, and (4) name of the person who performed the inspection.

Maintenance

Production equipment and machines fall under the safeguarding requirements of 29 CFR, Subpart O. OSHA requires the employer to conduct periodic inspections and ensure adherence to following proper procedures or requirements. This periodic inspection includes a review of each authorized worker's responsibilities under the energy control procedures. The inspections and the reviews provide a representative sample of compliance with the requirements of the standard and not a 100% inspection.

Tag-Out Devices

Tags affixed to energy isolating devices serve as warning devices only and do not provide any type of physical restraint. Never permit the removal of any tag attached to an energy isolating device without authorization of the person attaching it. Never bypass, ignore, or otherwise defeat the use of tag-out processes. Ensure that all tags remain legible and understandable. Use tags made of materials that will withstand the environmental conditions encountered in the workplace. When utilized, attach tags securely to energy isolating devices so that they will not come loose during use. Use tag-out devices substantial enough to prevent inadvertent or accidental removal. Tag-out devices must warn against hazardous conditions if the machine or equipment becomes energized. Devices must communicate as an appropriate warning such as the following:

- DO NOT START
- DO NOT ENERGIZE
- DO NOT OPEN
- DO NOT OPERATE
- DO NOT CLOSE

Lockout Devices

Lockout devices and practices vary by nature and function. Recommend the use of key-operated padlocks assigned to specific individuals. Multiple lock adapters will enable more than one worker to place their own padlock on the isolating device to guarantee that the machine or equipment will remain deactivated until each and every employee completes their own task, and only then will the last padlock be removed. Use chains or other commercially available devices to prevent valves from being opened or, in some cases, closed. Operations requiring lockout by more than a single employee should use multiple lock adapters. Safely release any stored energy before the start of maintenance or installation work. Electrically powered equipment shall be de-energized and their source of electricity manually disconnected from them prior to the removal of protective covers or the start of other maintenance or installation work. Please note that locking and tagging on/off switches often do not prevent accidental start-up or prevent voltage from being present in the equipment.

Training

Providing training helps all employees to understand the purpose and function of the lockout/tag-out procedures. Workers must demonstrate that they possess the knowledge and skills for safe application, usage, and removal of energy controls. Personnel who work around electrical equipment but who do not perform a primary duty of electrical system installation or maintenance must receive a briefing from their supervisor. The briefing must focus on the hazards of electricity and the proper observation precautions. Each authorized employee who will use a lockout/tag-out procedure must receive training in the recognition of applicable hazardous energy sources, the type and magnitude of the energy available in the workplace, and the methods and means necessary for isolation and control.

Conduct retraining as necessary whenever a periodic inspection reveals or an employer believes that shortcomings exist in an employee's knowledge. Employers must review their procedures at least once a year to ensure that workers remain protected. As part of the review, employers must correct any deviations and inadequacies identified in the energy control procedure or its application. Retrain employees when a change occurs in their job assignment. Retrain when a change occurs in machines, equipment, or processes that present a new hazard. Retrain when lockout/tag-out procedures change.

PERMIT CONFINED SPACES (29 CFR 1910.146)

OSHA revised the standard in December 1998 to provide for enhanced employee participation in the employer's permitted confined space efforts. It authorized representatives with the opportunity to observe any testing or monitoring of permit spaces. OSHA defines a confined space as one with limited or restricted means of entry or exit but large enough to enter and perform their work. The space design also prohibits continuous occupancy (29 CFR 1910.146(b)). A permit-required confined space must contain one or more of the following characteristics: (1) a hazardous atmosphere, (2) material with potential for engulfing the entrant, (3) inwardly converging walls, and/or (4) any other recognized safety or health hazards. OSHA also specifies the requirements of a non-permit-required confined space. The space must not contain atmospheric hazards with potential to cause death or serious physical harm. When developing confined space procedures, evaluate the workplace and determine whether the space meets the OSHA permit required definition. When designating an area as permit confined space, the employer must inform all exposed employees of the dangers by posting signs or using some other equally effective means. Signs should read as follows: DANGER—PERMIT-REQUIRED CONFINED SPACE, DO NOT ENTER or other similar language. The next decision the employer must make concerns whether or not a confined space

should be entered. If not, the employer must take effective measures to prevent employees from entering the permit space. If yes, the employer must develop and implement written permit space entry procedures.

Vaults, Manholes, and Tanks

Consider all vaults, manholes, and tanks as confined spaces. All enclosed areas must be considered hazardous until tested. Test for oxygen deficiency, dangerous gas, and combustible gas prior to entry. Atmospheres containing 19.5% or less of oxygen by volume should not be entered without the use of an air-supplied respirator. Use manhole cover hooks or other approved methods when removing or replacing manhole covers. When replaced, covers must properly seat. Ensure that the bearing surfaces remain free from dirt, debris, or ice that could prevent proper cover seating. When authorized, personnel should enter and leave manholes or vaults only by means of a ladder. Never step on cables, cable hangers, or pipes. Personnel must never throw tools or materials into or out of manholes or vaults. Use canvas buckets, hand lines, or other approved methods for lowering and removing tools and equipment. Working on energized equipment can pose serious hazards in subsurface structures and require work to be performed by an electrician. Provide cool vests or other heat-reducing equipment to workers who enter vaults or manholes under high heat conditions such as a steam leak repair.

Written Elements

Procedures must allow for the identification and evaluation of all permit space hazards before entry. Employers must establish and implement means to prevent unauthorized entry. Employers must also establish and implement means to eliminate or control hazards necessary for safe entry by specifying acceptable entry conditions and isolating the space. The employer must purge, make inert, flush, or continuously ventilate the permit space as necessary to eliminate or control atmospheric hazards. Additionally, the employer must provide, maintain, and require the use of PPE necessary for safe entry. Employers ensure the testing of atmospheric conditions inside the SPACE BEFORE ENTRY (Table 5.10).

Attendant Duties

Station at least one attendant outside during entry and coordinate actions with contractors used to conduct rescue procedures. Establish a written permit system and review the effectiveness of the system annually. OSHA also requires training to ensure that employees involved in confined space work can perform their job functions safely. This training covers specific items for the authorized entrant, the attendant, and the entry supervisor. Training will cover the following authorized entrant responsibilities: (1) hazards involved in confined space entry, (2) use of appropriate PPE for confined space entry, (3) communication policies with the attendant, (4) requirement to leave

TABLE 5.10
Conduct Tests for the Following Hazards

- O_2 (Oxygen, 19.5%–23.5% acceptable)
- Lower explosive limit (LEL, <10% acceptable)
- Any known toxins present

TABLE 5.11
Specific Attendant Duties

- Remaining outside unless relieved
- Performing nonentry rescue when specified in procedure
- Knowing existing and potential hazards of the confined space
- Maintaining communication at all times with entrants
- Ordering evacuation of the space when conditions warrant
- Ensure that unauthorized people stay clear and perform no other duties that may interfere with duties

the space immediately when ordered by the attendant, and (5) alert the attendant immediately if a problem develops (Table 5.11).

Potential Confined Space Hazards

Many confined spaces lack natural air movement that can result in deficient atmospheres of less than 19.5% of available oxygen. Deficient atmospheres require the use of approved self-contained breathing apparatus (SCBA). The oxygen level in confined space can decrease due to work activities such as welding, cutting, and brazing. Certain chemical reactions such as rusting and bacterial actions such as fermentation can impact oxygen levels. Other gases such as carbon dioxide or nitrogen can displace oxygen. An oxygen-enriched atmosphere above 21% will cause flammable materials such as clothing and hair to burn violently when ignited.

Always ventilate spaces with normal air and never pure oxygen. Introducing a source of ignition into a space containing a flammable atmosphere will cause an explosion. Consider hazardous most liquids, vapors, gases, mist, solid materials, and dusts space.

Toxic materials can be absorbed into the walls and give off toxic gases when removed. Toxic atmospheres can be generated in various processes. Cleaning solvent vapors can be very toxic in a confined space. Toxic materials produced by work in the area of confined spaces can accumulate and become a hazard to workers. Other hazards can include (1) extremely cold temperatures, (2) loose, granular material stored in bins and hoppers could cause suffocation, (3) noise within a confined space can be amplified, (4) slips and falls, (5) wet surfaces increase the chance of electric shock in areas with electrical circuits and equipment, and (6) topside openings with other tasks being done above the confined space worker. Consider self-rescue as the best option. Assign a trained standby person to remain on the outside of the space and stay in continuous contact with the workers inside. The standby person must never take on any other duties and should know who to notify in case of emergency. Standby personnel must never enter a confined space until help arrives and only with proper protective equipment, lifelines, and respirators.

All welding and cutting operations carried on in confined spaces must take place with adequate ventilation to prevent the accumulation of toxic materials, possible oxygen deficiency, or explosive atmosphere.

OSHA HEARING CONSERVATION STANDARD (29 CFR 1910.95)

We can define noise as any unwanted sound. Noise occurs by sound waves generating rapid vibrations in the air. The ear changes air pressure waves into impulses that the brain interprets as sound. Hair cells in the inner ear stimulate nerves that carry the message to the brain. Loud noise damages these nerves and decreases hearing acuity. Noise may also trigger changes in cardiovascular, endocrine, neurologic, and other physiologic functions. Noise hinders communication

among healthcare workers. Many healthcare organizations overlook this occupational hazard. OSHA requires organizations with workers exposed to decibel levels exceeding 85 on the A scale to implement a hearing conservation policy. The basic components of effective hearing conservation efforts must include recognition, evaluation, control, training, and documentation. A 1979 survey of noise levels in hospitals indicated five work areas with noise levels high enough to reduce productivity: (1) food service departments, (2) laboratories, (3) engineering departments, and (4) administrative offices. OSHA identifies 90 decibels (dBA) based on an 8 h time-weighted average (TWA) as the safe level of noise exposure. This 90 dB concentration is referred to as the OSHA permissible exposure limit (PEL) for noise exposure. Any 8 h TWA exceeding 90 dBA requires the employer to implement control measures to reduce the exposure to 90 dBA or below. In addition to the 90 dBA PEL, OSHA also recognizes an 85 dBA TWA as its action level. While employee exposure to the action level does not force the employer to implement measures to reduce employee noise exposure, it does require the employer to develop hearing conservation procedures.

Measuring Noise Levels

Instruments used to monitor noise levels include sound level meters and noise dosimeters. Define a decibel as a measurement unit that expresses a logarithmic ratio to an established reference level. Consider a reading of 20 dB as 100 times greater (10 × 10) than a reading of 1 dB. Sound level meters and noise dosimeters usually measure on two or three different frequency scales. Frequency refers to the number of vibrations per second a noise contains. It measures in hertz (Hz) and uses frequency scales known as A, B, or C. OSHA requires that noise measurements be conducted using the A scale that most closely resembles the human ear. Use sound meters to determine which areas require a dosimeter measurement to determine TWA. Conduct noise level monitoring to ensure that worker exposure remains below the action level of 85 dBA. Workers exposed at above the PEL of 90 dBA must receive audiometric testing. Only use measuring instruments that meet ANSI specifications. Permit employees or their representatives to observe monitoring. Notify employees of noise exposure at or above an 8 h TWA of 85 dBA. Consider perceived loudness as subjective and therefore not measurable (Table 5.12).

TABLE 5.12
Common Noise Controls

- Mount tabletop equipment on rubber feet or pads and install sound absorbent floor tiles.
- Use acoustical ceiling tiles and wall hangings where possible.
- Install mufflers where possible on generators, air compressors, etc.
- Decrease volume of intercom speakers, televisions, and radios.
- Keep wheels, hinges, and latches lubricated.
- Adjust door closing mechanisms to prevent slamming and use sound absorbent materials.
- Enclose noisy equipment and reduce metal to metal contact.
- Limit worker exposure by implementing administrative controls.
- Use technology to reduce noise levels.
- Keep machinery in good maintenance repair to minimize noise.
- Erect total or partial barriers to confine noise.
- Limit employees' scheduled work time in a noisy area.
- Limit noisy operations and activities per shift.

Hearing Protection Evaluation

Ear protection provided for employees can include earplugs or earmuffs, or both. Employers must evaluate the sound attenuation provided by ear protectors for the specific environment in which it is used. Use evaluation methods found at Appendix B of the OSHA standard. Each hearing protection device possesses an assigned noise reduction rating (NRR). The NRR developed by the EPA determines the adequacy of a hearing protector's attenuation or noise-reducing capacity. Evaluate the NRR of a hearing protector based on the amount of decibels by which a given device reduces noise exposure. If an individual exposed to a TWA of 100 dB uses earmuffs with an NRR of 26, subtract 26 dB from 100 dB, leaving the worker with a 74 dB TWA exposure. Please note that the calculation remains valid only if the original TWA determination used a noise-measuring instrument reading in the C scale. When using the A scale for the initial noise level monitoring, OSHA requires subtracting 7 dB from the hearing protector's NRR. Then subtract this number from the TWA exposure. If using the A scale to record an above 100 dB TWA exposure, then subtract 7 dB from the hearing protector's 26 dB NRR. This leaves a 19 dB NRR that must be subtracted from the 100 dB exposure, leaving the worker with an 81 dB TWA exposure.

Audiometric Testing

Conduct a baseline audiogram within 6 months of confirmation of an exposure equal to or exceeding the 85 dB action level. This establishes a reference point for future annual audiograms comparisons. Conduct the initial annual audiogram within 1 year of the baseline. Perform subsequent annual audiograms yearly thereafter. Employers must provide testing free of cost to employees with noise exposure equal to or above an 8 h TWA of 85 dBA. Calibrate audiometers to meet ANSI standards. Only a licensed or certified audiologist, otolaryngologist, physician, or technician certified by the Council of Accreditation in Occupational Hearing Conservation or some with demonstrated competence can perform audiometric testing. All records must include the name and job classification of the employee, date of the test, examiner's name, date of the last acoustic or exhaustive calibration of the audiometer, and employee's most recent noise exposure assessment. Maintain audiometric test records for the duration of the affected employee's employment. Retain noise exposure measurement records for 2 years. Grant access to audiometric test records and noise exposure measurement upon request to the employee, former employees, or an employee's designated representative. Provide training and education to those employees with noise exposure at or above 85 dBA. Repeat training and education annually for exposed employees.

HEATING, VENTILATING, AND AIR-CONDITIONING SYSTEMS

Introduction

HVAC systems include heating, cooling, and ventilation equipment. These systems can include furnaces, boilers and chillers, cooling towers, air handling units, exhaust fans, duct work, filters, steam pipes, and hot water piping. A ventilation system consists of a blower to move air, ductwork to deliver the air, and vents to distribute the air. A good ventilation system distributes supply air uniformly. Place exhaust fans away from supply vents. ASHRAE recommends 20 ft^3 of outside air per minute per person as adequate for most office environments. Develop procedures for conducting a partial or complete shutdown of each HVAC system. Equipment failures can result not only in loss of heating or cooling capabilities but can impact special needs such as support for hood exhaust systems. Provide detailed education about HVAC onto maintenance and operating personnel. Education and training should focus on the technical aspects of maintaining systems including the role that each system plays in specific areas of buildings.

Maintenance personnel and plumbers usually encounter three basic types of heating systems: (1) hot water, (2) steam, and (3) gas forced air. These sources can present energy and burn hazards. For example, hot water temperatures of 180°F can scald the skin. Steam leaks can also cause burns. Require personnel to lock out all source of energy before starting work. Require personnel to use a meter to test electrical circuits. In older facilities, personnel can encounter areas containing asbestos. Remind maintenance personnel never to disturb asbestos. Only qualified personnel should handle asbestos-containing materials. Facilities should develop asbestos management and access procedures. Maintenance personnel must know the procedures concerning roof access and permits to confined spaces. Ventilation work performed on rooftops should require the use restricted access procedures. Hazards encountered when working with air-conditioning systems can include refrigerants, electrical components, displaced oxygen levels due to large leaks, and heavy equipment. Report all hazardous conditions or situations encountered.

Boiler Systems

The ASME Boiler and Inspection Code covers design, fabrication, and inspection of boiler systems during construction or installation. Once installed, refer to the National Board of Boiler and Pressure Vessel Inspectors Inspection Code for guidance on maintenance of the system. Always refer to instructions provided by the manufacturer of the boiler. Boilers can use a variety of fuels depending on the design. Effective maintenance policies must address water treatment, maintenance, inspections, permits and licenses, potential system failures, emergency shutdown, and training/education. Check the treatment of water used in boilers and maintain proper levels. Monitor water columns to ensure that connections remain clear. Ensure that water returns to the proper level with drain valves closed. Inspect boilers at least annually focusing on the flame safeguard supervisory system and other safety controls. Conduct the inspection during a scheduled shutdown by an authorized boiler inspector. Repair or replace all defective parts. Conduct inspections with boilers cool and hand holes and manholes open, and ensure proper boiler ventilation. Conduct safety valve inspections as outlined in the National Board Inspection Code. Equip boiler feed lines with check and cutoff valves. Locate these valves as close as possible to each boiler. Place guarded water gauge glasses less than 15 ft from the floor or on the water tender platform. Inspect and test pressure every 12 months. Never make adjustments to valves or remove valves to increase discharge pressure. Properly guard hoist ways, driving machinery, conveyors, worm gears, and reciprocating pumps. Never operate a boiler at pressures higher than determined safe by the most recent boiler inspection. Never operate any boilers at a pressure greater than specified by the manufacturer. Periodic inspections of the systems will permit an immediate check of integrity and safety between preventive maintenance checks and tests. Effective management provides for the proper maintenance of boiler controls and system safety controls or devices. NFPA publications 85A through E, Boiler Furnace Standards, also detail minimum design and installation requirements for high-pressure boilers. Refer to ASME Boiler and Pressure Vessel Code (1990) and ANSI/ASME PVHO-1A-1990, Safety Standard for Pressure Vessels for Human Occupancy, for additional guidance.

Pipe Marking Standards

The ANSI 13.1 standard merged into the ANSI/ASME A13.1 Scheme for Identification of Piping Systems to provide marking requirements. The standard addresses pipe marking requirements for use in all industrial, commercial, and institutional facilities and in buildings used for public assembly. This standard does not apply to buried pipelines or electrical conduits. Pipe marking labels must effectively communicate the contents and provide additional information about special hazards. Keep the legend short in length and easy to read. Use an arrow in conjunction with the legend to show which direction the material flows. Display arrows in both directions when content flow both ways. ANSI/ASME A13.1-2007 changed the color scheme requirements for the

TABLE 5.13
Pipe Contents Color Scheme

- Fire-quenching fluids—white text on red
- Toxic and corrosive fluids—black text on orange
- Flammable fluids—black text on yellow
- Combustible fluids—white text on brown
- Potable, cooling, boiler feed, and other water—white text on green
- Compressed air—white text on blue
- User-defined—white text on purple
- User-defined—black text on white
- User-defined—white text on gray
- User-defined—white text on black

labels. The standard presents six standard colors. The standard bases color requirements on the characteristic hazards of contents (Table 5.13).

Label Placement

Place labels on the lower or upper side of a pipe to permit easy reading (up or down) depending on the location. Place labels near valves, at branches, near change in directions, on entry or reentry points, through walls or floors, and on straight segments with spacing between labels. Facilities may use other labeling systems that meet the basic ANSI requirements. Document in writing the labeling system used.

Ventilation Systems

NFPA 90A, Installation of Air Conditioning and Ventilating Systems, details specific suggestions for maintaining systems. Proper temperature, humidity, and air flow will provide a comfortable environment inside a building regardless of climatic conditions outside. Ventilation should conform to ASHRAE Standard 62 requirements. Air enters buildings or spaces through mechanical ventilation systems and naturally through leaks around windows and doors. Consider all newly constructed buildings as highly energy efficient due to sealed windows and heavy insulation. These buildings primarily depend on mechanical ventilation. Many older, smaller, and low occupancy office buildings can adequately ventilate through natural sources. In modern buildings, HVAC systems keep occupants comfortable and healthy by controlling the amount of outside air that is added to the building atmosphere, filtering both incoming and recirculated air to remove particulate matter and controlling the temperature (Table 5.14).

Design mechanical ventilation systems to provide outside air to mix a percentage of return or inside air. The system then cools, heats, or humidifies and distributes the air. More than half of air quality-related problems result from insufficient or ineffective ventilation. General office space requires 20 ft^3 of intake air per minute for each occupant. Carbon dioxide provides a good indicator of insufficient intake air. Consider ventilation as inadequate when carbon dioxide levels reach 1000 ppm. ASHRAE Standard 55 describes temperature and humidity ranges for building occupants. Ensure that the system distributes and blends proper amounts of outdoor and recirculated air to meet requirements found in ASHRAE 62. Isolate and remove odors or contaminants through pressure control, filtration, and exhaust systems. Positive-pressure rooms will contain more supplied air than exhausted air. Negative-pressure rooms will contain less supplied air than exhausted air. Ventilation maintenance plans should describe equipment covered,

TABLE 5.14
Ventilation Terms

- An anemometer measures air velocity, normally in feet per minute.
- Capture velocity refers to the velocity of air produced by a hood to capture contaminants outside the hood area.
- Dilution ventilation exposure control methods use an air purification device and returns the exhaust to work area air.
- A manometer measures pressure differences, usually in inches of a water gauge.
- Consider static pressure as pressure developed in a duct by a fan.

TABLE 5.15
Relevant ASHRAE Standards

ASHRAE 52, Method of Testing Air Cleaning Devices in General Ventilation for Removing Particulate Matter: This standard can assist professionals in the evaluation of air cleaning systems for particle removal. The standard also includes information about the uniform comparative testing procedure. It addresses the establishment of a standard reporting method for performance and methods of assessing resistance to airflow and dust holding capacity.

ASHRAE 55, Thermal Environmental Conditions for Human Occupancy: This standard covers several areas, including temperature, humidity, and air movement. Important aspects of the standard include the definition of acceptable thermal comfort. It provides information on environmental parameter considerations. The standard makes recommendations for summer and winter comfort zones for humidity and temperature. It also contains guidelines for conducting measurements.

ASHRAE 62, Ventilation for Acceptable Air Quality: This standard can assist professionals in the proper design of building ventilation systems. Important aspects of the standard include the definition of acceptable air quality and information about ventilation effectiveness. It makes a recommendation about using source control through isolation and local exhaust. The standard also contains information on the use of heat recovery ventilation and provides a guideline for allowable carbon dioxide levels.

specific procedures, and frequency schedule. HVAC systems should operate in accordance with their original design or meet construction or renovation requirements, whichever occurred most recently. Notify building occupants at least 24 h prior to the use of any cleaning or chemical substance within the facility (Table 5.15).

Exhaust and Ventilation Standards

Local exhaust ventilation systems must conform to the construction, installation, and maintenance requirements found in ANSI Fundamentals Governing the Design and Operation of Local Exhaust Systems, Z9.2, and ANSI Z33.1. OSHA Standard 29 CFR 1910.107 contains information on local exhaust duct systems, independent exhausts, and room intakes. For ventilation requirements for inside storage rooms with flammable materials, refer to 29 CFR 1910.106. OSHA also covers a number of air contaminants in 29 CFR Subpart Z. Refer to 29 CFR 1910.1450 for laboratory ventilation guidance. OSHA standards also cover ventilation requirements for a variety of operations including abrasive blasting, grinding and polishing operations, and spray finishing tasks.

Local exhaust refers to any method designed to capture airborne contaminants nearest the point of generation or release. The system should draw the contaminant away from a person's breathing zone. Mechanical exhaust dilutes contaminated air and lowers the concentration of a hazardous substance. The effectiveness depends on the number of air changes per hour. A fume hood or fume removal system can capture hazardous air contaminants such as vapors, dusts, mists,

gases, and metal fumes. A fume removal system consists of a blower that removes a contaminant. Blowers come in sizes relevant to the amount of cubic feet of air moved at a given resistance. The type of collection mechanism used and length of duct work can influence this resistance or static pressure. Blower flywheels come constructed in a number of materials depending on the contaminant being removed. Hoods come in explosion proof or nonsparking models. Ventilation ducts normally contain galvanized steel, stainless steel, or PVC-type materials. Air purification devices can include chemical adsorption and mechanical filters that remove particulate matter. Cabinet hood devices, often used in laboratories, can prove very effective against a variety of chemicals. The three-sided enclosure, normally made of chemically resistant materials, pulls air through the front and away from the worker. Canopy hoods are mounted on walls or hung from ceilings over a work area and capture contaminants that rise. Local collection hoods are directly attached to the duct and provide exhaust for contaminants at a specific location. Refer to NFPA 45, *Standard on Fire Protection for Laboratories Using Chemicals*, for guidance on fume hood requirements.

ASSESSING IAQ

Monitor the quality of air inside healthcare facilities since many infectious agents can spread through the air and ventilation systems. Healthcare facilities also use a number of chemical substances that can contaminate the air. Remember, many odors associated with chemical contaminants can come from inside or outside the building. Off-gassing from such things as paints, adhesives, sealants, office furniture, carpeting, and vinyl wall coverings provides a source for a variety of irritant compounds. The study of IAQ and pollutant levels within building environments remains a complex challenge. Many health symptoms manifest themselves in vague or common manners. Formal guidelines or standards for permissible exposure limits to indoor pollutants remain almost nonexistent.

Sources that originate outside a building can include (1) pollen, dust, and fungal spores, (2) general vehicle exhaust, (3) odors from garbage dumpsters, and (4) exhaust from the building itself or from neighboring buildings. Examples of sources that originate from within the building include (1) building components and furnishings, (2) smoking, (3) maintenance or remodeling activities, (4) housekeeping activities, (5) unsanitary conditions such as standing water from clogged drains or dry traps, (6) water damage contamination, (7) emissions from office equipment, and (8) special use area contaminants such as print shops, paint shops, and laboratories (Table 5.16).

Preventing IAQ Problems

Most air contaminants refer to substances contained in vapors from paint, cleaning substances, pesticides, solvents, particulate materials, outdoor air pollutants, and other airborne substances. Healthcare facilities must be aware that new carpet and particle board can release volatile organic compounds such as formaldehyde. Healthcare facilities must also contend with a number of other potential contaminants such as antibiotics and antineoplastic drugs. Healthcare facilities must also

TABLE 5.16
Factors Contributing to Good IAQ

- Proper ventilation
- Temperature, humidity, and air movement
- Maintenance of equipment and building surfaces
- Isolation of emission sources from occupied spaces
- Major contamination sources properly controlled
- Controlling maintenance and construction contaminants

TABLE 5.17
Indoor Illness Definitions

- Sick Building Syndrome (SBS): A health condition or symptoms possibly related to possible contaminants existing in building but without medical or scientific confirmation.
- Building Related Illness (BRI): Refers to an illness brought on by exposure to contaminants in a building. Legionnaires' disease and hypersensitivity pneumonia remain two commonly occurring examples.
- Multiple Chemical Sensitivity (MCS): A controversial term not recognized by many medical organizations. MCS relates to simple exposure to a number of substances at small concentrations and experiencing health problems as a result.

be concerned about microbiological contamination. Microbes such as Legionnaires' bacilli can exist in the cooling towers of healthcare facilities. Wet, moist, and damp areas can be breeding grounds for microbes that can become airborne and cause problems for workers. *ASHRAE 12-2000 Minimizing the Risk of Legionellosis Associated with Building Water Systems* provides guidance on water-based utility systems. These systems must be properly designed, installed correctly, and effectively maintained to control pathogenic biological agents. Healthcare facilities should consider establishing a written IAQ plan to help manage the ventilation system. The written plan should cover a number of areas, including maintenance, testing, monitoring, and training. Healthcare facilities should obtain the EPA/NIOSH Publication entitled *Building Air Quality: A Guide for Building Owners and Facility Managers* (Table 5.17).

Workplace Mold

Mold can grow in buildings and become a healthcare hazard. Research indicates that about 1000 known species of mold exist in the United States. Outdoor molds play an important role in nature by breaking down organic matter such as toppled trees, fallen leaves, and dead animals. Food and medicine production depends on molds. Avoid indoor mold growth since molds can grow on virtually any substance with moisture or water, oxygen, and an organic source of food. Molds reproduce by creating tiny spores (viable seeds) that usually cannot be seen without magnification. Mold spores continually float through indoor and outdoor air. When excessive moisture or water accumulates indoors, the result can include mold growth. Currently, no federal standards regulate the airborne concentrations or mold or mold spores (Table 5.18).

TABLE 5.18
Mold Prevention Tips

- Repair plumbing leaks and leaks in the building structure as soon as possible.
- Look for condensation and wet spots.
- Fix sources of moisture incursion problems as soon as possible.
- Increase surface temperature, insulate, or increase air circulation.
- Reduce the moisture level in the air, repair leaks, increase ventilation.
- Keep HVAC drip pans clean, flowing properly, and unobstructed.
- Perform regularly scheduled building/HVAC inspections and maintenance.
- Maintain indoor relative humidity below 70% (25%–60%, if possible).
- Vent moisture-generating appliances, such as dryers, to the outside where possible.
- Vent kitchens (cooking areas) and bathrooms according to local code requirements.
- Clean and dry wet/damp spots as soon as possible but no more than 48 h after discovery.
- Provide adequate drainage around buildings and slope landscape away from buildings.

Remediation Actions

Remediation includes both the identification and correction of the conditions that permit mold growth, as well as the steps to safely and effectively remove mold-damaged materials. Before planning the remediation, assess the extent of the mold or moisture problem and the type of damaged materials. Outside, cleanup contractors must demonstrate experience in mold remediation actions. Check references and ask the contractor to follow the recommendations in EPA publication entitled *Mold Remediation in Schools and Commercial Buildings.* NIOSH provides practical suggestions on preventing, identifying, and resolving IAQ problems in public and commercial buildings. This guidance provides information on factors affecting IAQ and describes how to develop an IAQ profile of building conditions. It also addresses how to create an IAQ management plan, describes investigative strategies to identify causes of problems, and provides criteria for assessing alternative mitigation strategies.

POWERED INDUSTRIAL TRUCKS (FORKLIFTS, 29 CFR 1910.178)

Some healthcare facilities use powered industrial trucks including forklifts in their receiving, materials, and warehousing area. Preventing forklift incidents requires comprehensive worker training, systematic traffic management, a safe work environment, a safe forklift, and safe work practices. Trucks must bear a label or another identifying mark indicating approval by the testing laboratory as required by OSHA and ANSI B56.1. Use trucks listed and approved for fire safety purposes by a nationally recognized testing laboratory. Storage and handling of liquid fuels such as gasoline and diesel must meet the requirements of NFPA 30. Ensure that storage and handling of liquefied petroleum meets requirements of NFPA 58, Storage and Handling of Liquefied Petroleum Gases. The concentration of carbon monoxide gas created by powered industrial truck operations must never exceed the levels specified by OSHA in 29 CFR 1910.1000. Dock boards or bridge plates must meet the OSHA requirements of 29 CFR 1910.30.

Permit only authorized and trained personnel to operate trucks. Forklifts should contain the following equipment: an overhead carriage, fire extinguisher, rotating beacon, face plate, horn, and backup alarm. The operator must perform daily preinspections before each use. Report any safety defects such as hydraulic fluid leaks, defective brakes, defective steering, missing face plate, nonworking horn, or missing fire extinguisher to maintenance personnel. Operators must adhere to recharging or refueling safety procedures. Title loads back and carry cargo no more than 6 in. from the ground. Any load restricting operator must transport backward. Operators will sound horn and use extreme caution when meeting pedestrians, making turns, and turning corners. Trucks equipped as a man lift must contain an appropriate platform or cage equipped with standard rails and toe boards. Operators will ensure that a load never exceeds rated limits. Turn off trucks when not attended, lower forks to the ground, apply the brake, and remove the key. OSHA requires training that must include classroom and practical training on proper vehicle operation. Provide training on hazards of operating the vehicle and the requirements of the OSHA standard. Operators who complete training must also receive an evaluation while operating the vehicle. Reevaluate operators every 3 years. OSHA does not require training that duplicates other training previously received by the operator. However, the organization must evaluate the operator competency. OSHA requires employers to certify the training and driving evaluation. Only certified instructors can provide training. Provide training on new types of trucks or when conditions change in the work place. Conduct refresher training every 3 years.

LANDSCAPE AND GROUNDS MAINTENANCE

The equipment, site conditions, and weather can make these tasks very dangerous. It is important that the employees responsible for grounds keeping stay alert and watch for the unexpected.

The following safety tips may help avoid accidents and injuries to employees. Ensure that workers wear properly fitting, long- or short-sleeved shirts with long pants. High-top, lace-up shoes, or boots with traction soles provide the best support and protection. Use face shields or goggles to protect eyes from dust and flying particles. Wraparound sunglasses with UVA and UVB protection can reduce the risk of cataracts from sun exposure. Provide appropriate hearing protection devices such as earmuffs or ear plugs when noise exceeds OSHA requirements. Require the use of proper respiratory protection for extremely dusty conditions or when applying pesticides. Provide appropriate head protection for individuals working under low branches or where falling object hazards exist. Select the proper gloves based on the tasks. Various glove styles can provide hand protection from hazards such as cuts, scrapes, chemical exposures, thermal burns, and vibrating equipment. OSHA requires a formal assessment to determine types of PPE needed.

Provide education and training that covers all equipment and tools used. Ensure that workers know how to operate the controls and use the equipment safely. They need to know how to disengage and stop the equipment quickly in the event of an emergency. Inspect equipment carefully for loose, broken, or damaged parts. Repair or replace the equipment prior to use. Educate employees on the hazards associated with operating equipment while on medications that can impair judgment. Ensure grounding of electrically operated equipment. Teach workers to inspect areas for potential hazards and remove all debris from the area. Never allow employees to operate gasoline or diesel equipment inside a building. Ensure that employees rest periodically during strenuous jobs. Establish work–rest schedules according to temperature conditions and worker acclimation to the workload. Groundskeepers use various types of equipment while performing their job tasks. Train and authorize each individual to operate specific equipment.

Blower Safety

Start and run the equipment in an upright position. Operate the blower with tubing attached and direct the discharge of debris away from people, animals, glass, and solid objects that could cause material to ricochet. Never use blowers while on elevated or unstable surfaces. Never use blowers to apply pesticides, fertilizers, or other toxic substances.

Edger Safety

Require disengagement of the blade before starting the engine. Train workers to hold the edger with both hands in a comfortable and well-balanced stance. Instruct individuals to keep hands and feet well clear of the cutter blade. Watch the discharge direction carefully and direct it away from people, animals, children, and windows. Stay alert for situations that contribute to ricochets incidents. Disengage and stop the engine before adjusting or repairing.

Chain Saw Safety

When operating chainsaws, the use of PPE, effective training, and understanding the proper cutting technique remain the keys to preventing injuries. Most chain saw injuries involve contact with the cutting chain that can result in severe injury to the hands, legs, feet, and head. All chain saw operators must receive training to include classroom and hands-on instruction.

Trimmer Safety

Use only trimmers with the cutting teeth and guards close enough together to prevent fingers from fitting between them. Select trimmers with two handles, including a wide forward handle high above the cutting blade. Lightweight models are handled much easier than heavier ones. Never

operate trimmer above chest height and keep hands and body away from the blades. Keep the cord of electric models away from the trimmer to avoid damage or cuts to the cord. Work slowly and deliberately. Plan cuts before proceeding. Stop the engine or unplug electric models before cleaning or adjusting.

Push Mower

Never take a running mower over gravel, stones, or hard objects such as pipes, rocks, or sidewalks.

Never pull, always push the mower forward. Plan to mow across slopes since the feet will less likely get caught in the blade. Keep hands and feet clear of the blade housing and the discharge chute.

Ensure the correct positioning of safety devices including the rear shield, grass chute deflector, handle up stops, and dead man control. Ensure dryness of the grass before beginning. Disconnect the spark plug wire before attempting service, adjustment, or repair of the mower.

Riding Mower Safety

Ensure that all riding mowers contain a working engine interlock and *dead man* controls.

Disengage both the mower and transmission before starting the engine. Drive the mower up and down gentle slopes for stability. Back up moderate slopes and avoid steep slopes completely. Turn off the engine and wait for moving parts to stop before dismounting and always remove the key. Slow down when turning sharply and on slopes to avoid tipping. Keep the discharge chute pointed away from buildings, people, and animals. Keep hands and feet away from all moving parts. Disconnect the spark plug wire and remove the ignition or starter key before attempting to service, adjust, or repair the mower.

FLEET AND VEHICLE SAFETY

Healthcare organizations with fleet or driver safety functions must make driver selection and qualification critical to success. Ensure that each applicant that will operate a motor vehicle completes a release to permit the company to obtain their formal driving records from the state Department of Motor Vehicles. Conduct substance abuse testing, check all references, and provide training sessions. Many insurance carriers provide training on fleet safety. They normally *train the trainer* who then will conduct sessions for drivers. Some safety councils provide training sessions and even specialized training classes. The effective supervision of drivers poses the greatest challenge to any fleet manager. Publish driver policies in writing and ensure wide dissemination. NIOSH established the Center for Motor Vehicle Safety (NCMVS) in 2010 to promote research related to preventing motor vehicle crashes. NIOSH focuses on the use of occupant restraints, driver fatigue, vehicle design, work organizational factors, and employer policies. NIOSH hopes to develop injury prevention strategies and transfer the information into workplaces. The NSC publishes the Fleet Safety Manual that provides an excellent resource for promoting organizational motor vehicle safety (Table 5.19).

Safe Practices for Motor Vehicle Operations (ANSI/ASSE Z15.1 Standard)

ANSI/ASSE Z15.1 provides organizations with a guidance document to assist with the development of policies and procedures necessary to control risks related to the operation of motor vehicles. The standard applies to the operation of organization-owned or organization-leased vehicles on public roads. Motor vehicle practices and operations play a vital role on the effectiveness of any overall safety and health management function. The new publication places added emphasis

TABLE 5.19
Major Fleet Safety Components

- Management support: Leaders provide the direction for safety efforts. The development of a safety policy by senior management should address the expectations of all drivers. Management involvement and support remains the most important aspect of the fleet safety.
- Driver selection and qualification: Companies must make driver selection and qualification critical to success. Place an emphasis of hiring the right person for the job. Ensure that the applicant understands the job requirements and expectations including any physical qualifications for the position. Ensure that the applicant meets all mandatory and legal requirements. Investigate any gaps in employment. Ensure that each applicant completes a formal application and signs a release to permit the company to obtain their driving records from the Department of Motor Vehicles. Conduct substance abuse testing and check all references.
- Driver training: Driver training can take several forms. Many insurance carriers provide training to the fleet or safety managers. In effect, they train the trainer, who in turn trains the drivers. Some carriers offer training referred to as commentary class. The driver spends time in a classroom setting and then applies the concepts learned to a real-life road test. The trainer sits in the passenger seat with a scorecard and takes notes to make sure the trainee is verbalizing appropriate defensive driving decisions. Some safety councils provide training sessions and even specialized training classes.
- Supervision: The effective supervision of drivers poses the greatest challenge to the fleet manager. Some organizations use *how's my driving* bumper stickers encouraging reporting of erratic driving. The information reported can be used to determine trends or document multiple reports on the same driver.
- Vehicle maintenance: Some experts indicate that about 90% of accident investigations reveal that a human serves as one of the primary causes. Proper vehicle maintenance and documentation is critical. Drivers must use a vehicle inspection checklist and do a daily inspection. Fleet repair shops must employ qualified mechanics that conduct periodic maintenance. Drivers can perform only as good as their equipment. Poorly maintained equipment is an accident waiting to happen.
- Accident investigation: Organizations must conduct proper investigations to permit analysis of all accident events. This permits safety personnel to document (1) lessons learned, (2) take actions to prevent future events, (3) improve training, and (4) discipline drivers not following procedures.

on restraint systems, impaired driving, aggressive driving, distracted driving, journey management, and fatigue management. ANSI Z15.1 also places an increased emphasis on the vehicle acquisition, inspection, and maintenance. The standard recommends that organizations develop written motor vehicle safety policies to meet organizational needs.

HELICOPTER SAFETY (1910.183)

Hospital staff accessing the hospital helipad risk exposure to equipment hazards associated with helicopters, such as the tail rotor and the main rotor system. These blades can injure or kill an unaware or uneducated staff member. Hats, loose clothing, gloves, etc., can be sucked into the engine air intake fans and cause the helicopter to malfunction and potentially crash. Limit access in this area to staff trained in helicopter equipment hazards. Do not administer CPR to patients on transport carts while the carts remain under the helicopter blade. This may elevate height of staff member to the extent that the staff member could be hit by the helicopter blades. When in the helicopter area, properly secure all items such as loose clothing, hats, gloves, and scarves. Avoid the tail rotor area and helicopter blade area. Elevated noise levels can pose an additional risk to workers if unable to communicate or warn others of potential dangers or risky situations. Provide appropriate equipment to protect the hearing of staff. Use aviation helmets that include special hearing protection and communication systems to enable staff to communicate through the helmets. High winds generated by the helicopter blades can throw loose items or trash at employees and cause them injury. Good housekeeping shall be maintained in all helicopter loading and unloading areas. Keep

helipad area free from garbage, litter, or other debris. Properly secure all items such as loose clothing, hats, gloves, and scarves before entering the helipad area. Use appropriate eye and face protection. Workers can experience possible musculoskeletal disorders from lifting and moving patients to and from helicopter to carts or gurneys. Use ergonomic equipment to minimize employee lifting and/or twisting. Provide a moveable and adjustable stretcher inside the helicopter to avoid employee twisting and minimize lifting. Provide a cart to drive patients to the emergency room. Employee exposure to fueling hazards such as fire or explosions that can occur from sparks or matches in the helipad area is an additional risk. Never permit smoking in helipad areas. Attach a grounding cable to the helicopter while fueling to prevent sparks.

CONTRACTOR AND CONSTRUCTION SAFETY

Healthcare construction continues across the country as many healthcare organizations seek to build, improve, or expand campus facilities. Healthcare organizations must ensure that all contractors make safety a priority during the duration of any project. Most of the work fatalities reported to OSHA in recent years relate to construction project accidents or mishaps. Contractors must ensure compliance with applicable safety regulations and facility requirements. Contracts require adherence to federal, state, and local safety, health, and environments codes and regulations. Contractors must provide site workers with the proper training, health screening, medical examinations, and appropriate PPE. Require contractors to develop a comprehensive written construction safety and health plan. Ensure that all contracts contain a provision requiring the *parties* to execute and sign an acceptable *reciprocal safety* agreement. The healthcare organization must provide guidance to the general contractor about mandated accreditation and statutory safety requirements. Ensure that the general contractor responds immediately to any reports of unsafe behaviors, hazardous situations, and safety standard deviations. Contractors must correct each situation immediately. When planning for new, altered, or renovated space, hospitals should use design criterion published in state regulations or Guidelines for Design and Construction of Hospitals and Healthcare Facilities, published by the AIA. When the earlier regulations and guidelines do not meet the proposed design, hospitals must follow reputable standards and guidelines that provide equivalent design criteria. Hospitals should conduct a preconstruction risk assessment for air quality requirements, infection control, utility requirements, noise, vibration, and other hazards that affect care, treatment, and services prior to any demolition, construction, or renovation.

The organization should inform contractors and project management teams about environmental and safety provisions specified in the contract. Each healthcare organization should also designate someone to monitor contractor safety. Refer concerns about safety or compliance to appropriate leaders for resolution. The safety director must ensure that contractors obtain required permits, complete a safety report on a weekly basis, communicate life safety issues daily, and coordinate any safety issues that arise. The organization should ensure the inclusion of health and safety requirements in any contract. The contracting company or person designated to ensure site safety must ensure compliance with contractual safety agreements. Explain the requirement that the site safety representative must conduct regular safety inspections of all site areas, materials, equipment, and employee competency. During the preconstruction meeting, address the following safety-related issues: (1) dust and infection control measures, (2) adequacy of the site- specific safety plan, and (3) the availability of SDS. During the meeting, the organization must make the contractor aware of any hazards present at the work site not controlled by the contractor. The healthcare organization must provide written procedures for lockout/tag out, welding or brazing, permit confined space entry, other permit processes, fire safety, emergency procedures, blood-borne pathogens exposure, smoking policies, and security plans. Make sure the contractor understands the need to adhere to the provisions of NFPA 101 at all times.

OSHA Construction Standards (29 CFR 1926)

OSHA standards address a variety of work and processes that occur in residential to commercial construction. Construction employers must comply with these standards and related general industry standards that also apply. The OSHA general industry standards (29 CFR 1910) and construction standards (29 CFR 1926) function as separate standards with some notable differences. There exist differences between standards in the areas of fall protection, confined space, GFCI requirements, PPE, stairways and ladders, fire extinguishers, accident prevention signs/tags, eye wash stations, and illumination requirements.

Healthcare Construction Site Safety Issues

Perimeter fences that block sidewalks must contain adequate signs directing pedestrian traffic to a safe walkway. Place primary signs on the perimeter fence. However, use other signs to communicate other safety-related information to pedestrians. Inform contractors to keep all corridors and exit doors clear at all times. Keep all external exit ways, walks, and drives free from debris, material, tools, and vehicles. Contractors must conduct all safety training and education of their employees. Many healthcare organizations may require some construction workers to attend facility-conducted sessions.

During the project, contractors must protect smoke detectors in work areas to prevent false alarm incidents. Hold contractors responsible for false fire alarms generated by dust traveling beyond inadequate protection barriers. Contractors must obtain facility approval before turning off existing or newly installed fire alarm systems. Require contractors to follow established procedures for utility outages and any costs incurred by the facility for response to a false alarm. Ensure the uncovering and testing of all protected smoke detectors. Ensure use of a temporary alarm method whenever any fire-related alarm system is disabled or impaired. Site project managers must conduct fire inspection surveys and provide the facility with a daily report of the findings. The contractor must take responsibility for the monthly inspection and/or testing of temporary fire systems including portable fire extinguishers. Contractors working in occupied buildings must obtain formal approval before conducting hot work tasks. Define hot work as any operation with open flames or tasks that generate heat and/or sparks. Hot work includes brazing, cutting, grinding, soldering, pipe thawing, torch-applied roofing, and cad welding. Contractors working in a facility should use the hot work permit issued by the healthcare organization. Contractors must follow the provisions of the site-developed hazard communication plan. When contractors work in facility locations, the healthcare organization must provide information about hazardous materials as needed. Contractor personnel must leave chemicals or other hazardous materials on the site unless approved in advance by the organization. Hazardous materials left on site must be secured with proper secondary containment provisions. Contractors must provide written information about the hazardous materials to the healthcare organization. Consider compressed gas cylinders as hazardous. Contractors must adhere to standard practices outlined in Compressed Gas Cylinder Association pamphlets. Contractors must ensure the use of appropriate barriers around cranes and material hoists to protect pedestrian and vehicular traffic in the area. Provide appropriate flag personnel to warn pedestrians and vehicles that a crane is operating and moving in the vicinity. Contractors must adhere to the provisions of their own lockout/tag-out procedures. However, in situations that pose a danger to facility personnel, contractors must follow the organization's procedures. Contractors should supply equipment with a hasp that can accommodate multiple locks. Before beginning an excavation project, contractors must notify the organizational construction safety coordinator. The coordinator will contact local sewer, cable, gas, telecommunications, electric, and water providers. Establish the exact location of underground utilities before proceeding. Contractors must provide barriers for any open excavation to protect pedestrians and vehicular traffic. Determine walkway closures and post signs at a point nearest the closure. Contractors must follow their own confined space entry procedures and

training as required by 29 CFR 1910.146 and 1926.21. All equipment required to provide a safe entry, rescue, and to limit access to only authorized personnel must be provided by the contractor. Scaffolding must meet the requirements of 29 CFR 1926 (Subpart L) and/or 29 CFR 1910.28. The contractor must employ a *competent person* to approve the initial scaffolding plan, initial setup, and provide periodic inspection.

Healthcare Construction Site Hazardous Waste Issues

Contractors must provide the organization with a summary listing of projected and possible types of hazardous waste. Contractors must meet the requirements of the RCRA. Contractors retain responsibility for all hazardous waste generated. They must meet provisions of other local, state, and federal waste disposal requirements. Contractors needing to store hazardous materials temporarily on site must adhere to the proper labeling of containers and tanks, ensuring adequate secondary containment, segregating of incompatible material, and conducting/documenting weekly inspections of all storage areas. Contractors must maintain an adequate contingency plan to address releases, spills, and fires. Contractors must take appropriate precautions when dealing with asbestos-containing materials, lead-based paint surfaces, radioactive materials, mercury-containing products, and PCB-containing equipment or transformers. In most jurisdictions, grading, clearing, excavation, and other earth-moving tasks require a storm water permit to prevent water pollution. Check with the state environmental agency for details about permits.

WEATHER-RELATED SAFETY

Hot Weather Safety

OSHA and NIOSH provide excellent information on worker exposure to heat on their respective websites. Refer to the OSHA/EPA booklet entitled *A Guide to Heat Stress in Agriculture* for additional prevention guidance. The wet bulb globe temperature (WBGT) index remains a very common method for measuring heat exposure. This method combines the effects of radiant heat and humidity with the dry bulb temperature. Consider heat stroke as a serious condition that results from the body's failure or inability to cool. The condition characterized by hot dry skin, dizziness, headache, thirst, nausea, cramps, and mental confusion can cause loss of consciousness. A victim's body temperature can exceed 105°F. Take quick action by moving the victim to a cool area and work to lower body temperature by soaking the victim with water and fanning vigorously. Get medical treatment immediately. Heat exhaustion occurs when a person becomes dehydrated. The symptoms of heat exhaustion present as similar to heat stroke but not as severe. Move the victim to a cool area and give him or her large amounts of liquids. Severe cases may require the attention of a physician. Some other heat-related conditions include heat cramps, fainting, and heat rashes. Schedule heavy work early in the day and require workers to take frequent breaks in cool areas. Provide adequate liquids at the work site to help keep workers hydrated. Isolate, enclose, and/or insulate hot equipment. Remove heat from work areas by mechanical means. Install reflective shielding materials where appropriate. Provide fans in hot areas to promote sweat evaporation. Ensure that break areas and lunchrooms remain cool. Train workers to recognize heat-related symptoms.

Cold Weather Safety

Prolonged exposure to freezing temperatures can result in health problems as serious as trench foot, frostbite, and hypothermia. When body temperature drops even a few degrees below its normal temperature of 98.6°F, the blood vessels constrict, decreasing peripheral blood flow to reduce heat loss from the surface of the skin. The four environmental factors that contribute to cold-related stress include low temperatures, high/cool winds, dampness, and cold water. Wind chill, a combination

of temperature and velocity, presents a challenge to those working outside. Taking certain drugs or medications such as alcohol, nicotine, caffeine, and medication can inhibit the body's response to the cold or impairs judgment. Having a cold or certain diseases, such as diabetes and heart, vascular, and thyroid problems, may make a person more susceptible to the winter elements. Becoming exhausted or immobilized, especially due to injury or entrapment, may speed up the effects of cold weather. Use insulated footgear to protect against cold and dampness. Keep a change of clothing available in case work garments become wet. Cold weather clothing remains the most important aspect of fighting the elements. Wear at least three layers of clothing consisting of an outer layer to break the wind and allow some ventilation, a middle layer of wool or synthetic fabric to absorb sweat and retain insulation, and an inner layer of cotton or synthetic weaves to allow ventilation.

REVIEW EXERCISES

5.1 List at least four changes made in the 2012 version of NFPA 99.
5.2 List two standards that address slip and trip hazards.
5.3 What should be the ideal height of a wet floor sign?
5.4 How many handrails should be present for stairs less than 44 in. wide?
5.5 Define the concept known as *SCOF.*
5.6 List at least five factors to consider when selecting new flooring materials.
5.7 What standard addresses the height and width of the letters found on safety signs?
5.8 What standards organization publishes the elevator safety code?
5.9 What is the maximum step spacing distance for ladders?
5.10 What organization publishes a standard that addresses reinforced plastic ladders?
5.11 List seven types of information that marked on ladders.
5.12 When working from a scaffold, what's the minimum working distance from electrical power lines?
5.13 List the two OSHA mandated options for guarding a skylight.
5.14 List the five basic rules for tool safety.
5.15 How does OSHA classify three basic areas requiring safeguarding of dangerous equipment?
5.16 List the seven elements of the hierarchy of guarding equipment.
5.17 List the two primary NFPA codes that contain special electrical requirements for healthcare facilities?
5.18 List the five factors that can affect shock severity.
5.19 List six electrical-related standards that would apply to healthcare facilities.
5.20 Describe the purpose of any lockout procedure.
5.21 List the five basic characteristics that could apply to a *permit-required* confined space.
5.22 Define the following noise-related terms:
- Frequency
- Amplitude
- Decibel scale

5.23 List at least five *pipe contents color* schemes.
5.24 Define the following *ventilation terms*:
- Anemometer
- Capture velocity
- Dilution ventilation

5.25 What percentage of all IAQ problems result from insufficient or ineffective ventilation?
5.26 Describe the basic OSHA training requirements for operators of powered industrial trucks.
5.27 List the key elements of a fleet safety management function.

6 Emergency Management

INTRODUCTION

The International Board for Certification of Safety Managers developed the Certified Healthcare Emergency Professional (CHEP) credential in 2008. The board believes that CHEP personnel can help to standardize management and system principles in the field of emergency planning, response, mitigation, and recovery. CHEP personnel working in healthcare facilities can lead the way by promoting healthcare emergency management as a *true* profession. Many of the CHEP credentialed individuals working in nonclinical and support areas understand the importance of coordinating healthcare emergency planning efforts. We can define an emergency as an unexpected or sudden event that significantly disrupts a healthcare organization's ability to provide care or significantly changes or increases the demand for services. Emergencies can result from human-made or natural events or a combination of both. A disaster-type emergency due to its complexity, scope, or duration can threaten the organization's capabilities. These events can require outside assistance to sustain patient care activities and facility safety or security. Healthcare organizations need to engage in planning activities to prepare a comprehensive emergency operation plan (EOP).

Healthcare facilities must prepare to respond to and recover events using the all-hazards planning approach. Hospitals must plan to maintain a medical surge capacity and capability that will support the community. Use a multidisciplinary process when conducting a healthcare facility risk assessment for emergency response planning. The healthcare hazard vulnerability analysis (HVA) must consider the impact of realistic emergency or disaster incidents. These incidents could include hazardous materials releases, industrial and chemical accidents, transportation accidents, natural disasters, and even bioterrorism events. The HVA process must also assess the probability of each type of event, the risks involved, and the organization's level of preparedness to respond. Emergency management consists of mitigation, preparedness, response, and recovery phases. These four phases occur over time with mitigation and preparedness generally occurs before an emergency. Response and recovery phases usually occur during or after an emergency event.

JOINT COMMISSION REQUIREMENTS

The EOP identifies the individuals with the authority to activate the response and recovery phases of the emergency response. The EOP must identify alternative sites for care, treatment, and services that meet the needs of the hospital patients during emergencies. The Joint Commission spells out emergency management related responsibilities in its Emergency Management Standard.

The Joint Commission Standard provides excellent guidance for accomplishing actions to support the four phases of emergency management. The Joint Commission allows hospitals to develop a single HVA that accurately reflects all sites of the hospital, or the organization can develop multiple HVAs. Some remote sites may be significantly different from the main hospital site. Community partners may include other healthcare organizations, public health departments, vendors, community organizations, public safety and public works officials, representatives of local municipalities, and other government agencies. The hospital must communicate its needs and vulnerabilities to community emergency response agencies and identify the community's capability to meet its needs. This communication and identification should occur at the time of the hospital's annual review of the EOP and whenever its needs or vulnerabilities change. The hospital HVA provides the basis for defining mitigation activities needed to reduce the risk of damage

during an emergency. Hospital leaders, including members of the medical staff, should participate in planning activities prior to developing an EOP. Ensure that the plan addresses mass casualty situations including terrorist events of a chemical, biological, or radiological nature. The plan should consider risks and their potential liabilities. Coordinate plans for maintaining a predictable environment of care during any emergency situation. Develop plans to guide response for any situation. The plan must provide for a command structure to assess situations, coordinate actions, and make decisions. Plan to deal with any situation that significantly disrupts the environment of care or patient treatment.

Planners should reference NFPA 1600, NFPA 99, 29 CFR 1910.138, 40 CFR 264, applicable accreditation standards, and DHS publications for additional information and guidance. Provide realistic training and education for all emergency personnel. Ensure all staff members understand their roles and responsibilities. Validate their understanding during readiness drills. Educational sessions can help reduce fear or anxiety among hospital personnel responding to terrorism-type events. Train medical and hospital staff to report unexpected illness patterns to appropriate agencies. When possible ensure a physician meets with the local media to provide updated information about medical issues. Make the public aware of any changes in hospital treatment procedures. Ensure the incident command integrates into the community's command structure. The incident command structure should provide scalable mechanisms to better respond to different types of emergencies. The hospital should maintain an inventory of the resources and assets. These assets should include but never be limited to PPE, water, fuel, and medical, surgical, and medication-related resources and assets.

The local EOP must guide the coordination of communications, resources, assets, safety and security, and staff responsibilities. The plan must address patient, clinical, and support activities during an emergency. Emergencies may vary, but the effects on these organizational functions may be similar. This *all-hazards* approach supports a general response capability that sufficiently nimble to address a range of emergencies of different duration, scale, and cause. The EOP permits response procedures to address prioritized emergencies. A comprehensive but flexible EOP can guide decision making at onset and as a situation evolves. Response procedures should address the following: (1) maintaining or expanding services, (2) conserving resources, (3) curtailing services, (4) supplementing resources from outside the local community, (5) closing the hospital to new patients, and (6) staged evacuation or total evacuation. The EOP describes the processes for initiating and terminating the hospital's response and recovery phases of an emergency, including under what circumstances these phases are activated. The EOP identifies hospital's capabilities and establishes response procedures for when the hospital can't be supported by the local community. Hospitals should plan to stockpile enough supplies to last for 96 h of operation. The EOP should describe the recovery strategies and actions designed to help restore the systems that are critical to providing care, treatment, and services after an emergency.

Develop contingency plans to ensure the availability of critical supplies. Examples of resources and assets that might be shared include beds, transportation, linens, fuel, PPE, medical equipment, and supplies. The EOP describes the hospital's arrangements for transporting some or all patients, their medications, supplies, equipment, and staff to an alternative care site when environments can't support care, treatment, and services. The EOP also addresses the arrangements for transferring pertinent information, including those of essential clinical and medication related, with patients moving to alternative care sites. The EOP should describe the hospital's arrangements for internal security and safety. The EOP should also address the roles that community security agencies will play in supporting security activities. The EOP must also describe how the hospital will manage hazardous materials and wastes. Plan to address radioactive, biological, and chemical isolation or decontamination activities. The Joint Commission requires hospital to provide safe and effective patient care during an emergency. Document staff roles and responsibilities are included in the EOP. Due to the dynamic nature of emergencies, effective training

prepares staff to adjust to changes in patient volume or acuity. The EOP should describe the process for assigning staff to all essential staff functions.

The hospital must communicate, in writing, with each of its licensed independent practitioners regarding his or her roles in emergency response and to whom they report. The Joint Commission provides guidance to its accredited facilities on how to grant disaster privileges to volunteer licensed independent practitioners when the EOP has been activated. The medical staff must describe how it will oversee the performance of volunteer licensed independent practitioners granted disaster privileges. Before determining a volunteer practitioner as eligible to function as a volunteer licensed independent practitioner, the hospital should obtain his or her valid government-issued photo identification and at least one of the following: (1) current picture identification card from a healthcare organization that clearly identifies professional designation; (2) current license to practice; (3) primary source verification of licensure; (4) identification indicating that the individual is a member of a Disaster Medical Assistance Team, the Medical Reserve Corps, the Emergency System for Advance Registration of Volunteer Health Professionals, or other recognized state or federal response organization or group; (5) identification indicating that the individual possesses granted authority by a government entity to provide patient care, treatment, or services in disaster circumstances; or (6) confirmation by a licensed independent practitioner privileged by the hospital or by a staff member with personal knowledge of the volunteer practitioner's ability to act as a licensed independent practitioner during a disaster. During a disaster, the Joint Commission requires that medical staff oversee the performance of each volunteer licensed independent practitioner. Primary source verification of licensure occurs as soon as a disaster becomes under control or within 72 h from the time the volunteer licensed independent practitioner presents himself or herself to the hospital, whichever comes first. If primary source verification of a volunteer licensed independent practitioner's licensure cannot be completed within 72 h of the practitioner's arrival due to extraordinary circumstances, the hospital documents all of the following: (1) reasons it could not be performed within 72 h of the practitioner's arrival; (2) evidence of the licensed independent practitioner's demonstrated ability to continue to provide adequate care, treatment, and services; or (3) evidence of the hospital's attempt to perform primary source verification as soon as possible.

The Joint Commission requires hospitals to conduct an annual review of its planning activities to identify such changes and support decision making regarding how the hospital responds to emergencies. The hospital must also conduct an annual review of its risks, hazards, and potential emergencies as defined in its HVA. The hospital must conduct an annual review of the objectives and scope of its EOP. The findings must be documented.

Facilities must conduct exercises to assess EOP appropriateness, adequacy, and the effectiveness. Key areas to evaluate include logistics, human resources, training, policies, procedures, and protocols. Exercises should stress the limits of the plan to support assessment of preparedness and performance.

The design of the exercise should reflect likely disasters but should test the organization's ability to respond to the effects of emergencies on its capabilities to provide care, treatment, and services. For each site of the hospital that offers emergency services or a community-designated disaster receiving station, at least one of the two required emergency response exercises or drills must include an escalating event in which the local community is unable to support the hospital. Tabletop sessions are acceptable in meeting the community portion of this exercise. For each site of the hospital with a defined role in its community's response plan, at least one of the two emergency response exercises must include participation in a community-wide exercise. Tabletop sessions meet only community portions of the exercise. Emergency response exercises incorporate likely disaster scenarios that allow the hospital to evaluate its handling of communications, resources and assets, security, staff, utilities, and patients. Staff in freestanding buildings classified as business occupancies that neither offer emergency services nor are community designated as disaster-receiving

stations need to conduct only one emergency management exercise annually. Tabletop sessions, though useful, are not acceptable substitutes for these exercises.

The hospital should designate individuals to monitor drill or exercise performance and document opportunities for improvement. This person must be knowledgeable in the goals and expectations of the exercise and may be a staff member. Hospitals may use observations of those involved in the command structure as well as the input of those providing services during an actual emergency. The hospital must evaluate all emergency response exercises and all responses to actual events using a multidisciplinary process. Communicate all identified deficiencies and opportunities for improvement to the improvement team responsible for monitoring environment of care issues. The hospital must modify the EOP based on findings of emergency exercises and actual events.

The facility must maintain a written inventory of utility system components considering risks for infection, occupant needs, and systems critical to patient care. The facility must identify in writing inspection and maintenance activities for operating components. The facility must identify the intervals for inspecting, testing, and maintaining all operating utility systems using manufacturer recommendations, risk levels, or hospital experience. The facility must take actions to minimize pathogenic biological agents in cooling towers, domestic hot and cold water systems, and other aerosolizing water systems.

The facility must map and document distribution of its utility systems. The facility must also label utility system controls to facilitate partial or complete emergency shutdowns. The facility must also develop written procedures for responding to utility system disruptions.

EMERGENCY ELECTRICAL POWER SOURCES

The hospital must provide emergency power for exit route and exit sign illumination as required by NFPA 101. The hospital must also provide emergency power for emergency communication systems as required. The hospital must provide emergency power for at least one elevator for nonambulatory patients. The hospital is required to support equipment that could cause patient harm when it fails. The types of equipment would include life support systems, blood, bone, and tissue storage systems. Other support equipment includes medical air compressors and medical/surgical vacuum systems. The hospital must ensure that emergency power remains available for operating rooms, recovery rooms, obstetrical delivery rooms, nurseries, and urgent care areas. At 30-day intervals, the facility must perform a functional test of battery-powered lights required for egress for a minimum duration of 30 s. Every 12 months, the hospital must perform a functional test of battery-powered lights required for egress for 1.5 h. The hospital can choose to replace all batteries every 12 months and, during replacement, can perform a random test of 10% of all batteries for 1.5 h. Each quarter, the hospital must perform a functional test of stored emergency power supply systems (SEPSS) for 5 min or as specified for its class. The hospital must also perform an annual test at full load for 60% of the full duration of its class. SEPSS are intended to automatically supply illumination or power to critical areas and equipment essential for safety to human life. Class of equipment defines the minimum time for which the SEPSS is designed to operate at its rated load without being recharged. Refer NFPA 111 for complete information.

Twelve times a year, at intervals of not less than 20 days and not more than 40 days, the facility must test each emergency generator for at least 30 continuous minutes. The emergency generator tests will be conducted with a dynamic load that is at least 30% of the nameplate rating of the generator or meets the manufacturer's recommended prime movers' exhaust gas temperature. If the facility does not meet either the 30% of nameplate rating or the recommended exhaust gas temperature during any test, then they must test each emergency generator once every 12 months using supplemental dynamic or static loads of 25% of nameplate rating for 30 min, followed by 50% of nameplate rating for 30 min, followed by 75% of nameplate rating for 60 min, for a total of 2 continuous hours. Twelve times a year, at intervals of not less than 20 days and not more than 40 days, the hospital tests all

automatic transfer switches. At least once in every 36 months, facilities with a generator providing emergency power must test each emergency generator for a minimum of 4 continuous hours.

EMERGENCY WATER SUPPLY PLANNING

In order to maintain daily operations and patient care services, healthcare facilities need to develop an Emergency Water Supply Plan (EWSP) to prepare for, respond to, and recover from a total or partial interruption of the facilities' normal water supply. Water supply interruption can be caused by several types of events such as a natural disaster or a failure of the community water system, construction damage, or even an act of terrorism. Because water supplies can fail, it is imperative to understand and address how patient safety, quality of care, and the operations of your facility will be impacted. What follows are a few examples of critical water usage in a healthcare facility that could be impacted by a water outage. Water may not be available for hygiene, drinking, food preparation, laundry, central services, dialysis, hydrotherapy, radiology, fire suppression, water-cooled medical gas, suction compressors, HVAC operation, decontamination and hazmat response. A healthcare facility must be able to respond to and recover from a water supply interruption. A robust EWSP can provide a road map for response and recovery by providing the guidance to assess water usage, response capabilities, and water alternatives. The EWSP will vary from facility to facility based on site-specific conditions and facility size. Regardless of size, a healthcare facility must develop an effective EWSP to ensure patient safety and quality of care while responding to and recovering from a water emergency.

Healthcare facilities are a critical component to a community's response and recovery following an emergency event. A number of incidents could impact the water supply of a healthcare facility. In the case of some natural disasters, such as a hurricane or flood, a facility may know days ahead of the risks. These events allow more time for preparation, which typically speeds up response. Earthquakes, tornadoes, or external/internal water contamination can occur with little or no warning. Joint Commission standards address the provision of water as part of the facility's EOP. CMS conditions for participation/coverage also require healthcare facilities to make provisions in their preparedness plans for situations in which utility outages of gas, electric, or water may occur. Incorporate the principles and concepts of the plan into the overall facility EOP. It remains vital that the emergency water supply receive an annual review. Exercise and revise the plan on a regular basis or at least annually. The process of developing an emergency water supply plan for a healthcare facility will depend on the size of the facility and will require the participation and collaboration of both internal and external stakeholders.

For a small facility, of less than 50 beds, where one individual performs multiple functions, the process may be relatively simple, with a single individual coordinating the development of the EWSP. However, for a large hospital of several hundred beds, the process of developing the plan will be more complex.

Step 1: Assemble the facility EWSP team and the necessary background documents. Begin by identifying appropriate staff members needed for the facility team that will assume responsibility for plan development. Develop and publish a team contact list. Expertise from a range of individuals will ensure a comprehensive and robust plan. External community partners who would play a role in the response should be invited and encouraged to participate in the plan development process.

Step 2: Conduct a water use audit. The water use audit will help identify emergency conservation measures that could be used. This audit often can identify conservation measures that are easy and simple to implement, resulting in less water use and lower water bills for the facility.

Step 3: Analyze alternative emergency water supplies.

Step 4: Develop and exercise your plan based on an analysis of the water use audit and the availability of alternate emergency water supplies. Develop a written EWSP for the facility. Review and exercise the plan annually.

Plan Elements

- Facility description should include the following: type and location of facility, type of population served, essential services, types of care offered, size of facility, and the number/distribution of beds.
- Provide a clear description of facility water sources, supplier, supply mains, and corresponding meters for water entering the facility.
- Describe water demands during normal usage and during potential reduced usage during an emergency. This provides detailed information about how to understand water usage patterns by means of a water use audit.
- Obtain facility drawings, diagrams, and/or photos showing all water mains, valves, and meters for the facility. These drawings, diagrams, and/or photos should accurately show main lines for all utilities including water, sewer, gas, electric, cable television, and telephone. Describe their physical relationship to each other.
- Develop listings for all equipment, processes, and materials including high-usage areas such as HVAC systems, food preparation, laundry, hemodialysis, laboratory equipment, and water-cooled compressors that use water. Provide documentation about the location of all plumbing fixtures.
- Create a backflow prevention plan to prevent possible reversal of water flow and resultant water contamination that can occur from unwanted pressure changes.
- The maintenance plan should describe valve exercising such as testing the operation of water valves. Ensure that valve exercising routinely involves open and closing water valves to ensure proper operation.
- Obtain copies of all contracts and other agreements related to supplying emergency water and providing any equipment or other supplies that would be used to produce/supply an emergency water supply such as bottled water, tankers, mutual aid agreements, and portable water treatment units.
- Develop a menu of emergency water supply alternatives identified as a result of the analysis of the alternatives.
- Design operational guidelines and protocols that address treatment processes and water quality testing, if treatment and/or disinfection of water are included as part of the plan.
- Establish a timeline during an emergency and include the EWSP as an integral part of the EOP and ICS activation process.

KEY EMERGENCY MANAGEMENT CONCEPTS

Standardization

Standardized processes and methods involve well-described, reproducible, and usually sequential steps to accomplish a stated objective. The EOP guides response and recovery using standardized formats and the ICS. Standardized processes can be used throughout all four phases of emergency management. Standardized templates from the ICS can be used for developing incident action plans, conducting briefings, and using situation reports.

All-Hazards Planning

All-hazards planning is based upon an HVA. The FEMA Comprehensive Preparedness Guide 1010, Version 201, describes emergency operations planning issues. The most successful organizations do constant self-evaluation. Organize EOPs around functions and not particular hazards. Response-generated demands include good decision making, reliable communication, and interagency coordination.

Understanding System Thinking

The many things taking place within an environment can form a larger pattern as distinguished from any of the individual parts. Organizational systems are recognized as having interdependent relationships with many defined components. The subsystems or components can include the external environment, the individuals inside the system, and relationships that generate cooperation or conflict. Open systems recognize that goals of individual members can be as important as any singular organizational purpose declared by leadership. System theory focuses on the complexities of these open systems and the necessity for organizations to adapt to changing environments. Competencies must be described in the context of the organizational structures, processes, procedures, and relationships. Define competencies related to emergency response and recovery operations context of conditions and response systems. A system can consist of four things: (1) objects are the parts, elements, or variables within the system; (2) attributes are the qualities or properties of the system and its objects; (3) internal relationships between or among its objects; and (4) external relations with the environment and its objects.

Hospital Evacuation Planning

Develop plans for evacuating the facility either horizontally and/or vertically. Also plan to identify care providers and other personnel during emergencies. Create a priority listing of institutions or facilities to which the patients or residents will be evacuated. Specify the locations that will serve as a staging area pending further decisions. Develop procedures for obtaining an accurate account of personnel after a completion of the evacuation. Designate assembly areas where personnel should gather after evacuating. Establish a method for accounting for nonemployees such as suppliers and visitors. Establish procedures for further evacuation in case the incident expands. The ADA defines a disabled person as anyone with a physical or mental impairment that substantially limits one or more major life activities. Emergency planning priorities must consider disabled visitors and employees.

Community Involvement

FEMA has developed a publication titled *A Guide to Citizen Preparedness* (*FEMA Publication H-34*). The guide contains facts on disaster survival techniques, disaster-specific information, and how to prepare for and respond to both natural and man-made disasters. Healthcare organizations must adopt a community-wide perspective when planning for mass casualty incidents. Senior leaders must maintain a good relationship with response agencies in the community including other area healthcare facilities. Clinics and nursing homes may play key roles in large disasters. Public health departments will usually institute appropriate public health interventions including immunizations and prophylactic antibiotics. Establish working relationships with all responders including local emergency management agencies, law enforcement personnel, and local fire officials. Coordinate the healthcare emergency plan with the official responsible for area-wide disaster planning.

Partnership for Community Safety

The Partnership for Community Safety: *Strengthening America's Readiness* serves as a new coalition formed to advocate for strengthening community readiness for biological, chemical, or nuclear terrorism and other disasters. The Partnership for Community Safety will call on federal policymakers to support and sustain comprehensive readiness efforts in the nation's public health departments, emergency departments, hospitals, fire services, ambulance and emergency medical services (EMS) organizations, medical education institutions, and the nursing profession.

While proposals pending in Congress represent important first steps, the partnership will advocate for a comprehensive and sustained approach to community readiness. Partnership members said the tragic events of September 11 and the recent anthrax incidents demonstrate the urgency for strengthening community preparedness plans to protect the public from acts of terrorism. In addition to working together to help shape national policy, the new alliance will promote collaboration among its members to retool disaster plans and focus on the need to increase capacity for frontline responders to prepare for the new challenges of terrorism. In addition, Partnership members will work to reduce duplication of effort and develop a *bank* of best practices through exchanging ideas and highlighting model plans. The partnership also plans to educate the public about local readiness issues. *The Partnership for Community Safety: Strengthening America's Readiness* represents firefighters, paramedics and other EMS professionals, emergency physicians, all other physicians, hospital officials, medical education professionals, public health officials, nurses, and state regulatory agencies in the United States.

Hospital Roles in Community Emergencies

Healthcare organizations must work to help assess community health needs and available resources to treat evacuees from other areas. The organization must determine community priorities as identified in the HVA. Clarify the organization's role during the annual community-wide emergency exercise. Develop plans for coordinating with the media. Establish a media briefing area with established security procedures. Establish procedures for ensuring the accuracy and completeness of all information approved for public release. Provide for decontamination and treatment for any and all victims. Promote a wider level of preparedness in the community by providing low-cost hazard communication or hazardous waste operations and emergency response (HAZWOPER) training for local government and business emergency response personnel. Provide information and services related to emergency preparedness. Participate actively in community planning and preparedness activities.

Healthcare facilities should focus on the following key areas when conducting planning:

Communication—Assess the ability of the organization to maintain communications within the organization and with all appropriate community disaster resource agencies

Resources and assets—Develop plans to access necessary materials, supplies, vendors, community resources, and government support if necessary to sustain operations such as patient care, safety, and medical services

Safety and security—Create contingency plans to ensure the safety and welfare of all patients, staff, and visitors during emergencies and disasters

Staff responsibilities—Design appropriate curriculums to orient, educate, or train staff members about their changing roles and demands during emergency incidents

Utilities management—Establish plans for maintaining key utilities such as drinking water, power sources, ventilation, and fuel supplies

Clinical support activities—Establish clinically coordinated policies and procedures that will ensure quality patient care during extreme emergency conditions when organizational resources are stretched (Table 6.1)

LEGISLATION

FEMA possesses the authority to release resources and supplies during a disaster or emergency declared by the president. FEMA coordinates the federal response through the Federal Response Plan (FRP), which details the roles and responsibilities of federal agencies during national emergencies. If a terrorist event occurs that requires a presidential disaster declaration, FEMA will implement the FRP. FEMA will coordinate its own response activities, including releasing federal

TABLE 6.1
OSHA Emergency Planning Related Standards

- HAZWOPER—29 CFR 1910.120(q)
- Personal protective equipment—29 CFR 1910.132
- Eye and face protection—29 CFR 1910.133
- Respiratory protection—29 CFR 1910.134
- Hand protection—29 CFR 1910.138
- Hazard communication—29 CFR 1910.1200(h)
- Bloodborne pathogens—29 CFR 1910.1030
- Ethylene oxide—29 CFR 1910.1047
- Formaldehyde—29 CFR 1910.1048

pharmaceutical stockpiles. FEMA also coordinates other federal agencies that may provide assistance. Local governments with support from state and federal agencies when appropriate shoulder much of the initial responsibility for providing effective medical response to a terrorist attack. Local public health systems will be called upon to provide protective and responsive medical measures such as patient care, immunizations or prophylactic drug treatments for exposed populations, and decontamination of the environment.

Congress passed the Disaster Mitigation Act (2000), which required that all state, local, and tribal governments meet FEMA standards for disaster mitigation planning to receive grant assistance. Congress passed the Public Health Security and Bioterrorism Preparedness and Response Act (2002).

The act known as the Bioterrorism Act, called for improvement of local state, and hospital preparedness/response to bioterrorism and other public health emergencies. The act also created the position of the assistant secretary for Public Health Emergency Preparedness within DHHS. The act directly influenced hospital emergency management by calling for healthcare personnel to receive training/equipment for use in emergency response. Congress passed the PAHPA in 2006. PAHPA replaced the former assistant secretary with a new ASPR within the DHHS. The act called for the development of a National Health Security Strategy by the DHHS and amended the Public Health Service Act to require DHHS to lead all federal public health and medical responses to public health emergencies and incidents covered by the National Response Plan (NRP). This amendment resulted in the National Disaster Medical System moving from Homeland Security to DHHS. The National Bioterrorism Hospital Preparedness Program moved from the HRSA to ASPR. The act also mandated that state and local governments and other eligible entities (including hospitals) develop and implement emergency management plans consistent with evidence-based benchmarks and/or standards.

DISASTER MANAGEMENT, EMERGENCY MANAGEMENT, AND BUSINESS CONTINUITY

The NFPA 1600 standard was first published on April 1, 2004, and revised in 2007. NFPA issued the 2010 Edition in December 2009. The newly published standard reordered the content of the 2007 version. Chapter 4 was expanded to emphasize the importance of commitment and leadership. Chapter 5 was broken into four chapters dealing with planning, implementation, exercises, and improvement processes. In November 2009, the new NFPA 1600 received certification by the passage of The SAFETY Act. We can best describe the purpose of the standard as to help the disaster management, emergency management, and business continuity communities to cope with disasters and emergencies.

NIMS Healthcare Implementation

Facilities receiving DHHS or ASPR funding will be required to implement and report on all 14 National Incident Management System (NIMS) implementation objectives. The 14 NIMS implementation objectives as follows:

Adoption (*Items 1–2*)

1. Adopt NIMS throughout the healthcare organization.
2. Ensure that federal preparedness awards support NIMS implementation.

Preparedness Planning (*Items 3–4*)

3. Revise and update EOPs, Standard Operating Procedures (SOPs), and standard operating guidelines to incorporate NIMS and NRF components, principles, and policies. Be sure to include planning, training, response, exercises, equipment, evaluation, and corrective actions.
4. Participate in interagency mutual aid and/or assistance agreements to include agreements with public and private sectors and nongovernmental organizations.

Preparedness Training and Exercises (*Items 5–7*)

5. Identify the personnel to complete ICS-100, ICS-200, and IS-700, or equivalent courses.
6. Identify the appropriate personnel to complete IS-800 or an equivalent course.
7. Promote NIMS concepts/principles in all organization-related training and exercises.

Communications and Information Management (*Items 8–10*)

8. Ensure that equipment, communication, and data interoperability are incorporated into the healthcare organization's acquisition efforts.
9. Apply common and consistent terminology as promoted by NIMS including the establishment of plain language communications standards.
10. Utilize systems, tools, and processes that facilitate the collection and distribution of consistent/accurate information during an incident or event.

Command and Management (*Items 11–14*)

11. Manage all emergency incidents, exercises, and preplanned events in accordance with ICS organizational structures, doctrine, and procedures.
12. ICS implementation must include the consistent application of incident action planning and common communications plans if appropriate.
13. Adopt the principle of public information as facilitated by the use of the Joint Information System and Joint Information Center during an incident or event.
14. Ensure that public information procedures and processes gather, verify, coordinate, and disseminate information during an incident or event.

EMERGENCY EXERCISES

Healthcare facilities must test their emergency plan twice annually in response to an actual event of planned exercise. If the facility offers emergency services or participates as a community emergency receiving station, one of the two drills must be an exercise with the influx of patients or simulated patients.

The exercise should evaluate performance if the facility can't get support from community resources. Evaluate all exercises to determine performance and opportunities for improvement. Ensure that the six critical areas listed later are properly monitored. Use a multidisciplinary evaluation process that includes administration, clinical professionals, and support personnel. Communicate strengths and weaknesses to the improvement team. Consider every worker, visitor, or patient as someone needing training, education, or helpful information. Focus on execution, training deficiencies, and problem areas.

Homeland Security Exercise and Evaluation Program

The purpose of the Homeland Security Exercise and Evaluation Program (HSEEP) is to provide common exercise policy and guidance that constitutes a national standard for exercises. HSEEP includes consistent terminology that can be used by all exercise planners, regardless of the nature and composition of their sponsoring agency or organization. The volumes also provide tools to help exercise managers plan, conduct, and evaluate exercises to improve overall preparedness. HSEEP reflects lessons learned and best practices from existing exercises. It can be adapted to the full spectrum of hazardous scenarios and incidents including natural disasters, terrorism, and technological disasters. HSEEP integrates language and concepts from the NRP, NIMS, the National Preparedness Goal, the Universal Task List, the Target Capabilities List, existing exercises, and prevention and response protocols from all levels of government. In the spirit of NIMS, all efforts should be made to ensure consistent use of the terminology and processes described in HSEEP.

Engaging Stakeholders

Broad stakeholder participation also helps to ensure that exercises will be more realistic, encompassing the full spectrum of response disciplines. Exercise managers should identify a wide range of stakeholders and create a database cataloging POCs. This database should contain contact information, areas of expertise, and prior exercise experience. When identifying stakeholders, be sure to consider individuals and organizations with actual incident or event experience.

INCIDENT COMMAND SYSTEM

There are five basic functional areas of management during a major incident including (1) command, (2) operations, (3) planning, (4) logistics, and (5) finance/administration. The system coordinates responses involving multiple jurisdictions or agencies. It retains the principle of unified command for coordinating the efforts of many jurisdictions.

The system must ensure joint decisions in areas such as objectives, strategies, plans, priorities, and communications. The system focuses on responder readiness to manage and conduct incident actions by coordinating before an event. Some benefits include (1) maintaining a predictable chain of accountability, (2) flexible response to specific incidents, (3) improved documentation, (4) common language to facilitate outside assistance, (5) prioritized response checklists, and (6) cost-effective planning (Table 6.2).

Incident Commander Responsibilities

Assign the duties to certain positions and never to specific individuals. The incident commander must maintain emergency command center effectiveness, ensuring communications, and maintaining security. Key duties include providing public information and media releases, coordinating facilities, sheltering, feeding, and counseling as needed. The incident commander must oversee establishing the morgue and making EMS available as needed.

TABLE 6.2
Common ICS Principles

- *Common terminology*: The use of similar terms and definitions for resource descriptions, organizational functions, and incident facilities across disciplines.
- *Integrated communications*: The ability to send and receive information within an organization and externally to other disciplines.
- *Modular organization*: Assets within each functional unit may be expanded or contracted based on the requirements of the event.
- *Unified command structure*: Disciplines and response organizations work through designated managers to establish common objectives and strategies to reduce conflict or duplication.
- *Span of control*: The structure permits each supervisory level to oversee an appropriate number of assets based on size and complexity of the event.
- *Span of control ratio*: Maintaining effective supervision with an element supervising three to seven entities with five being the ideal.
- *Consolidated incident action plans*: Goals, objectives, strategies, and major assignments are defined by the incident commander or by unified command.
- *Comprehensive resource management*: System processes are in place to describe, maintain, identify, request, and track all resources within the system during an incident.
- *Predesignated incident facilities*: Assign locations where expected critical incident-related functions will occur and ensure adequate space and technical support for the assigned function.

Incident Action Planning and Information Assessment

Management by objective can be accomplished through a process known as incident action planning. This process addresses the multiple considerations necessary for establishing and efficiently achieving objectives. Situational awareness refers to a person's knowledge of the situation around the individual or the operating unit. This includes an understanding of the evolving state of the environment. Situation assessment occurs during emergency response and recovery that combines incident geography, topography, weather, hazard, hazard impact, and resource data to provide a balanced knowledge base for decision making.

Multiagency Coordination

The NIMS model defines a Multiagency Coordination (MAC) as a system where resource coordination takes place. MAC entities establish priorities and associated resource allocation. A community's emergency management and public safety incident management must be intertwined with the medical and health planning and response. The medical or health support requirements such as security or transportation should be identified and/or assured through existing local and regional emergency constructs. The physical size, staffing, and equipping of a local government will depend on the size and complexity of the local government and the emergency operations it can expect to manage. Staffing levels can vary with the specific emergency situation. Most of these decisions are beyond the control of healthcare system leaders and the healthcare system emergency managers, but may be influenced by good-faith participation in community preparedness planning.

Managing Complex Incidents

One of the primary tenets of ICS relates to recognizing the many different activities that must occur to successfully manage response to any event. These tasks can be grouped into categories that reflect functional similarities. For instance, all tasks that represent support of the organization's

response through the acquisition and provision of accurate information can be grouped together into one functional group. This approach resulted in the description of five main functional management areas.

Command Function

The command function provides overall direction of the response through the establishment of objectives for the organization to meet. Consider other important management issues:

Safety—Identify and assess hazards to the organization's personnel and develop measures to prevent injury or illness from the hazards.
Liaison—Provide coordination and integration with agencies or organizations external to the response system in question.
Public information—Develop and provide, subject to the incident commander's approval, incident information for both the public and response personnel.
Senior advisors—Additional positions, as designated by the incident commander, to provide needed advice and expertise to the command staff.

Operational Functions

The operations function develops strategies and tactics to achieve command objectives.

Operations in coordination with command sets the goals and objectives of the response for the organization. The planning function supports the response organization by conducting the incident planning activities and by acquiring, processing, documenting, and disseminating all incident-related information. Logistics supports the response organization with facilities, transportation, supplies, equipment maintenance and fuel, food services, communications and IT support, and emergency responder medical services. The combined function of finance and administration support the response organization by tracking incident costs and addressing issues such as reimbursements, claims, and regulatory compliance. Communications and information management functions provide responders and managers in all agencies and jurisdictions with data that help create a common operating picture for a more efficient and effective incident response.

STRATEGIC NATIONAL STOCKPILE

CDC's Strategic National Stockpile (SNS) maintains large quantities of medicine and medical supplies to protect the American public if there is a public health emergency such as a terrorist attack, flu outbreak, or earthquake severe enough to cause local supplies to become diminished. Once federal and local authorities agree that the need for SNS, medicines will be delivered to any state in the United States in time for them to be effective. Each state has a plan to receive and distribute SNS medicine and medical supplies to local communities as quickly as possible. The SNS stockpile contains enough medicine to protect people in several large cities at the same time. Federal, state, and local community planners are working together to ensure that the SNS medicines will be delivered to the affected area to protect you and your family if there is a terrorist attack. Local communities are prepared to receive SNS medicine and medical supplies from the state to provide to everyone in the community who needs them. The SNS consists of a national repository of antibiotics, chemical antidotes, antitoxins, life support medications, IV administration, airway maintenance supplies, and medical/surgical items. SNS can supplement and resupply state and local public health agencies in the event of a national emergency anywhere and anytime within the United States or its territories.

If the incident requires additional pharmaceuticals and/or medical supplies, vendor-managed inventory (VMI) supplies will be shipped to arrive within 24–36 h. If well defined, the agent VMI can be tailored to provide pharmaceuticals, supplies, and/or products specific to the suspected or

confirmed agent(s). In this case, the VMI could act as the first option for immediate response from the SNS program. The first line of support lies within the immediate response 12 h push packages. These are caches of pharmaceuticals, antidotes, and medical supplies designed to provide rapid delivery of a broad spectrum of assets for an ill-defined threat in the early hours of an event. These push packages are positioned in strategically located secure warehouses ready for immediate deployment to a designated site within 12 h of the federal decision to deploy SNS assets. However, SNS does not function as a first response tool.

WEATHER EMERGENCIES AND NATURAL DISASTERS

The Storm Prediction Center (SPC) functions as a part of the National Centers for Environmental Prediction (NCEP) and the National Weather Service (NWS). The SPC works to give timely, accurate forecasts and watch/warning information for severe thunderstorms and tornadoes over the contiguous United States. Heavy rainstorms, heavy snowfall, and fire weather events are also monitored by the SPC. The SPC relays forecasts of severe weather as much as 3 days ahead of time, as well as continually updating that information until the storm event ends. Local NWS offices, emergency managers, TV and radio meteorologists, private weather forecasting companies, the aviation industry, storm spotters, persons in the agricultural industry, and others use information provided by the SPC. All products issued by the SPC are available on the World Wide Web. The Tropical Prediction Center (TPC) functions as a component of the NCEP. It works to save lives, mitigate property loss, and improve economic efficiency by issuing watches, warnings, forecasts, and analyses of tropical weather and increasing the understanding of weather hazards. TPC responsibility includes generating and coordinating tropical cyclone analysis and forecast products for 24 countries in the Americas, Caribbean, and for waters of the North Atlantic Ocean, Caribbean Sea, Gulf of Mexico, and the eastern North Pacific Ocean.

National Oceanic and Atmospheric Administration Weather Radio

In cooperation with the Federal Communication Commission (FCC) Emergency Alert System, NOAA Weather Radio (NWR) serves as a network of radio stations that broadcast continuous weather information direct from NWS offices. The NWR network consists of 850 transmitters that cover all 50 states, adjacent coastal waters, Puerto Rico, the US Virgin Islands, and the US Pacific Territories.

NWR broadcasts NWS watches, warnings, forecasts, and other nonweather-related hazard information 24 h/day. NWR also broadcasts warning and after-event information for natural and environmental hazards, including earthquakes, volcanoes, oil spills, and chemical releases. Weather radios equipped with the special alarm tone feature called Specific Area Message Encoding (SAME) can sound an alert and give immediate information about emergency situations. During an emergency, NWS forecasters will interrupt routine weather broadcasts and transmit a special tone that will activate weather radios in the listening area. When that occurs, the receiver will activate for that message. A warning alarm tone will be heard, followed by an emergency broadcast message. At the end of the message, an end-of-message static burst will be transmitted, and then the NWR broadcast cycle will resume.

Emergency Alert System

The Emergency Alert System (EAS) replaced the Emergency Broadcast System in 1996. The EAS designed by the FCC allows officials to quickly relay emergency information to specific areas. This is an automated system similar to NWR SAME technology. The EAS system is capable of sending information via cable television, satellite, pagers, direct-broadcast satellite, high-definition television, and video dial tone. Backup procedures exist for those areas outside the range of an NWR station.

Local and county emergency operations centers can input messages into the EAS, as well as radio and television stations. FCC rules require that broadcasters monitor at least two independent sources for emergency information to ensure that emergency information gets delivered to viewers and listeners.

Tropical Analysis and Forecast Branch

The Tropical Analysis and Forecast Branch (TAFB) of the TPC provides year-round weather analysis and forecast products for the waters of the eastern North and South Pacific and North Atlantic Basin. Forecast products include the following:

- *High seas forecasts for the tropical and subtropical Atlantic, eastern Pacific, and south Pacific Oceans*: These are updated every 6 h. Topics covered include information about winds, waves, marine, and convection. The forecasts address marine warnings for gale, storm, tropical cyclone conditions, reduced visibility, and other marine hazards.
- *Offshore waters forecasts for the Southwest North Atlantic, Caribbean Sea, and Gulf of Mexico*: These are now-casts through 36-h forecasts (updated every 6 h) and cover marine warnings for gale, storm, and tropical cyclone conditions—as well as information on reduced visibility and other marine hazards.
- *Satellite rainfall estimates*: The TAFB furnishes satellite rainfall estimates for tropical cyclones or other significant convective systems when they threaten land in the Caribbean Region, southeastern United States, or the west coast of Mexico.
- *Tropical/subtropical cyclone position and intensity estimates*: The TAFB provides the National Hurricane Center with position estimates of tropical cyclones every 3 h and intensity estimates every 6 h. The TAFB position and intensity estimates are not available to the public.
- *Gulf of Mexico, Atlantic, and Caribbean wind/wave now-cast and forecast*: The TAFB produces a graphical marine forecast of wind and waves for select points in the Gulf of Mexico, Atlantic, and Caribbean in addition to a forecast of significant storm positions. This information is composed of a now-cast and 24 h forecast (issued four times/day) as well as 48 and 72 h forecasts (issued two times/day).
- *Eastern Pacific wind/wave analysis*: A graphical marine forecast of wind and waves is produced for selected points in the eastern and south Pacific. Products include a now-cast and 24 h forecast (issued four times/day) and 48 and 72 h forecasts (updated two times/day). Wind/wave forecasts are transmitted by radio fax from Pt. Reyes, California, and Honolulu.

Hurricanes

The NWS issues warnings when hurricanes appear to be a threat to the US mainland, Puerto Rico, the Virgin Islands, Hawaii, and the Pacific Territories. As soon as conditions intensify to the tropical storm level even though thousands of miles from the mainland, the storm receives a name, and the Weather Service begins issuing advisories. The advisories are issued every 3 h, or less, as it nears. Location, wind intensity, speed, and direction are given. As a hurricane moves toward the mainland, hurricane watch notices are issued.

Tropical Storm Watch

An announcement that tropical storm conditions exist with sustained winds of 39–73 mph and could hit a specified coastal area within the next 48 h.

Tropical Storm Warning

An announcement that tropical storm conditions (sustained winds of 39–73 mph) are expected somewhere within the specified coastal area within 36 h.

Hurricane Watch

An announcement that hurricane conditions (sustained winds of 74 mph or higher) are possible within the specified coastal area. Because hurricane preparedness activities become difficult once winds reach tropical storm force, the hurricane watch is formally issued 48 h in advance of the anticipated onset of tropical-storm-force winds.

Hurricane Warning

An announcement that hurricane conditions (sustained winds of 74 mph or higher) are expected somewhere within the specified coastal area. Because hurricane preparedness activities become difficult once winds reach tropical storm force, the hurricane warning is formally issued 36 h in advance of the anticipated onset of tropical-storm-force winds.

Inland Tropical Storm Watch

Announcement that tropical storm conditions exist with sustained winds of 39–73 mph and are possible within the specified interior area within 48 h.

Inland Tropical Storm Warning

Announcement that tropical storm conditions exist with sustained winds of 39–73 mph and are expected somewhere within the specified interior area within 36 h.

Inland Hurricane Watch

Announcement that hurricane conditions exist with sustained wind of 74 mph or higher and are possible within the specified interior area. Because hurricane preparedness activities become difficult once winds reach tropical storm force, the hurricane watch is issued 48 h in advance of the anticipated onset of tropical-storm-force winds.

Inland Hurricane Warning

An announcement that hurricane conditions exist with a sustained wind of 74 mph or higher and are expected somewhere within the specified interior area. Because hurricane preparedness activities become difficult once winds reach tropical storm force, the hurricane warning is issued 36 h in advance of the anticipated onset of tropical-storm-force winds.

Thunderstorms

Previously, the NWS issued Severe Thunderstorm Warnings whenever a thunderstorm is forecast to produce wind gusts to 58 mph (50 knots) or greater and/or hail size ¾ in. (penny-size) diameter or larger. Beginning in January 2010, the minimum size for severe hail nationwide increased to 1 in. (quarter-size) diameter. There will not be a change to the wind gust criterion of 58 mph. This change is based on research indicating that significant damage does not occur until hail size reaches 1 in. (quarter-size) in diameter and as a response to requests by core partners in emergency management

and the media. Particularly in areas of the Central United States, the frequency of severe thunderstorm warnings issued for penny-size and nickel size hail might desensitize the public to take protective action during a severe thunderstorm warning. In areas that experimented with changing to the 1 in. hail criterion, media partners stated that their user feedback suggests warnings are now more meaningful. In addition, television networks receive fewer viewer complaints for interrupting programming for nondamaging storms. The emergency management community in those areas agreed that warnings carry more weight, and spotters now concentrate on the more significant events.

Floods

Floods are the most common and widespread of all natural disasters. Most communities in the United States can experience some degree of flooding after spring rains, heavy thunderstorms, or winter snow thaws. Most floods develop slowly over a period of days. Flash floods, however, are like walls of water that develop in a matter of minutes. Flash floods can be caused by intense storms or dam failure. Stay tuned to NOAA Radio and prepare to evacuate. Tune to local radio and television stations for additional information.

Tornadoes

Tornadoes are one of nature's most violent storms. Tornado watches and warnings are issued by the NWS. It's important to stay tuned to local television or radio stations for the current weather conditions, especially when weather conditions are right for generating a tornado. The width of a tornado path ranges generally from 200 yards to 1 mile. They can travel 5–50 miles along the ground at speeds of 30–75 mph. Tornadoes sometimes reverse or move in circles. When a tornado warning is issued, ensure the safety of patients, residents, visitors, and employees. A watch alerts the public that conditions exist for the development of tornadoes in and close to the watch area. These watches describe watch areas and length of time in effect. Local NWS offices issue warnings when storm spotters or law enforcement personnel confirm a tornado or when radar indicates its presence. The warnings contain location and which communities lie in its path (Table 6.3).

Wildfires

Healthcare organizations located in areas where wildfires can pose great threats must develop procedures to address the risks to the facility's operation. In some western states, wildfires could be highly probable events that should be addressed by the HVA. The National Interagency Fire Center in Boise, Idaho, serves as the country's support center for wildland firefighting. Seven agencies from the Departments of the Interior, Agriculture, and Commerce work together to make up the fire center. The fire center website provides information on safety training, safety advisories, and fire incident reporting.

TABLE 6.3
Fujita Scale

- F0 Gale tornado 40–72 mph
- F1 moderate tornado 73–112 mph
- F2 significant tornado 113–157 mph
- F3 severe tornado 158–206 mph
- F4 devastating tornado 207–260 mph
- F5 incredible tornado 261–318 mph

Blizzards

Preparing for cold weather conditions and responding to them effectively can reduce the dangers caused by winter storms. It's important to identify the different types of winter storms. These storms include blizzards, blowing snow, snow squalls, snow showers, snow flurries, and ice storms. A winter storm becomes a blizzard when there are winds of 35 mph or more with snow and blowing snow reducing visibility to less than 1/4 mile for at least 3 h. Blowing snowstorms consist of wind-driven snow that reduces visibility. Blowing snow may be falling snow and/or snow on the ground picked up by the wind. Snow squalls are brief intense snow showers that are accompanied by strong, gusty winds. Accumulation from a snow squall may be significant. Snow showers occur when snow falls at varying intensities for brief periods of time. Some accumulation is possible. Snow flurries are light snowfalls for short durations with little or no accumulation. Ice storms usually occur when freezing rain or sleet is present. Different regions usually experience storms common to the geographic area. The Mid Atlantic and New England States are more likely to experience heavy snow showers, blizzards, and ice storms. Southeastern and Gulf Coast states are more likely to experience ice storms or occasional snowfall. The Midwest and Plains states are more susceptible to heavy snow showers, blizzards, and ice storms, while the Rocky Mountain states experience heavy snow showers and blizzards. And in Alaska, heavy snow showers and blizzards are the common winter storms.

There are different winter weather warnings to advise the public of adverse winter conditions. Winter weather advisories go out when winter weather conditions are expected to cause significant inconveniences and may be hazardous, especially to motorists. A frost or freeze warning indicates expectation of below freezing temperatures that may cause damage to plants, crops, or fruit trees. A blizzard warning indicates snow and strong winds will combine and produce blinding snow, near zero visibility, deep drifts, and life-threatening wind chill—seek refuge immediately. Scientists at the NOAA developed a rating system for snowstorms. The rating system used in the Northeast region of the United States may extend to other regions after further study. The rating system will be used to compare current storms after they strike with past storms. The rating considers factors such as inches of snow, land area affected, and the impact on people. The scale ranks storms in the following way using five levels of intensity:

- 1 = Notable
- 2 = Significant
- 3 = Major
- 4 = Crippling
- 5 = Extreme

Earthquakes

These events can seriously damage buildings and their contents. They can disrupt gas, electric, and telephone services while triggering landslides, avalanches, flash floods, fires, and even a tsunami. Aftershocks can occur for weeks following an earthquake. In many buildings, the greatest danger to people is when equipment and nonstructural elements such as ceilings, partitions, windows, and lighting fixtures become hazards. Earthquakes occur most frequently in the west of the Rocky Mountains but can happen in other locations also.

OTHER EMERGENCIES

Technology Emergencies

These emergencies include any interruption or loss of a utility service, power source, life support system, information system, or equipment needed to keep the business in operation. Identify all

critical operations, including electric power, gas, water, hydraulics, compressed air, municipal and internal sewer systems, and waste water treatment services. Consider security, alarm systems, elevators, lighting, life support systems, heating, ventilation, air conditioning systems, and electrical distribution systems. Evaluate transportation systems including air, highways, railroads, and waterways. Determine the impact of service disruption.

Transportation Accidents

The Department of Transportation (DOT) regulates the movement of hazardous chemicals. When hazardous chemicals that would pose a significant hazard to the public if released from their packing are transported interstate, they must be labeled with appropriate words of identification and caution. Shipping papers identifying the hazardous material being transported are required to be in the vehicle or vessel. Major transportation accidents often cause chemical spills, fires, explosions, and other problems, which call for special operations such as rescue and evacuation. DOT also regulates underground pipeline transportation.

Civil Disturbances

During recent years, a variety of demonstrations occurred at many locations throughout the country. Some demonstrations develop slowly, allowing the authorities to assess the problem, to conduct negotiations with the leaders, and to arrange for control measures. On other occasions, violence may flare up with little advance notice.

Bomb Threats

Prepare a questionnaire and place it near each phone. The information gathered on this questionnaire may be sufficient to discount the threat or may direct that actions other than evacuations. If locating a suspicious object thought to be a bomb, the FBI recommends evacuation immediately. Contact local law enforcement personnel or your emergency management agency to secure the services of the nearest explosive/bomb disposal team for assistance and training. According to the FBI, many callers ask to speak with a specific person. The questionnaire may be the most important resource for dealing with bomb threats and documenting information.

Information and Communication Technology Emergencies

The need to communicate and access pertinent information remains paramount to a successful response and recovery activities. The art of gathering information, analyzing and summarizing it, then sharing it with those who need it is known as information management. Identify key communications and IT components that are critical to the continuation of essential services in an emergency. When planning, consider protecting computers, paper records, and other important information or equipment.

EMERGENCY COMMUNICATIONS

Telecommunications Service Priority

Telecommunications Service Priority (TSP) efforts provide organizations engaged in national security and emergency preparedness functions with priority provisioning and restoration of telecommunications services that are vital to coordinating and responding to crises.

A telecommunications service user with a TSP assignment is assured of receiving service by the service vendor before a non-TSP service user.

Government Emergency Telecommunications Service

Government Emergency Telecommunications Service (GETS) provides emergency access and priority processing in the local and long-distance segments of the public switched network. The service supports emergency or crisis situations during which the probability of completing a call over normal or other alternate telecommunication means significantly decreases.

Wireless Priority Service

Wireless Priority Service (WPS) can improve connection capabilities for a limited number of authorized national security and emergency preparedness mobile phone users. In the event of congestion in the wireless network, an emergency call using WPS will take priority queuing for the next available channel. Obtain a last-resort backup means of communication such as wireless, WIFI, or satellite. Consider HF radio as an option, recognizing that HF usually requires a skilled operator such as a licensed HAM radio operator. Evaluate the resiliency, redundancy, and interoperability of the system while performing your inventory and risk assessment analysis.

Cyber-Attack: Response

The array of data sources in emergency management is staggering. Data from voice, text, video, sensors, databases, forms, satellites, telemetry, and eyewitness accounts all play a role in managing disasters. Add to this the variety of data at various stages of planning, and the volume and sources of data can become overwhelming. Avoid sensory overload by understanding the risk associated with inability to fuse various data streams into a coherent view.

Imagine a screen with summary information on current bed status, patient status, resource availability, and links to up-to-date response plans and guides. Now imagine logging into five separate systems to access this information. The ability to access pertinent data in a timely fashion provides the key to success. Consider defining scope and impact of potential problems and isolating affected systems. Work to restore automated systems and services. Notify affected end-user supervisors and provide guidance on system usage. Take actions immediately during the initial operational period (0–2 h).

The Cyber Security Evaluation Program, within the Department of Homeland Security's (DHS) National Cyber Security Division, conducts a no-cost voluntary Cyber Resilience Review (CRR) to develop an understanding of an organization's operational resilience and ability to manage cyber risk to its critical services and assets during normal operations and during times of operational stress and crises. The CRR seeks to understand cyber security management of services (and associated assets) critical for an organization's mission success by focusing on protection and sustainment practices within 10 key domains that contribute to the overall cyber resilience of an organization. The CRR results in a report that summarizes observed strengths and weaknesses in each domain and provides options for consideration containing general guidance or activities aimed at improving the cyber security posture and preparedness of an organization.

The DHS Control Systems Security Program also offers the Control Systems Cyber Security Self-Assessment Tool (CS2SAT), a desktop software tool that guides users through a step-by-step process to assess their control system network security practices against recognized industry standards. The output from the CS2SAT is a prioritized list of recommendations for improving the cyber security posture of the organization's industrial control systems (ICS) environment. The CS2SAT derives recommendations from a database of cyber security standards and practices. Each recommendation is linked to a set of actions that can enhance cyber security controls.

EMERGENCY EGRESS

Designing exits involves more than a study of numbers, flow rate, and population densities. Exits must provide alternative pathways. The building's purpose, population, and degree of hazard are the major factors when designing exits. Exits must provide alternative pathways to counter exits blocked by fire. Each employee should recognize and report all common hazards and fire safety hazards. Safe exits also require a safe path of escape from the fire. Design exits and other safeguards not to depend solely on any single safeguard. Exit doors must withstand fire/smoke during the length of time for which designed. Provide exits with adequate lighting and mark exits with readily visible signs. Protect exiting personnel and areas of a hazard that might spread fire and smoke. Every required exit sign must be suitably illuminated by a reliable light source and be visible in both normal and emergency lighting modes. NFPA 101 requires 5 ft-candles for internally and externally illuminated signs. Signs can't contain decorations, furnishings, or pieces of equipment that impair visibility. Never place other illuminated signs, displays, or objects in the line of vision of an exit sign. An employer who demonstrates compliance with the exit route provisions of NFPA 101 will be deemed to be in compliance with the corresponding OSHA requirements found in 29 CFR 1910.34, 36, and 37.

Any door, passageway, or stairway not designated as an exit must not be located or arranged in such a way that it could be mistaken for an exit. Identify these areas with a sign reading *Not an Exit* or something similar. You can use a sign indicating its actual character such as *To Basement* or *Storeroom*. Signs designating an exit or a way of exit must be distinctive in color and provide a contrast with decorations, interior finish, or other signs. Every sign must contain the word *Exit* in plainly legible letters not less than 6 in. high, with the principal stroke of the letter 0.75 in. wide. Where the direction of travel to the nearest exit is not immediately apparent, provide a sign reading *Exit* or a similar designation with an arrow indicating the direction to the required exit. The illuminated surface of the exit sign should possess a value of not less than 5 ft-candles to meet 29 CFR 1910.37 standards.

NFPA 101 also requires 5 ft-candles for internally and externally illuminated signs with some exceptions such as approved self-luminous or electro-luminescent signs that provide evenly illuminated letters (Table 6.4).

Emergency Lighting

NFPA 101 establishes requirements for emergency lighting. When required, it must provide a minimum of 1.5 h of light. Arrange lighting to provide initial illumination of not less than an average of 1 ft-candle. This level can decline to a 0.6 ft-candle average and 0.06 ft-candle at any point at the end of emergency lighting time of 1.5 h. Measure the intensity of visible light in units of candles. Measure the rate of flow of light or luminous flux as a lumen. Consider a single lumen as the flux on 1 ft^2 of a sphere. It describes a 1 ft radius with a light source of one candle at the center and radiating uniformly in all directions. One *Lux* equals a unit of illumination equal to 1 lumen/m^2. Define a

TABLE 6.4
NFPA 101 Defined Methods to Illuminate Exit Signs

- Externally illuminated: Light source contained outside of the device or legend needing illumination
- Internally illuminated: Light source contained inside the device such as incandescent, fluorescent, electro-luminescent, light-emitting diodes, or self-luminous
- Self-luminous: Sign illuminated by self-contained power sources such as tritium and operates independently of external power sources (batteries do not qualify) with the light source contained inside the device
- Electro-luminescent: Light-emitting capacitor with the light source contained inside the device

foot-candle as the direct measurement of visible radiation falling on a surface. Foot Lambert refers to the unit measure of physical brightness on any surface emitting or reflecting visible light.

HAZARDOUS MATERIAL RESPONSE

HAZWOPER Emergencies

Hospitals and healthcare facilities can experience hazardous material releases or spills including formaldehyde, ethylene oxide, xylene, and benzene. Employees particularly benefit from the practical experience they gain during training provided as part of exercises and drills. The HAZWOPER Standard, paragraph 1910.120(q)(6)(ii) requires that employees trained at the first responder operations level will receive at least 8 h of training or demonstrate sufficient experience to objectively demonstrate competency in selected areas (Tables 6.5 and 6.6).

Industrial/Agricultural Chemical Decontamination Guidance

Hospitals must develop plans to respond to hazardous material emergencies occurring in industrial or agriculture settings. ATSDR offers hospitals free hazardous substance response guidance materials. Refer to the ATSDR website for additional information on these tools and resources.

TABLE 6.5
HAZWOPER First Responder Operation Level Competency Topics

- Understand hazardous substances and associated risks during an incident
- Understand potential outcomes when hazardous substances are present
- Ability to recognize the presence of hazard substances' signs and exposure symptoms
- Ability to identify hazardous substances
- Understand roles in the hospital's emergency response plan
- Understand site security control and decontamination procedures
- Ability to realize need for resources and ability to make notifications
- Knowledge of basic hazard and risk assessment techniques
- Know how to select/use proper PPE and understand hazardous material terms
- Know how to perform control, containment, and/or confinement operations
- Know how to implement basic decontamination procedures

TABLE 6.6
EPA Levels of Protection for Chemical Response Operations

- Level A: Highest level of skin and respiratory protection available. The protective clothing must be gas tight, vapor tight, and splash resistant. Appropriate for possible threats to life and health and during operations dealing with an unknown hazard. Level A requires the highest level of respiratory protection with air-supplied respirators.
- Level B: This level offers protection from a chemical splash, but does not prevent exposure to gases or vapors. Protective clothing may or may not be completely encapsulating. Level B requires the highest level of respiratory protection.
- Level C: The same as level B but requires an air-purifying respirator. This level applies to situations with known chemical exposures requiring the use of air-purifying respirators.
- Level D: Lowest level of protection used when no potential or actual hazard exists. It offers only minimal protection for nuisance exposures. Refer to 29 CFR 1910.120, Appendix B.

PLANNING FOR TERRORISM

Hospitals make up a substantial portion of the emergency response system. Educate and train staff about possible events and response actions. Experts advise that local communities should be prepared to deal with the consequences of a terrorist event for the 12–36 h before federal agencies can augment local response and provide specialized support. Potential risks are associated with nuclear, chemical, biological, or radiological weapons by terrorist calls for sound emergency planning procedures. Terrorist events can result in potentially large numbers of casualties. The psychological impact of weapons of mass destruction and the relative ease of their acquisition pose a great threat. Healthcare facilities preparing for a bioterrorism response plan should reference A Template for Healthcare Facilities, produced by the Association for Professionals in Infection Control. This resource outlines the steps necessary for responding to biological agents, such as smallpox, botulism toxin, anthrax, and plague and provides information on the unique characteristics, specific recommendations, management, and follow-up for each of these agents. The CDC National Public Health Strategy for Terrorism Preparedness and Response guide contains information on the following topics: (1) detection, investigation, and laboratory sciences; (2) prevention efforts, worker safety, and communication; (3) emergency response; (4) research and long-term consequence management; and (5) workforce development.

Biological Agents

Clinical symptoms may not appear for some time after an exposure. Biological agent organisms can live in a form of liquid droplets, aerosols, or dry. The signs and symptoms are usually nonspecific and may mimic natural infections such as flu. Pathogens or disease-causing organisms include bacteria, viruses, and fungi. Viruses are submicroscopic organisms that require living cells to reproduce and multiply. Be aware of signs and symptoms that develop at an uncharacteristic time of the year, in an unusual pattern, or in a normally healthy population. Be alert for groups of patients from a single location or event. Watch for lower incidences of symptoms among people who stayed indoors. Respond to large numbers of fatalities or unusual numbers of sick/dying people or animals including vector-borne diseases without vectors and patients with uncommon disease.

Bacteria are self-sustaining organisms that do not require a host to reproduce. Examples of harmful bacteria include (1) anthrax, (2) cholera, and (3) plague. Viruses are much smaller than bacteria and need a host to survive. The host can be plants, animals, insects, bacteria, or humans. Examples include the following: (1) smallpox, (2) Venezuelan equine encephalitis, and (3) Ebola.

Toxins are poisonous chemical compounds produced by living organisms such as animals, plants, and microbes. These agents demonstrate lethality about 1000 times higher than standard chemical agents. Toxins normally do not pose an absorption risk. Examples include the following: (1) botulism, (2) ricin, and (3) staphylococcal enterotoxin B.

Chemical Agents

Classify these agents into general categories of blood, blister, choking, irritating, and nerve classifications. The toxicity, mode of action, and effects can vary depending on the agent. Consider inhalation as the primary route of exposure. Listed next is a partial listing of chemical emergency response cards available on the CDC website:

- Abrin
- Hydrogen cyanide (AC)
- Mustard gas (H)
- Nitrogen mustard (HN-1, HN-2, HN-3)
- Potassium cyanide (KCN)

- Ricin
- Sarin (GB)
- Sodium cyanide (NaCN)
- Soman (GD)
- Sulfur mustard (H)

Blood Agents

These agents interfere with the ability of the blood to transport oxygen. Consider all blood agents as toxic at high concentrations. Exposure can lead to rapid asphyxiation and death. Symptoms can include respiratory distress, vomiting, diarrhea, vertigo, and headaches. Fresh air and respiratory therapy may help some victims. Cyanide would be an example of a blood agent.

Blister Agents (Vesicants)

These agents cause burns to the eyes, skin, and respiratory tract tissues. They can penetrate clothing and be absorbed into the skin. Symptoms vary but can include the following: tears, swollen eyelids, itching, burning pain, and blisters in moist areas like the groin. Watch for burning sensation in the nose and throat, hoarse voice, shortness of breath, cough, abdominal pain, and diarrhea. Mustard is an example.

Choking and Irritating Agents

Choking agents stress the respiratory tract and can result in asphyxiation. An edema can develop in the lungs, and patient symptoms may resemble those of a drowning victim. Symptoms include eye irritation, choking and coughing, and respiratory distress. Victims may smell like chlorine or newly cut hay (phosgene). An example of a choking agent is phosgene. Irritating agents cause respiratory distress and tearing with the intention of incapacitating the victim. Symptoms include severe pain to the skin, burning and irritation of the eyes and throat, respiratory distress, coughing, choking, nausea, and vomiting. Most exposed people smell of pepper or tear gas. Examples of irritating agents include tear gas and pepper spray.

Nerve Agents

Nerve agents remain the most toxic chemical agents and can cause death in minutes. They can be inhaled or absorbed through the skin. Nerve agents affect organs as smooth muscles and glands. Watch for increased saliva and tears. Other symptoms include secretions from airways along with sweating, muscle contractions, and hyperactivity of the digestive tract. Some victims demonstrate symptoms of twitching, weakness, and hypertension. An example would be sarin.

Industrial Chemical Agents

There are a wide variety of potential chemicals that could be used for malicious purposes including organic-phosphate pesticides such as parathion. These agents are chemically related to nerve agents but not as toxic. These compounds disrupt the acetyl cholinesterase enzyme just like nerve agents. Arsenic trioxide is also a poison.

Nuclear Devices

A nuclear terrorist incident can involve the detonation or threatened detonation of a nuclear bomb or an explosive device that includes nuclear materials. Terrorists could also cause a nuclear incident

by detonating an explosive device near a nuclear power plant or attacking nuclear cargo during transport. Terrorists could contaminate food or other products with radioactive materials. Simple radiological devices such as an isotope could spread radiation without the use of an explosive device if placed in public. The Department of Energy Nuclear Incident Response Team provides expert personnel and specialized equipment to a number of federal emergency response entities that deal with nuclear emergencies, nuclear accidents, and nuclear terrorism. The department's emergency response personnel are experts in such fields as device assessment, device disablements, intelligence analysis, credibility assessment, and health physics.

Terrorist Dissemination Devices

Agents can be distributed using simple containers such as glass bottles or modified aerosol generators. In general, the effects of chemical agents occur more rapidly and contaminate smaller areas than biological agents on a per-weight basis. Biological agents, however, can cover vast areas, resulting in large numbers of indiscriminate casualties comparable to that of nuclear devastation. An incendiary device can be mechanical, electrical, or chemical. It can be sued to start combustion and intentionally set fire to something else. These devices can be simple or complex, but usually consist of three basic parts: (1) a fuse or igniter, (2) a container (glass, metal, plastic, or paper), and (3) incendiary material. An explosive device would be any substance or article designed to explode, either by a rapid release of gas and heat or by a chemical reaction. Examples of explosive devices include homemade bombs, pipe bombs, letter bombs, dynamite and military ordinances, and fertilizer bombs.

NIOSH Publication Number 2002-139

This document identifies actions that a building owner or manager can implement without undue delay to enhance occupant protection from an airborne chemical, biological, or radiological attack.

Pandemic Planning

The DHHS Supplement 3 provides healthcare partners with recommendations for developing plans to respond to a pandemic. Focus on planning during the Inter-Pandemic Period for issues such as surveillance, decision-making structures, communications, education and training, patient triage, clinical evaluations, admission, facility access, occupational health, distribution of vaccines, antiviral drugs, surge capacity, and mortuary issues. The activities suggested in Supplement 3 are intended to be synergistic with those of other pandemic influenza planning efforts, including state preparedness plans. Healthcare facilities must be prepared for the rapid pace and dynamic characteristics of pandemic influenza. All hospitals should be equipped and ready to care for a limited number of patients infected with a pandemic influenza virus or other novel strains of influenza. Hospitals should prepare for a large number of patients in the event of escalating transmission of pandemic influenza. Healthcare facilities must develop planning and decision-making structures for responding to pandemic. This planning includes developing written plans that address (1) disease surveillance, (2) hospital communications, (3) education and training, (4) triage and clinical evaluation, (5) facility access, (6) employee health, (7) use and administration of vaccines or antiviral drugs, (8) surge capacities, (9) supply chain issues, (10) access to critical inventory needs, and (11) mortuary-related issues.

HEALTHCARE EMERGENCY COALITIONS

A healthcare coalition consists of a group of healthcare organizations in a specified geographic area that agree to work together to enhance their response to emergencies or disasters. The response objectives of any coalition will vary depending on how the coalition is constructed in a

particular area. Example objectives include promoting situational awareness, facilitating resource sharing, and coordinating response actions among its member organizations. The coalition also promotes the efficient interface of its member organizations with jurisdictional authorities in Tier 3. A healthcare coalition contains both preparedness and response elements. Response methods should use ICS and the NIMS structures. Healthcare coalitions must possess baseline operational capability and remain available to receive initial information about an emergency and then rapidly notify member organizations. This baseline capability does not need to be time or resource intensive. The healthcare coalition mobilizes and activates processes for response using a medical MAC system that supports but does not replace incident response activities of individual healthcare organizations and jurisdictional authorities. The primary purpose for any healthcare coalition should be promoting optimal situational awareness for its member organizations through the collection, aggregation, and dissemination of incident information. Mass casualty and effect incidents may occur suddenly with extraordinary medical resource needs. They could also evolve slowly and with warning, which would allow time for more extensive evaluation before instituting responses. During sudden onset incidents, many victims reach hospitals on their own or through the assistance of others and not by way of EMS.

Six-Tier Model

Tier 1—This level encompasses all individual healthcare organizations in a geographic area that deliver *point of service* medical care during emergencies or disasters.

Tier 2—This tier consists of a formed coalition sharing assets and incident information, exchanging resource status information to supports mutual aid, coordinating response strategies and tactics, and using a common interface with local jurisdictional authorities to exchange information and request assistance.

Tier 3—This level includes municipal, county, or similar agencies with jurisdiction over the impacted areas and responsibility for the local government responses.

Tier 4—This level refers to state-level response that supports Tiers 1–3 by managing statewide and substate regional coordination of the healthcare response activities.

Tier 5—This state-level response level manages interstate regional coordination of response to support Tiers 1–3 healthcare response assets.

Tier 6—This level involves federal assistance to state, tribal, local, and nongovernmental healthcare response at Tiers 1–5, as managed through a Joint Field Office and/or other federal coordinating center.

Developing a Coalition EOP

The EOP should describe the structure of a coalition response organization and how it will respond during an emergency. The EOP can prove helpful in developing and conducting education, training, and exercises, as well as in evaluating coalition performance in exercises or actual emergencies. The EOP must be usable under emergency conditions to guide response actions, demobilization, recovery, and return to readiness. The components of an EOP designed for use during response consists of the specific *tools*, including call-down lists, operational checklists, mobilization and demobilization procedure checklists, reporting templates, and other SOPs. Personnel developing the EOP should include representatives from various members of the coalition.

Healthcare Coalition Standard Operating Procedures

SOPs can prove useful and should include the EOP. Potential SOPs for the functional annexes of the EOP may include the following:

1. Resource support: Describes specific procedures for assisting member organizations in sharing resources between them during emergencies. Attachments to this SOP might include a memorandum of understanding for a Strategic National Stockpile distribution plan.
2. Patient tracking: Describes specific procedures used for tracking patients among different healthcare facilities and actions that coalition member organizations should conduct such as reporting patient lists to facilitate patient tracking.
3. Public information: Describes processes for coordinating the public message among coalition member organizations and the relevant Tier 3 agencies.
4. Volunteer management: Describes how a coalition might facilitate the management of solicited and unsolicited volunteers for integration into healthcare organizations and coordinate this with Tier 3 agencies.
5. Patient evacuation: Most coalitions face the potential of a hazard impact that would require the evacuation of a healthcare facility. Clearly defined procedures for how the coalition might support this should be included within the context of a hazard or incident-specific annex. This material should be presented in a format that is useful during response operations.
6. Mass fatality: Describes procedures that will be used when the number of fatalities exceeds the normal capacity for managing fatalities at individual healthcare organizations. The SOP may address issues such as how the coalition could facilitate victim tracking or the acquisition of storage sites for human remains through appropriate jurisdictional channels. Once written, implement and regularly evaluate the EOP for adequacy, with organizational improvement actions conducted as necessary. Most coalitions should develop a base plan first and then address other components of the EOP using a priority scheme that is based upon identified risks.

Coalition Exercises

The healthcare coalition should use exercises to evaluate the EOP. Exercises may evaluate specific elements of a coalition EOP or evaluate the EOP in a broader context. Common elements that may be evaluated during an exercise include SOPs, organizational structure, or the effectiveness of specific technologies used by the coalition during emergency response. An important consideration, when designing an exercise, relates to establishing a predetermined evaluation plan. The HSEEP contains mandatory requirements when organizations use federal emergency preparedness funds to develop and conduct the exercise. The purpose of the exercise should be clearly stipulated in the exercise plan. This drives the scenario to ensure that areas of focus receive proper attention during the exercise. The level of anticipated play by the participating entities should be established.

2013 NATIONAL PREPAREDNESS REPORT

Presidential Policy Directive 8: National Preparedness requires an annual National Preparedness Report (NPR) that summarizes national progress in building, sustaining, and delivering the 31 core capabilities outlined in the National Preparedness Goal. The 2013 National Preparedness Report identified areas of national strength in the following core capabilities:

- *Planning*: The nation continues to expand upon the foundation for an integrated, all-hazards planning architecture that considers routine emergencies and catastrophic events and increasingly integrates whole community perspectives. At the federal level, interagency partners made significant progress in finalizing National Planning Frameworks and Federal Interagency Operational Plans across preparedness mission areas.

- *Operational coordination*: The NIMS provides a common doctrine for incident management, allowing the whole community to use shared language and principles. Nationwide adoption of NIMS increased in 2012, with an additional 900,000 completions of introductory NIMS and ICS courses. Furthermore, federal agencies continue to implement NIMS to manage incidents and report having the operational capability to meet the goal.
- *Intelligence and information sharing*: The national network of fusion centers and Joint Terrorism Task Forces continued to mature. In addition, new national strategies and federal interagency governance structures emerged to provide a consistent and unified approach to guide the implementation of fusion center policies and standards.
- *Operational communications*: States and territories continue to develop state emergency communications plans. In addition, the nation began facilitating a transition to a nationwide public safety broadband system for emergency communications and continued development of next generation 9-1-1 systems.

Opportunities for Improvement

The nation did make important progress in the national areas for improvement identified in the 2012 NPR—cyber security, recovery-focused core capabilities, and integration of individuals with disabilities and access and functional needs—but challenges remain. Enhancing the resilience of infrastructure systems and maturing the role of public-private partnerships are newly identified national areas for improvement.

Key Factors for Future Progress

The 2013 NPR represents the second opportunity for the nation to reflect on progress in strengthening national preparedness and to identify where preparedness gaps remain. Looking across all 31 core capabilities outlined in the goal, NPR provides a national perspective on critical preparedness trends for whole community partners.

REVIEW EXERCISES

6.1 List five areas that should be addressed by a healthcare organization's EOP in response procedures.

6.2 How often must a healthcare facility perform a functional test of battery-powered lights required for egress?

6.3 How often must a healthcare facility perform a functional test of battery-powered lights required for egress?

6.4 List the elements of an emergency water supply plan.

6.5 Define or describe the following concepts or principles:
- Standardization
- All-hazards planning
- System thinking

6.6 List six areas that healthcare facilities should focus when conducting emergency planning.

6.7 What are the five basic functional areas of an ICS?

6.8 Define the following terms or principles:
- Integrated communications
- Modular organization
- Unified command structure
- Span of control

6.9 Describe the EPA-defined levels of personal protection for chemical response operations.

6.10 Describe the concept of healthcare emergency coalitions.

6.11 Describe the four phases of emergency management.
6.12 What's the purpose of NFPA 1600?
6.13 List five key emergency assessment topics.
6.14 Describe the purpose of the CDC National Pharmaceutical Stockpile.
6.15 Describe the parameters for the issuance of a severe thunderstorm warning.
6.16 Describe the purpose of the following programs or services:
- The Telecommunications Service Priority (TSP) Program
- The Government Emergency Telecommunications Service (GETS) Program
- The Wireless Priority Service (WPS)

6.17 List the key issues to consider following a cyber-attack.
6.18 What's the purpose of HSEEP?
6.19 Define or describe the following potential terrorist agents:
- Blood agents
- Blister agents
- Choking agents
- Irritating agents
- Nerve agents
- Industrial chemical agents

7 Hazardous Materials

INTRODUCTION

Healthcare organizations use a wide variety of hazardous substances, including disinfectants, sterilizing agents, solvents, chemotherapeutic drugs, compressed gases, and hazardous wastes. Occupational Safety and Health Administration (OSHA), EPA, Department of Transportation (DOT), and accreditation organizations, including the Joint Commission, require healthcare organizations to properly receive, handle, manage, and dispose of hazardous materials in an effective manner. Organizations should develop and implement comprehensive written plans that protect staff, patients, and visitors. Organizations must adhere to the requirements of the OSHA Hazard Communication Standard (HCS), the EPA Resource Conversation and Recovery Act (RCRA), and DOT Hazardous Materials Regulations. Healthcare organizations should work to consolidate hazardous material management plans with requirements of accreditation, licensing, and regulatory agencies. Using an integrate approach would improve hazardous material safety and disposal efforts.

The OSHA HCS requires organizations to maintain an SDS for each hazardous substance used in the workplace. Refer to the SDS and, in some situations, the container label for information on special storage requirements. Typical storage considerations may include factors such as temperature, ignition control, ventilation, segregation, and identification. Properly segregate hazardous materials according to compatibility. For example, never store acids with bases or oxidizers with organic materials or reducing agents. Corrosives and acids will corrode most metal surfaces, including storage shelves or cabinets. Store flammable and combustible materials in appropriate rooms or approved cabinets (Table 7.1).

HAZARDOUS SUBSTANCE SAFETY

Identify and mitigate risks associated with selecting, handling, storing, transporting, using, and disposing of chemicals, dangerous medications, and hazardous gases or vapors. Label hazardous materials and wastes to identify the contents and provide hazard warnings (Tables 7.2 and 7.3).

Hazardous Substance Exposures

Toxic substances can enter the body through the skin, the respiratory system, the mouth, and the eyes. Some substances can also damage the skin or eyes directly without being absorbed. A person can inhale or swallow inorganic lead, but it does not penetrate the skin. Sometimes, a chemical substance can enter through more than one route. Exposures to hazardous materials can cause stress on the body if inhaled, absorbed, or ingested. Exposure effects depend on concentration, duration of exposure, route of exposure, physical properties, and chemical properties. Other chemicals, physical agents, and the general health of the person exposed can influence the effects exerted by a hazardous substance. Train workers how to safely handle, store, use, and segregate hazardous materials and waste products. The OSHA HCS, 29 CFR 1910.1200, specifies education and training for users of hazardous chemicals (Tables 7.4 through 7.6).

TABLE 7.1
Hazardous Material Management Suggestions

- Conduct an inventory and control of all materials used, stored, or generated.
- Provide adequate space and equipment for handling and storing hazardous materials.
- Monitor and document correct disposal of hazardous gases and vapors.
- Develop work area and emergency response procedures to address specific hazards.
- Use protective equipment when responding to hazardous materials spills or releases.
- Maintain hazardous wastes manifests, permits, and licenses.
- Ensure proper labeling of all-hazardous materials and wastes.

TABLE 7.2
Joint Commission Hazardous Material and Waste Categories

- Hazardous chemicals
- Hazardous medications and drugs
- Radiation hazards (ionizing and nonionizing)
- Dangerous gases and vapors

TABLE 7.3
Characteristics of Hazardous Substances

- Corrosiveness: Any substance with the ability to degrade the structure or integrity of another substance, object, or material. Examples include acids and alkalis.
- Ignitability: Any material that can too readily burn or ignite including some chemicals that can autoignite upon contact with the air.
- Reactivity: Any substance with the ability to readily combine with other chemicals to produce a sudden or violent release or heat/energy.
- Toxicity: Any material with the capability of causing illness or death in man, animals, fish, plants, or damage the environment.

TABLE 7.4
Exposure Considerations

- Concentration of hazardous substance
- Duration of exposure
- Available ventilation
- Temperature of the chemical
- Temperature of the surrounding air

Hazardous Chemical Determination

Consider a substance as hazardous if regulated by OSHA in 29 CFR Parts 1910, Subpart Z. Treat any substances included in the latest edition of the ACGIH *Documentation of the Threshold Limit Values and Biological Exposure Indices* as hazardous. Any substance confirmed or suspected to be

TABLE 7.5
Hazardous Material Exposure Terms

- Air contaminant standards: A term used by OSHA to describe hazardous materials regulated by specific substance standards or exposure tables of 29 CFR 1910, Subpart Z
- Permissible exposure limit (PEL): The maximum allowed OSHA exposure for workers working 8 h during a 40 h week
- Short-term exposure limit (STEL): The exposure allowed for a one-time excursion (normally measured in a 15 min period)
- Ceiling: The maximum amount of an airborne concentration exposure
- Threshold limit value (TLV): A voluntary TWA exposure limit published by ACGIH
- Air contaminants: Hazardous substances regulated by 29 CFR 1910, Subpart Z
- OSHA additive formula: The method described in 29 CFR 1910.1000 for use to determine exposure effects of a substance containing two or more hazardous ingredients

TABLE 7.6
Identifying and Evaluating Hazardous Substances

- Determine hazardous properties including toxicity and health hazards.
- Identify purpose, quantities, and locations using the substance.
- Implement proper storage procedures including flammable material locations.
- Make SDS readily available for each substance.
- Adhere to compliance and regulatory requirements of OSHA, DOT, and EPA.
- Develop written plans as required by compliance agencies and accrediting organizations.
- Require use of PPE handling hazardous materials.
- Evaluate possible use of less hazardous substances.
- Create detailed spill containment plans and train properly response teams.
- Conduct and document personal/area monitoring as required by standards.
- Provide education and training for all workers with any potential exposures.

a carcinogen by the National Toxicology Program and published in their latest edition of the *Annual Report on Carcinogens* would also be hazardous. Finally, any substance listed by the International Agency on Research on Cancer and in the latest edition of *IARC Monographs* is also considered to be hazardous.

Reproductive Hazards

Some substances or agents may affect the reproductive health of women or men. These risks may manifest as chemical, physical, or biological hazards. Reproductive hazards can include lead, radiation, and even viruses. Reproductive hazard exposure can occur by inhalation, skin contact, and ingestion. Potential health effects can include infertility, miscarriage, birth defects, and child development. Organizations must work to limit exposures by the use of workplace engineering controls, proper work practices, and good hygiene practices. Current scientific evidence suggests that chronic exposure to anesthetic gases increases the risk of congenital abnormalities in offspring among female workers. While more than 1000 workplace chemicals may cause reproductive effects in animals, most physical and biological agents in the workplace that may affect fertility and pregnancy outcomes remain unstudied. The inadequacy of current knowledge, coupled with the ever-growing variety of workplace exposures, poses a potentially serious public health problem. The "Effects of Workplace Hazards on Female Reproductive Health," NIOSH Publication No. 99-104,

TABLE 7.7
Healthcare Reproductive Hazards

- Nitrous oxide
- Ethylene oxide
- Toluene
- Xylene
- Some aerosolized drugs
- Cadmium
- Ionizing radiation
- Lead
- Solvents

addresses exposure, prevention, and reproductive hazards for female workers and their unborn babies. The "Effects of Workplace Hazards on Male Reproductive Health," NIOSH Publication No. 96-13, identifies steps to reduce or prevent workplace exposure to male reproductive hazards (Table 7.7).

Threshold Limit Values

Published by ACGIH, threshold limit values (TLVs) represent the opinion of the scientific community for the purpose of encouraging exposure at or below the level of a published TLV. The values serve as guidelines and not as standards. TLVs help industrial hygienists make decisions regarding safe levels of exposure to various chemical or physical agents found in the workplace. TLVs serve as health-based values established by committees that review the existing published and peer-reviewed literature in various scientific disciplines, including industrial hygiene, toxicology, and occupational medicine. ACGIH bases TLVs solely on health factors and not on economic issues or any technical feasibility.

Chemical Properties

The physical properties of a chemical substance include characteristics such as vapor pressure, solubility in water, boiling point, melting point, molecular weight, and specific gravity. Chemical properties describe the reactivity of a substance with other chemicals. Reactive substances can burn, explode, or give off hazardous vapors when mixed with other chemicals or when exposed to air or water. Reactive substances can self-ignite, and the chemical reaction itself creates the hazard. Oxidizing chemicals easily release oxygen that can fuel fires when stored near flammable substances. Oxidizers cause other materials to burn even though most oxidizers won't burn themselves. Ensure storage is away from heat sources because warming causes oxygen release that can create the perfect environment for a fire. Corrosive chemicals can eat through other materials, including human skin. Irritants such as ammonia possess corrosive characteristics that attack mucous membranes in the nose and mouth.

Flash Points

According to NFPA 30, Class I flammable liquids possess a flash point of less than 100°F (38°C) while combustible liquids possess a flash point of 100°F (38°C) or more. Please note that the Globally Harmonized System (GHS) may define flammable liquids using different criteria. Vapor is simply the gaseous state of a material. We can smell some vapors, and some possess no odor.

Vapors combine with oxygen in the air, forming a mixture that will ignite easily and burn rapidly, often with explosive force. Vapor density relates to the ratio of the weight of a volume of vapor or gas to the weight of an equal volume of clean but dry air. SDSs contain vapor densities for the chemical substances. Knowing the vapor density can tell you how a vapor will act. A vapor density less than 1.0 will tend to rise and spread out. This reduces the hazard. A vapor density of 1.0 or more will tend to sink to the lowest point on the ground. These vapors can then travel along the ground sometimes for long distances and find ignition sources. This makes chemicals with high vapor densities particularly dangerous. Consider an ignition source as anything that causes something to burn. Common ignition sources include sparks from tools and equipment; open flames such as torches, smoking materials, and pilot lights, hot particles, and embers generated while grinding or welding; and hot surfaces such as electric coils and overheated bearings. Flowing liquid chemical can create static electricity. Grounding ensures that an electrical charge goes to the ground rather than building up on the drum of flammable or combustible material. Bonding refers to a process that equalizes the electrical charge between the drum and the transfer container. This prevents the buildup of electrical charges on one of the containers. Ignition temperature refers to the minimum temperature at which a chemical will burn and continue burning without the need for an ignition source. The main difference between flammable and explosive refers to the rate of combustion or the speed at which a material burns. A fire results from a rapid release of energy. An explosion occurs when an instantaneous release of energy involves an extremely rapid rate of combustion.

Airborne Exposure

An exposure of an individual relates directly to the concentration of a hazardous substance as related to the per-unit volume of air. We usually express airborne concentrations in terms of milligrams of substance per cubic meter of air (mg/m^3) or parts of substance per million parts of air (ppm). Express asbestos and other airborne fibers by using per cubic centimeter (f/cc) or fibers per cubic meter (f/m^3) of air. OSHA requires consideration of feasible administrative or engineering controls to reduce exposure risks. When these controls prove ineffective, organizations must use PPE or other protective measures to protect employees. Ensure that the use of any equipment and/or technical measures receive approval from a competent industrial hygienist or other technically qualified person. 29 CFR 1910, Subpart Z, contains exposure limit Tables Z-1, Z-2, or Z-3 for substances not covered by a specific standard.

OSHA Additive Formula

OSHA provides an *additive formula* in 29 CFR 1910.1000 for computing exposure to a substance containing two or more hazardous ingredients. Employers must monitor and compute the equivalent exposure using the following formula:

- E (m) is the equivalent exposure for the mixture
- C is the concentration of a particular contaminant
- L is the exposure limit for that substance specified in Subpart Z
- Value of E (m) shall not exceed unity (1)

To illustrate the formula prescribed in paragraph (d)(2)(I) of Subpart Z, consider the following exposures:

Substance A—actual exposure at 500 ppm with a PEL of 1000 ppm
Substance B—actual exposure at 45 ppm with a PEL of 200 ppm
Substance C—actual exposure at 40 ppm with a PEL of 200 ppm

Substituting the values provided earlier into the formula achieves the following results:

$$E\,(m) = 500 \text{ divided by } 1000 + 45 \text{ divided by } 200 + 40 \text{ divided by } 200$$

$$E\,(m) = 0.500 + 0.225 + 0.200$$

$$E\,(m) = 0.925$$

Since E (m) is less than the unity (1), the exposure combination is within acceptable limits. If the value exceeds one (1), consider the exposure as above the acceptable limit.

Emergency Showers and Eyewashes

OSHA standard (29 CFR 1910.151) requires employers to provide suitable facilities for quick drenching of the eyes and body for individuals exposed to corrosive materials. OSHA does not specify minimum operating requirements or installation setup requirements. ANSI standard Z-358.1 recently underwent revision led by the efforts of the International Safety Equipment Association (ISEA). Approved by ANSI, the standard became known as ANSI/ISEA Z358.1. Organizations should ensure that flushing fluids remain clear and free from foreign particles. For self-contained units, manufacturers provide suggested fluid replacement guidelines. Preservatives can help control bacteria levels in flushing fluids. A preservative's performance depends upon several factors, including the initial bacterial load of the water and a potential biofilm in the station. Self-contained eyewash stations should be drained completely, disinfected, and rinsed prior to refilling. Always inspect and test the unit if you doubt its dependability. Identify problems or concerns and establish regular maintenance procedures. Consult the manufacturer's operating manual and ANSI Z358.1 for assistance in performing test procedures, maintenance operations, and training. Personal eyewash bottles can provide immediate flushing when located in hazardous areas. However, personal eyewash equipment does not meet the requirements of plumbed or gravity-feed eyewash equipment. Personal eyewash units can support plumbed or gravity-fed eyewash units but cannot serve as a substitute (Table 7.8).

Compressed Gas Safety

The CGA promotes safe work practices for industrial gases and develops safe handling guidelines. OSHA regulates the use and safety of compressed gases in the workplace. Refer to 29 CFR 1910.101 for complete information on inspecting gas cylinders. The DOT regulates the transportation of compressed gases by rail, highway, aircraft, and waterway. Store compressed gas cylinders in cool and dry areas with good ventilation. Storage areas should meet fire-resistant standards. Never store compressed gas cylinders at temperatures higher than 125°F. Do not store cylinders near heat, open flames, or ignition sources. Properly label all cylinders, and never remove valve protection caps until

TABLE 7.8
Basic Requirements for Eyewash and Shower Facilities

- Valves must activate in 1 s or less.
- Installed in locations 10 s from the hazard.
- Located in a lighted area and identified with a sign.
- Train workers on equipment use and appropriate PPE.
- Activate plumbed units weekly.
- Maintain self-contained units according to the manufacturer's specifications.

securing cylinder for use. Comply with OSHA 29 CFR 1910.101–105 and DOT 49 CFR 171–179 standards when handling compressed gases. Refer to ANSI-Z48.1 and CGA pamphlet C-7 for marking cylinders. When not in use, close valves and properly secure. Use appropriate lifting devices to transport gas cylinders. Refer to the appropriate SDS for information about cylinder content. Inside of buildings, separate oxygen and flammable gas cylinders by a minimum of 20 ft. You can also store cylinders in areas with a fire-resistible partition between oxygen and flammable materials.

OSHA HAZARD COMMUNICATION STANDARD (29 CFR 1910.1200)

OSHA requires the development of a written hazard communication plan. The plan must address container labeling, SDS availability, and training requirements. Employers must identify the person responsible for each plan element. Organizations must make the plan available on all shifts. The plan must direct the actions taken to communicate appropriate hazard information to all affected or exposed individuals.

Globally Harmonized System

GHS stands for the international approach to hazard communication. This global system provides criteria for classifying chemical hazards and standardizing labels and SDS. The development of GHS required a multiyear endeavor by hazard communication experts from different countries, international organizations, and stakeholder groups. OSHA recently modified the HCS to adopt the GHS approach. Since 1983, OSHA requires employers to communicate hazardous materials information to employees. The original performance-oriented standard allowed chemical manufacturers and importers to convey information on labels and SDS in a variety of formats. GHS requires a more standardized approach to classifying the hazards and conveying the information to those needing to know. The GHS requires providing detailed criteria for determining what hazardous effects a chemical poses. It also requires a standardized label assigned by hazard class and category. This will enhance both employer and worker comprehension of the hazards, resulting in safer use and handling. The harmonized format of the SDS will enable employers, workers, health professionals, and emergency responders to access the information more efficiently and effectively. OSHA will require training on new label requirements and SDS format by December 2013. OSHA will require complete compliance in 2015.

Major Hazard Communication Standard Changes

The definitions of hazard will change to provide specific criteria for the classification of health and physical hazards, as well as the classification of mixtures. These specific criteria will help ensure that evaluations of hazardous effects remain consistent across manufacturers. This will result in more accurate labels and SDS. Chemical manufacturers and importers must provide a label that includes a harmonized signal word, pictogram, and hazard statement for each hazard class and category. Precautionary statements must also be provided. Finally, the SDS will contain a specified 16-section format. The GHS does not address harmonized training provisions. However, the revised hazard standard requires retraining of all workers within 2 years of the publication of the final rule. The parts of the OSHA standard not related to new system such as the basic framework, scope, and exemptions remain unchanged. OSHA did modify some terms to align the revised standard with language used in the GHS. The term *hazard determination* changed to *hazard classification* and *material safety data sheet* changed to *safety data sheet*. Evaluation of chemical hazards must use available scientific evidence concerning such hazards. The revised standard contains specific criteria for each health and physical hazard with instructions about hazard evaluations and determinations. The revised standard also establishes both hazard classes and hazard categories. The standard divides the classes into categories that reflect relative severity of the effect. The original

TABLE 7.9
New Labeling Requirements

- Pictogram: This method uses a symbol plus other graphic elements, such as a border, background pattern, or color to convey specific information about the hazards of a chemical. Each pictogram consists of a different symbol on a white background within a red square frame set on a point (a red diamond). The system requires the use of nine pictograms. However, OSHA requires the use of only eight pictograms under the revised standard.
- Signal words: This requirement consists of using a signal word to indicate the relative level of the severity of hazard to alert the reader of a potential hazard. The signal words used include *danger* and *warning*. Use danger for severe hazard and warning for less severe hazards.
- Hazard statement: This requirement consists of a statement assigned to a hazard class and category that describes the nature of the hazards of a chemical. It also includes, as appropriate, the degree of hazard.
- Precautionary statement: This phrase describes recommended measures to minimize or prevent adverse effects that could result from exposure to a hazardous chemical. It also applies to the improper storage or handling of a hazardous chemical.

standard did not include categories for most of the health hazards covered. OSHA included general provisions for hazard classification and Appendices A and B to address criteria for each health or physical effect.

Under the original standard, the label preparer provided the identity of the chemical and the appropriate hazard warnings. The preparer determined the method to convey the information. The revised standard specifies what information to provide for each hazard class and category (Table 7.9).

The revised standard requires the printing of all red borders on the label with a symbol printed inside. Chemical manufacturers, importers, distributors, or employers who become aware of any significant information regarding the hazards of a chemical must revise labels within 6 months of becoming aware of the new information. Employers can label workplace containers with the same label affixed to the shipped containers. Employers can also use label alternatives, including those described in NFPA 704, Hazard Rating and the Hazardous Material Information System. However, the information supplied on alternative labels must meet the requirements of the revised standard with no conflicting hazard warnings or pictograms.

Safety Data Sheet Changes

The information required on the SDS remains essentially the same as the original standard. The original standard requires specific information but did not specify a format for presentation or order of information. The revised standard requires presenting the information on the SDS using consistent headings in a specified sequence. Appendix D specifies the information required under each heading. The SDS format remains the same as the ANSI standard format (Table 7.10).

OSHA plans to retain the requirement to include the ACGIH TLVs on the SDS. OSHA found that requiring TLVs on the SDS will provide employers and employees with useful information to help them assess the hazards presented by their workplaces. OSHA will also require the inclusion of PELs and any other exposure limits used or recommended by the chemical manufacturer, importer, or employer preparing the SDS. The revised standard provides classifiers with the option of relying on the classification listings of IARC and NTP to make classification decisions regarding carcinogenicity rather than applying the criteria themselves. OSHA also included a nonmandatory Appendix F in the revised standard to provide guidance on hazard classification for carcinogenicity. Part A of Appendix F includes background guidance provided by GHS based on the "Preamble" of the IARC "Monographs on the Evaluation of Carcinogenic Risks to Humans." Part B provides IARC classification information. Part C provides background guidance from the National NTP "Report on Carcinogens."

TABLE 7.10
Required SDS Information

- Section 1. Identification
- Section 2. Hazard(s) identification
- Section 3. Composition/information on ingredients
- Section 4. First-aid measures
- Section 5. Fire-fighting measures
- Section 6. Accidental release measures
- Section 7. Handling and storage
- Section 8. Exposure controls/personal protection
- Section 9. Physical and chemical properties
- Section 10. Stability and reactivity
- Section 11. Toxicological information
- Section 12. Ecological information
- Section 13. Disposal considerations
- Section 14. Transport information
- Section 15. Regulatory information
- Section 16. Other information, including date of preparation or last revision

Note: OSHA does not mandate inclusion of Sections 12–15 in the SDS.

Managing and Communicating Changes to the Hazard Communication Standard

Consider the GHS as a living document with expectations of relevant updates on a 2-year cycle. OSHA anticipates future updates of the HCS to address the minor terminology changes, final rule text clarification, and additional rule-making efforts to address major changes.

Employee Training

The OSHA HCS (29 CFR 1910.1200) requires employers to provide employees information and training on hazardous chemicals used in their work areas. Employers must conduct training at the time of their initial assignment and upon the introduction of a new hazardous substance. Training must address the methods and observations used to detect the presence or release of the chemical. It must also address physical and health hazards, protective measures, labeling, and an explanation of the SDS. Employers must inform employees of the hazards of nonroutine tasks and the hazards associated with chemicals in unlabeled pipes (Table 7.11).

TABLE 7.11
HAZCOM-Mandated Training Topics

- Existence and requirements of the OSHA HCS
- Components of the local hazard communication plan
- Work areas and operations using hazardous materials
- Location of the written hazard evaluation procedures and hazard communication plan
- Location of the hazardous materials listing
- Location and accessibility of the SDS file

Aspects of Pesticide Regulation That GHS Does Not Affect

Implementing GHS does not change most aspects of the pesticide management. It does not affect supplemental information required on labels such as directions for use or additional hazard information that does not contradict or detract from GHS label requirements. It also does not impact testing methods for health and environmental hazards, data requirements, the scope of hazards covered, policies governing the protection of Confidential Business Information, or risk management measures.

DOT HAZARDOUS MATERIAL REGULATIONS

The secretary of the DOT receives the authority to regulate the transportation of hazardous materials from the Hazardous Materials Transportation Act, as amended and codified in 49 USC 5101 et seq. The secretary can issue regulations to implement the requirements of 49 USC. The Pipeline and Hazardous Materials Safety Administration (PHMSA) holds the responsibility to write the hazardous materials regulations, contained in 49 CFR Parts 100–180. Hazardous materials regulations changed significantly in recent years. The applicability of the hazardous materials regulations now extends to all intrastate shipments of hazardous materials by highway. Special agents of the DOT cannot be denied reasonable access to those areas that fall within the official scope of their duties. The secretary delegates authority to the FMCSA, Federal Railway Administration, PHMSA, and the USCG.

The Hazardous Materials Table located in 49 CFR 172.101 provides the initial step toward understanding how to ship a product. This table provides the proper shipping name (PSN), hazard class, UN identification numbers, and labels and packaging types necessary. Locate the PSN from the alphabetically arranged Hazardous Materials Table (Table 7.12).

Identify the contents of a shipment using shipping papers, markings, labeling, and placard information. Refer to the Hazardous Materials Table (49 CFR 172.101). A marking can include handwritten or a preprinted self-adhesive label containing required information such as PSN, the United Nations/North American (UN/NA) identification number, and the consignees or consignor's name and address (49 CFR 172.300). Labeling using a 4″×4″ square-on-point label helps visibly identify a hazardous materials package. Consider shipping labels as specific to the hazard classes of materials with strict specifications for setup, including color, size, and wording, as well as placement on a package (49 CFR 172.400–172.450). The Hazardous Materials Table contains a label column referencing the label for the specific chemical by the hazard class. A label chart that shows hazard class or division and the associated label plus the section reference can be found in 49 CFR 172.400(b). When using two labels, the less hazardous of the two is a secondary hazard. This secondary hazard must contain labeling that meets the requirements of 49 CFR 173.402. Use Special Precautions Labels such as *Empty* or *Cargo Aircraft Only* if required. OSHA standard 29 CFR 1910.1201

TABLE 7.12
DOT Hazard Classes

- Class 1: Explosive (1.1–1.6)
- Class 2: Gases (2.1 Flammable, 2.2 Non Flammable, 2.3 Poisons)
- Class 3: Flammable/Combustible Liquids
- Class 4: Solids (4.1 Flammable, 4.2 Spontaneously Combustible, 4.3 Dangerous When Wet)
- Class 5: Oxidizing Agents (5.1 Oxidizers, 5.2 Organic Peroxide)
- Class 6: Poisons (6.1 Poisons, 6.1 Keep Away from Food, 6.2 Infectious Material)
- Class 7: Radioactive (Radioactive I, Radioactive II, Radioactive III)
- Class 8: Corrosive
- Class 9: Miscellaneous

TABLE 7.13
Hazardous Materials Training

- Specific requirement located in 49 CFR 172.704.
- Air 49 CFR 175.20, Vessel 49 CFR 176.13, and Highway 49 CFR 177.800–177.816.
- Use a systematic approach consistent in approach, testing, and documentation.
- Ensure employees understand the regulations and can perform assigned functions.
- DOT 49, Hazardous Materials Table found in CFR 172.101 designates hazardous materials.
- List encompasses a wide range of chemicals and combustible/flammable liquids.

requires original DOT labels to remain on vehicles, tanks, and containers until removal or transfer of labeled substances.

Placards

Depending on the type and quantity of a shipment, placarding completes the identification process. Larger than labels, placards measure 10¾″ × 10¾″ but retain a similar square-on-point design. Placards deal with a specific hazard class of materials. DOT requires strict specifications for color, size and wording, and placement on a shipping vehicle (49 CFR 172.500.172.560).

Two tables help determine the requirement for placards (49 CFR 172.504). DOT requires placards for secondary hazards. Secondary hazards must follow the requirements contained in 49 CFR 172.519.

Containers

Determining the applicable container for shipping a hazardous material depends on the UN identification code on the drum. For more information regarding containers, refer to 49 CFR 178. To find information on a chemical, refer to the Hazardous Materials Table, SDS, *Merck Index*, *CRC Handbook of Chemistry and Physics*, or contact the manufacturer of the chemical (Table 7.13).

HEALTHCARE HAZARDOUS MATERIALS

Acetone

Acetone can be used as a chemical intermediate or as a solvent cleaner in fingernail polish remover, paint-related products, and in the chemical production of ketone substances. It possesses a vapor density twice that of air. Inhalation of acetone can result in slight narcosis to respiratory failure at extremely high concentrations. In the event of accidental contact, skin should be washed and affected clothing removed immediately. In case of eye contact, eyes should be rinsed for 15 min. Acetone should be stored in safety cans and cabinets that meet OSHA and NFPA 30 requirements. Workers should wear splash goggles and chemical protective gloves made of butyl. For respiratory protection, use air-purifying respirators equipped with organic vapor cartridges set to the manufacturer's maximum-use concentration.

Acryl Amide

Acryl amide, a resin usually found in research labs, is used to make gels for biochemical separations. It can cause eye and skin irritation. Long-term exposure could result in central nervous system disorders. Consider acryl amide as a suspected carcinogen and mutagen.

Ammonia

Ammonia is used as a liquid cleaning agent and as a refrigerant gas. Concentrated solutions of ammonia can cause severe burns. Workers should avoid skin contact with ammonia by wearing protective clothing. Workers handling concentrated solutions should wear rubber gloves and goggles or face shields. Provide adequate ventilation in areas where ammonia gas is released from concentrated solutions. Never store ammonia with deodorizing chemicals because the reaction can produce harmful by-products such as chlorine gas. The OSHA PEL is 50 ppm based on an 8 h TWA.

Asbestos

Airborne fibers that cause health damage may be too small to see with the eye. Inhaling these airborne asbestos fibers can cause asbestosis, mesothelioma, lung cancer, and cancers of the esophagus, stomach, colon, and rectum. OSHA regulations require surveillance and record-keeping for workers significantly exposed to asbestos. Asbestos is still encountered during routine maintenance activities, renovation projects, and demolition for new construction. Workers should work in a sealed environment using appropriate PPE. Periodic air sampling is required to document the level of exposure. Medical surveillance activities should include reinforcement of good work habits. Maintenance workers and facility engineers can be unknowingly exposed to asbestos from many possible areas and sources. Maintenance personnel can experience exposure when working in furnace rooms with asbestos-insulated boilers. Piping and tiles containing asbestos can also present exposure risks. Significant asbestos exposures can occur when removing insulation in older buildings. Maintenance personnel must use vigilance when working in areas that could contain asbestos.

OSHA Asbestos General Industry Standard (29 CFR 1910.1001)

Asbestos must be removed only by fully trained personnel using methods and protective equipment mandated by OSHA (29 CFR 1910.1001). The OSHA asbestos standard should be consulted along with the appropriate NIOSH and EPA publications. Only workers fully trained in asbestos handling should be allowed in areas where asbestos is exposed. OSHA outlines work practices appropriate for handling asbestos in 29 CFR 1910.1001. Healthcare organizations must outline OSHA requirements in the facility Asbestos Management Policy.

OSHA Asbestos Construction Standard (29 CFR 1926.1101)

The OSHA Construction Standard covers activities such as demolition, removal, repair, or encapsulation of ACM. It also covers building maintenance and custodial tasks. The Construction Standard divides asbestos work into four types:

- Class I asbestos work means activities in which thermal system insulation (pipe and boiler covering) or surfacing material such as sprayed-on fireproofing is removed.
- Class II asbestos work means removal of asbestos-containing wallboard, floor tile and sheeting, roofing and siding shingles, and construction mastics.
- Class III asbestos work means repair and maintenance jobs where ACM (including thermal system insulation or surfacing materials) is likely to be disturbed.
- Class IV asbestos work means maintenance and custodial activities during which employees contact ACM or PACM and clean up waste containing ACM and PACM.

EPA Standards

- EPA Asbestos-In-Schools Rule (40 CFR Part 763 Subpart E) requires schools to inspect buildings for asbestos and prevent exposure worker/occupant exposure.
- EPA National Emission Standards for Hazardous Air Pollutants (NESHAP 40 CFR 61 Subpart M) requires removal of asbestos before demolition, notification of EPA before removal, preventing release of fibers into the air, and waste disposal.

Benzene (29 CFR 1910.1028)

Benzene, a hazardous solvent found in laboratories and in some maintenance departments, can contribute to dangerous overexposure incidents. High levels of exposure can cause acute central nervous system depression. It can also cause eye, skin, and upper respiratory irritation. NIOSH considers benzene as a known human carcinogen. Personnel must properly store benzene to reduce contact with oxidizing materials such as nitrates, peroxides, and chlorates. For respiratory protection from benzene at any exposure level, use a NIOSH-approved supplied-air respirator with full face piece.

Cadmium (29 CFR 1910.1027)

Cadmium is a soft, blue and white metal or grayish-white powder commonly used as an anticorrosive for electroplated steel. Exposures occur mainly in the gas meter refurbishing, aircraft repair, and in shipyard industries. Certain materials and products such as paints, batteries, and phosphate fertilizers also contain cadmium. Healthcare safety personnel must remember that the presence of cadmium can occur in lead molds used in radiation medicine. Treat cadmium as a potential lung carcinogen. Breathing in high levels can cause severe damage to the lungs. Short-term effects of exposure include weakness, fever, headaches, chills, sweating, and muscular pain. Long-term effects can lead to kidney damage, emphysema, and bone deterioration. Cadmium exposure can also cause anemia, discoloration of teeth, and loss of the sense of smell. OSHA requires establishment and implementation of a written plan for cadmium if exposure levels exceed the PEL.

Carbon Monoxide

Carbon monoxide (CO), a colorless, odorless, and tasteless gas, is slightly lighter than air. It is sometimes called carbonic oxide, exhaust gas, or flue gas. CO occurs due to the incomplete combustion of any fuel that contains carbon. Sources include laboratories, equipment rooms, boilers, and emergency generators. CO can asphyxiate, and it is the leading cause of death in fires. High concentrations will displace enough oxygen in your body, resulting in oxygen starvation. The symptoms of low-level CO poisoning include headaches, nausea, weakness, dizziness, and confusion. If exposed to CO long enough, coma and death can occur. Consider any concentration of 1200 ppm or higher as immediately dangerous to life or health (IDLH).

Chlorine Compounds

Chlorine is commonly used for sanitizing counter and tabletop surfaces. Household bleach commonly used as a disinfecting solution is a mixture of ¼ cup chlorine to a gallon of water. Chlorine should be mixed fresh daily and used for disinfection on noncritical surfaces such as disinfecting water tanks and cleaning bathrooms. It is also used as a laundry additive, a sanitizing solution for dishwashing, and a disinfectant for floors. Chlorine-based substances should not be mixed with materials containing ammonia because the reaction will produce a toxic gas. Mild irritation of the mucous membranes can occur at exposure concentrations of 0.5 ppm. The OSHA PEL for chlorine is a ceiling of 1 ppm according to 29 CFR 1910.1000, Table Z-1. Chlorine possesses an odor threshold between 0.02 and 0.2 ppm, but a person's sense of smell is dulled by continued exposure.

Iodine

Iodine works as a general disinfectant and can be used with alcohol for use as a skin antiseptic or with other substances for general disinfecting purposes. Exposure can include irritation of the eyes and mucous membranes, headaches, and breathing difficulties. Crystalline iodine or strong solutions of iodine may cause severe skin irritation because it is not easily removed and may cause burns. The OSHA PEL sets a ceiling for iodine 0.1 ppm according to 29 CFR 1901.1000 Table Z-1.

Isopropyl Alcohol

Isopropyl alcohol, a widely used antiseptic and disinfectant, is used to disinfect thermometers, needles, anesthesia equipment, and other instruments. The odor of isopropyl alcohol may be detected at concentrations of 40–200 ppm. Exposure to isopropyl alcohol can cause irritation of the eyes and mucous membranes. Contact with the liquid may also cause skin rashes. The OSHA PEL is 400 ppm for an 8 h TWA. Workers should use appropriate protective clothing such as gloves and face shields to prevent repeated or prolonged skin contact with isopropyl alcohol. Splash-proof safety goggles should also be provided and required for use where isopropyl alcohol may contact the eyes.

Lead (29 CFR 1910.25)

The OSHA standard requires employers to provide initial and annual training to all employees exposed to an airborne concentration of lead of 30 $\mu g/m^3$, averaged over an 8 h period. In some old facilities, exposure can come from lead-based paint or lead-soldered pipe connections. Construction and renovation projects can release lead particles into the air. Hospital departments of nuclear medicine use lead molds in patient treatment. Organizations must confine lead to a specific area. Decontamination and shower facilities should be provided to keep lead from being tracked to other areas. Provide respiratory protection and protective clothing wherever there is known exposure potential.

Mercury

Mercury can be found in some pressure-sensing instruments such as barometers and sensors in mechanical rooms. It can also be found in laboratories and some physical plant instruments and switches.

Methyl Methacrylate

Methyl methacrylate is used in the fields of medicine and dentistry to make prosthetic devices and as a ceramic filler or cement. It is an acrylic cement–like substance used to secure prostheses to bone during orthopedic surgery. Exposure usually occurs during mixing, preparation, and in the operating room. Symptoms from overexposure can include coughing, chest pain, headache, drowsiness, nausea, anorexia, irritability, and narcosis. Very high levels may cause pulmonary edema and death. Exposure can cause irritation to skin, which can include redness, itching, and pain. The substance may be absorbed through the skin and can irritate the eyes. Dental technicians using bare hands with methyl methacrylate molding putty developed changes in the nerve impulse transmission in the fingers. Repeated skin exposures may cause tingling or prickling sensation of the skin. Persons with preexisting skin disorders or eye problems, or impaired liver, kidney, or respiratory function may be more susceptible to the effects of the substance. OSHA recommends mixing in a closed system, if possible.

Peracetic Acid

Peracetic acid is a powerful sterilant with a sharp, pungent odor. At higher concentrations (1%), it can promote tumors in mouse skin. A machine system containing 0.2% peracetic acid heated to about 50°C can sterilize rigid and flexible endoscopes within a 45 min cycle time. The system uses the peracetic acid once only and is relatively expensive. Minimize odor and toxicity concerns containing the peracetic acid within the closed machine. Peracetic acid is used to sterilize the surfaces of medical instruments and may be found in laboratories, central supply, and patient care units. It is a strong skin, eye, and mucous membrane irritant. Currently, no standards exist for regulating exposures to peracetic acid.

Pesticides

The EPA considers insecticides, herbicides, fungicides, disinfectants, rodenticides, and animal repellents as pesticides. OSHA considers pesticides as hazardous substances under the OSHA HCS. EPA regulates pesticides under their FIFRA regulations. All pesticides sold in the United States must carry an EPA registration number. Consider these registered substances as safe and effective when used according to directions. Pesticides labeled DANGER—POISON indicates highly toxic substances. If inhaled, ingested, or left on the skin, they may be lethal. All workers handling, loading, mixing, or applying pesticides fall under the EPA Worker Protection Standards. Responsibility for the safe use of these toxic materials begins with purchase and continues until the empty container is properly discarded. All pesticides sold in the United States must carry an EPA registration number. The EPA Worker Protection Standard, 40 CFR 156 and 170, contains regulations that address the handling, loading, mixing, or applying pesticides or those repairing pesticide-applying equipment. This standard affects all forestry, greenhouse, and nursery workers who perform hand labor in pesticide-treated fields. Some pesticide products require verbal warnings and posted warning signs.

Phenol Substances

Phenol solutions can prove effective for a wide range of bacteria. Some phenolic substances may also be used for intermediate-level disinfection when effective against TB. Phenol may work well for surfaces, equipment, prosthetics, bite registrations, and partial dentures. Avoid skin or mucous membrane exposures. Phenol may be detected by odor at a concentration of about 0.05 ppm. Serious health effects may follow exposure to phenol through skin adsorption, inhalation, or ingestion. The OSHA PEL for phenol is 5 ppm for an 8 h TWA skin exposure. Workers exposed to phenol should wash their hands thoroughly before eating, smoking, or using toilet facilities.

Quaternary Ammonium Compounds

These substances, widely used as disinfectants, do not work effectively against tuberculosis and gram-negative bacteria. Central sterile, environmental services, patient care areas, and clinical services use quaternary compounds for general low-level disinfecting tasks. These compounds may cause contact dermatitis and nasal irritation but less irritating to hands than other types of substances.

Solvents

Most solvents remove the natural fats and oils from the skin and may be absorbed. Organic solvents pose flammability hazards. Safety personnel must properly store solvents in approved safety containers. Local exhaust ventilation and enclosure of solvent vapor sources should be used to control laboratory exposures. When selecting engineering and other controls, safety personnel must consider both toxicity and flammability risks. Toluene and xylene used in laboratories can cause eye and respiratory irritation resulting from exposure to liquid and vapor forms. Other exposure symptoms include abdominal pains, nausea, and vomiting, and possible loss of consciousness could occur if ingested in large amounts. Most individuals can sense the odor of toluene at 8 ppm. Inhaling high levels of toluene in a short time can cause light-headed sensations and drowsiness. Toluene must be stored to avoid contact with strong oxidizers such as chlorine, bromine, and fluorine. Xylene can also be found in some maintenance departments and clinical labs. OSHA and NIOSH set xylene exposure limits at 100 ppm. Store all solvents in accordance with NFPA 30 requirements.

Ethyl Alcohol

Many healthcare facilities use 70% ethyl alcohol as a topical application in local skin disinfection. Consider ethyl alcohol as flammable in all dilutions where vapor may come in contact with an

ignition source. The flash point of a 70% solution is approximately 70°F. Ethyl alcohol can enhance the drying of the skin. Take care when using to avoid dermatitis. Make disposal after thoroughly diluting with water and only in an area with adequate ventilation. Maintain ethyl alcohol in volumes over 70% in a flammable storage cabinet away from patient care areas. In case of fire, use a type BC Fire Extinguisher.

Glutaraldehyde

Use glutaraldehyde to disinfect and clean heat-sensitive medical, surgical, and dental equipment. Glutaraldehyde solutions serve as a tissue fixative in histology and pathology labs. Absorption may occur by inhalation, dermal contact, or ingestion. Use ventilation controls to prevent overexposure, which can cause allergic eczema and mucous membrane irritation. Date all solutions to ensure effectiveness against bactericidal contamination. Glutaraldehyde is used to disinfect and clean heat-sensitive equipment such as dialysis instruments, surgical instruments, suction bottles, bronchoscopes, and endoscopes. It works well to disinfect ear, nose, and throat instruments. The colorless and oily substance gives off a pungent odor. Hospital workers use it most often in a diluted form mixed with water or in a commercially prepared product. OSHA does not currently publish a PEL for glutaraldehyde. The ACGIH recommends ceiling TLV of 0.05 ppm. NIOSH publishes a recommended exposure limit (REL) of 0.2 ppm for glutaraldehyde vapor from either activated or inactivated solutions. Refer to the NIOSH publication, *Glutaraldehyde Occupational Hazards in Hospitals,* DHHS (NIOSH) Publication No. 2001-115 May 2001.

ETHYLENE OXIDE (29 CFR 1910.1047)

Ethylene oxide (ETO) exposure most commonly occurs by dermal absorption or inhalation. ETO exists as a colorless liquid at temperatures below 51.7°F. As a gas, it produces ether-like odor at concentrations above 700 ppm. It is both flammable and highly reactive. The current OSHA PEL for ETO is 1 ppm for an 8 h TWA with a 5 ppm excursion level. ETO is used within central supply to sterilize items that cannot be exposed to steam sterilization. Exposure usually results from improper aeration of the ETO chamber after the sterilizing process. Exposure can also happen during off-gassing of sterilized items or poor gas line connections. You can find ETO in outpatient surgery clinics, cardiac cath-labs, operating rooms, dental labs, and autopsy labs. OSHA publishes a limit on workplace exposure of 1 ppm averaged over an 8 h TWA. OSHA mandates an action level of 0.5 ppm and a STEL of 5.0 ppm averaged over a sampling period of 15 min. OSHA prohibits worker rotation as a way of compliance with the excursion limit. OSHA requires employers to develop a *written emergency plan* to protect employees during any potential release. Employers must also provide information through signs and labels that clearly indicate carcinogenic and reproductive hazards. Initial and annual training should be given to workers who may be exposed at the action level.

FORMALDEHYDE (29 CFR 1910.1048)

Formaldehyde is used as a fixative and is commonly found in most laboratories and the morgue. It can cause eye and respiratory irritation, abdominal pains, nausea, and vomiting. High concentration of vapor inhaled for long periods can cause laryngitis, bronchitis, or bronchial pneumonia. Prolonged exposure may cause conjunctivitis. OSHA considers formaldehyde as a suspected carcinogen. Exposure risk areas include autopsy rooms, pathology laboratories, and dialysis units. Exposure also commonly occurs in endoscopy and surgical facilities. Preplacement and periodic examinations should include baseline and periodic pulmonary, dermal, and hepatic evaluations. Require the use of PPE, including appropriate gloves, when responding to spills. Odor is not a reliable warning for the presence of formaldehyde because the workers' ability to smell formaldehyde is quickly extinguished. Studies indicate formaldehyde as a potential carcinogen. Airborne

concentrations above 0.1 ppm can irritate the eyes, nose, and throat. Formaldehyde is often combined with methanol and water to make formalin. The 1992 OSHA lowered the PEL for formaldehyde to 0.75 ppm as an 8 h TWA.

HAZARDOUS DRUGS

Studies indicate that workplace exposures to hazardous drugs can result in health problems such as skin rashes, infertility, spontaneous abortions, congenital malformations, and possibly leukemia or other cancers. Health risks vary by the extent of the exposure and potency and/or toxicity of hazardous drugs. Potential health effects can be minimized through sound procedures for handling hazardous drugs, engineering controls, and proper use of protective equipment to protect workers to the greatest degree possible. The NIOSH Working Group on Hazardous Drugs in 2004 defined as hazardous any drug exhibiting at least one of the following characteristics in humans or animals: (1) carcinogenic or other developmental toxicity, (2) reproductive toxicity, (3) organ toxicity at low doses, and (4) structure and toxicity profiles of new drugs that mimic existing drugs as determined hazardous by the aforementioned criteria. Workers must receive standardized training on the hazardous drugs and equipment/procedures used to prevent exposure. Prepare all agents within a ventilated cabinet designed to protect workers and adjacent personnel from exposure. Develop procedures to provide product protection for all drugs that require aseptic handling. Use two pairs of powder-free, disposable chemotherapy gloves with the outer one covering the gown cuff when mixing drugs. Avoid skin contact by using a disposable gown made of a low-lint and low-permeability fabric. Require to wear a face shield to avoid splash incidents involving eyes, nose, or mouth when engineering controls do not provide adequate protection. Wash hands with soap and water immediately before using and after removing personal protective clothing, such as disposable gloves and gowns. Use syringes and IV sets with lock-type fittings when preparing and administering hazardous drugs. Decontaminate work areas before and after each mixing activity. Clean up small spills immediately using appropriate safety precautions and PPE. Implement the facility spill response plan for large spills. Refer to Chapter 14 for more comprehensive information about hazard and dangerous drug safety.

Hazardous Pharmaceutical Wastes

The EPA defines hazardous wastes in the RCRA. This waste also includes pharmaceutical wastes that contain toxic chemicals or exhibit properties that make them hazardous to the environment and/or humans. RCRA wastes include broken or spilled vials, partial vials, expired products, and patient's personal medications. EPA limits hazardous waste maximum storage time to 90 or 180 days based on generator status. All wastes must be stored in a separate and locked area clearly marked so that it cannot become a food source or breeding place for insects or animals. Like infectious wastes, there is no time limit to fill the container. Not all states mandate the same storage requirements. Contact local and state authorities for additional information. EPA's P-listed chemicals (40 CFR 261.33) include such pharmaceuticals as epinephrine, nicotine, chloroform, and warfarin over 0.3%. The U-listed chemicals (40 CFR 261.33) include many used in chemotherapy, such as paraldehyde, mercury, phenol, and warfarin under 0.3%.

MEDICAL GAS SYSTEMS

Refer to NFPA 99-2012, Chapters 1–5 medical gas information, previously contained in NFPA 99C. Medical gas personnel can also access the NFPA 99-2012 handbook for all of the former NFPA 99C medical gas and vacuum systems content. Refer to the CGA pamphlet "Characteristics and Safe Handling of Medical Gases" (No. P2). Refer to the OSHA publication, "Anesthetic Gases: Guidelines for Workplace Exposures," for occupational safety information. Bulk medical

gas systems involving oxygen and nitrous oxide should meet requirements of the CGA pamphlet "Standard for the Installation of Nitrous Oxide Systems" (No. 8.1) or NFPA 50, Standard for Bulk Oxygen Systems. Refer to the publication, "Anesthetic Gases: Guidelines for Workplace Exposures and Controlling Exposures to Nitrous Oxide during Anesthetic Administration," NIOSH Publication No. 94-100. For additional information, refer to ANSI/Z 79.11-1982, "Anesthesia Gas Scavenging Devices and Disposal Systems." The NIOSH publication "Development and Evaluation of Methods for the Elimination of Waste Anesthetic Gases and Vapors in Hospitals" contains information about control methods to establish and maintain low concentrations of waste anesthetic gas in operating rooms. ASSE 6040 Standard Medical Gas Pipeline System Certification requires that all maintenance of medical gas and vacuum systems must be performed by individuals who are qualified under the provisions of ASSE 6040. The candidates shall be employed or contracted by a healthcare facility, or actively engaged in working with medical gas systems, and document 1 year of minimum experience in the maintenance of medical gas systems. To pass the exam requires a minimum score of 75%.

Inspect, test, and maintain critical components of piped medical gas systems, including master signal panels, area alarms, automatic pressure switches, shutoff valves, flexible connectors, and outlets. Test piped medical gas and vacuum systems when the systems installed, modified, or repaired, including cross-connection testing, piping purity testing, and pressure testing. Maintain the main supply valve and area shut-off valves of piped medical gas and vacuum systems to be accessible and clearly labeled. These systems provide oxygen, nitrous oxide, and compressed air throughout the facility. When using such systems, heavy and bulky bottles or tanks do not require physical transport throughout a building. A plan addressing preventive maintenance and periodic inspection helps ensure that medical gas systems operate safely and reliably. As part of an effective management and maintenance plan, inspections and corrective actions should be documented and any faulty fittings should be repaired or replaced immediately. In the event of a system outage, notify nursing personnel and medical staff. In addition, labeling shutoff controls and providing signs at outlet locations, as well as identifying piping, will help ensure safety in a facility. Keep system piping free from contamination and protect cylinders from weather extremes. Some other requirements include checking the following:

1. Doors or gates to enclosures for the gas supply systems will be locked.
2. Enclosures for gas supply systems will not be used for storage purposes other than for cylinders containing the nonflammable gases that are to be distributed through the pipeline.
3. Storage of empty cylinders disconnected from the supply equipment is permissible.
4. Empty cylinders will be segregated and identified.
5. Cylinders not in use will be capped and secured in a vertical position by a chain or similar device.
6. Cylinders connected to a manifold will also be secured. Plumbing (tubing and so forth) to the manifold will not suffice for this purpose.
7. Smoking is prohibited in the gas supply system enclosure. *No Smoking* signs will be posted.

Anesthetic Gas Hazards

Healthcare worker exposures to anesthetic gases can result in the risk of occupational illnesses. Healthcare facilities can now better control anesthetic gases through the use and improved design of scavenging systems, installation of more effective general ventilation systems, and increased attention to equipment maintenance and leak detection as well as to careful anesthetic practice. Exposure can occur in the operating room, recovery room, or postanesthesia care unit. Some potential health effects of exposure to waste anesthetic gases include nausea, dizziness, headaches, fatigue, irritability, drowsiness, problems with coordination and judgment, as well as sterility, miscarriages, birth defects, cancer, and liver and kidney disease. Use appropriate anesthetic gas scavenging systems in

operating rooms. Appropriate waste gas evacuation involves collecting and removing waste gases, detecting and correcting leaks, considering work practices, and effectively ventilating the room. The American Institute of Architects recommends an air exchange rate of 15 air changes per hour with a minimum of 3 air changes of fresh air per hour. Never recirculate operating room air containing waste anesthetic gases to the operating room or other hospital locations. Exposure measurements taken in operating rooms during the clinical administration of inhaled anesthetics indicate that waste gases can escape into the room air from various components of the anesthesia delivery system. Potential leak sources include tank valves; high- and low-pressure machine connections; connections in the breathing circuit, defects in rubber and plastic tubing, hoses, reservoir bags, and ventilator bellows; and the connector. In addition, selected anesthesia techniques and improper practices such as leaving gas flow control valves open and vaporizers on after use, spillage of liquid-inhaled anesthetics, and poorly fitting face masks or improperly inflated tracheal tube and laryngeal mask airway cuffs also can contribute to the escape of waste anesthetic gases into the surgical area atmosphere. OSHA does not publish exposure limits regulating halogenated agents. NIOSH issues RELs for both nitrous oxide and halogenated agents. The NIOSH REL for nitrous oxide, when nitrous oxide is used as the sole inhaled anesthetic agent, is 25 ppm measured as a TWA during the period of anesthetic administration. NIOSH also recommended that no worker should be exposed at ceiling concentrations greater than 2 ppm of any halogenated anesthetic agent over a sampling period not to exceed 1 h. NIOSH does currently publish RELs for isoflurane, desflurane, and sevoflurane.

Scavenging

Scavenging is the process of collecting and disposing of waste anesthetic gases and vapors from breathing systems at the site of overflow. It is carried out to protect operating room personnel by preventing the dispersal of anesthetic gases into the room air. A scavenging system consists of two key components. The first is a collecting device or scavenging adapter to collect waste gases, and the second is a disposal route to carry gases from the room. This document includes techniques for scavenging, maintaining equipment, monitoring air, and minimizing leakage while administering anesthesia. Persons responsible for health and safety in the hospital surgical department should be aware of the availability of new products and new information on familiar products (Table 7.14).

Nitric Oxide

Nitric oxide was approved by the FDA in 1999 for use as a vasodilator in the treatment of hypoxic respiratory failure in full- and near-term infants. It is a colorless and essentially odorless gas with a very narrow therapeutic window for patients. Acute exposure effects include mucous membrane

TABLE 7.14
Scavenging System Components (ASTM F 1343-91)

- A gas collection assembly such as a collection manifold or a distensible bag captures excess anesthetic gases at the site of emission and delivers it to the transfer tubing.
- Transfer tubing then conveys the excess anesthetic gases to the interface.
- The interface, which provides positive and sometimes negative pressure relief and may provide reservoir capacity. It is designed to protect the patient's lungs from excessive positive or negative scavenging system pressure.
- Gas disposal assembly tubing conducts the excess anesthetic gases from the interface to the gas disposal assembly.
- The gas disposal assembly conveys the excess gases to a point where they can be discharged safely into the atmosphere. Several methods in use include a nonrecirculating or recirculating ventilation system, a central vacuum system, a dedicated waste gas exhaust system, or a passive duct system.

irritation and drowsiness. More serious effects include delayed pulmonary toxicity and damage to the central nervous system effects. Exposed employees may seem relatively asymptomatic at the time of exposure. It can take as long as 72 h to manifest clinical symptoms. OSHA classifies nitric oxide as a highly hazardous substance.

Nitrous Oxide

Nitrous oxide (N_2O), a clear, colorless, and oxidizing liquefied gas, possesses a slightly sweet odor. The product remains stable and inert at room temperature. While classified by the DOT as a nonflammable gas, nitrous oxide will support combustion and can deteriorate at temperatures in excess of 1202°F. Nitrous oxide is blended with oxygen when used in anesthesia applications. Pure nitrous oxide will cause asphyxiation. The painkilling and numbing qualities of inhaled nitrous oxide begin to take effect at concentrations of 10%. The CGA and National Welding Supply Association identify initiatives to address the N_2O abuse issues.

MANAGING WASTE

Virtually, all healthcare and industrial facilities generate hazardous wastes as defined by the Resource Conservation and Recovery Act. Each facility must develop effective waste management plans. Effectively managing inventory provides the next best opportunity to reduce hazardous waste generation. The land should be updated as required. Never discard any hazardous chemical down the drain, in a toilet, or on the ground outside. Never attempt to burn chemical waste under any circumstances. Never place hazardous chemicals in trashcans or garbage containers destined for landfills.

Always read the label, check the SDS, and follow established facility procedures. Even a small amount of some chemicals when left in a container can pose danger. Dispose of all waste containers according to required procedures. Wastes can react with one another and burn, release toxic vapors, or explode (Table 7.15).

The EPA requires generators to track all materials using the *cradle-to-grave* management approach. Develop policies and procedures for identifying, handling, storing, using, and disposing of hazardous wastes from generation to final disposal. Provide training for all exposed personnel. Monitor personnel who manage or regularly come into contact with hazardous materials and/or wastes. Evaluate effectiveness of the planning documents and provide reports to senior leaders. RCRA Subtitle C regulations focus on the management of wastes with hazardous properties. The regulations help protect human health and the environment from mismanagement of hazardous wastes. Generators normally cannot store hazardous waste for more than 90 days under EPA regulations. RCRA Subtitle C established four characteristics of hazardous waste. The four categories include corrosiveness, ignitability, reactivity, and toxicity. The EPA considers solid waste as hazardous waste if it meets the following criteria: (1) listed as a hazardous waste in the regulations;

TABLE 7.15
Key Elements of Waste Management

- Inventory and categorization of wastes
- Identification of hazards during daily activities
- Knowledge of storage requirements
- Distribution and special handling issues
- Special cleanup procedures
- Disposal procedures to include identification, transport, pickup, and end point

(2) substance contains a listed hazardous waste; and (3) waste was derived from the treatment, storage, or disposal of a listed hazardous waste. EPA and state environmental agencies possess authority to inspect facilities and their records at any reasonable time. When an EPA inspector finds that the facility is in violation of RCRA or its permit, enforcement action in the form of compliance order including administratively imposed injunctions or court actions may follow.

Medical Waste

Healthcare facilities, hospitals, clinics, physician offices, dental practices, blood banks, veterinary clinics, medical research facilities, and laboratories all generate medical waste. The Medical Waste Tracking Act of 1988 defines medical waste as "any solid waste that is generated in the diagnosis, treatment, or immunization of human beings or animals, in research pertaining thereto, or in the production or testing of biologicals." This definition includes, but is not limited to blood-soaked bandages, culture dishes and other glassware, surgical gloves and instruments, sharps and needles, cultures, and pathological waste. The EPA also defines medical waste in 40 CFR 259.10 and 40 CFR 22 as any solid waste generated in the diagnosis, treatment, or immunization of human beings or animals. Most states regulate medical waste within their jurisdictions.

Other Types of Hazardous Waste

The EPA considers as hazardous any *ignitable solid waste* exhibiting any of the following properties: (1) any liquid, except aqueous solutions containing less that 24% alcohol that possesses a flash point less than 140°F; (2) any nonliquid substance capable, under normal conditions, of spontaneous or sustained combustion; or (3) an ignitable compressed gas or oxidizing material as defined by DOT regulations. The EPA considers mixed waste as hazardous under RCRA and radioactive under the Atomic Energy Act. Both the NRC and the EPA work together to address the management of these wastes. Generators of mixed waste must comply with both RCRA and NRC regulations.

Universal Waste

EPA's waste regulations streamline management standards for federally designated universal wastes. These wastes include batteries, pesticides, and mercury-containing equipment, bulbs, or lamps. Universal waste normally poses a relatively low risk during accumulation and transport. Recycling these wastes by adhering to the universal waste regulation facilitates environmentally sound management practices. The regulations also ensure that the wastes subject to this system will go to appropriate treatment or recycling facilities pursuant to the full hazardous waste regulatory controls. Refer to 40 CFR 273 for the federal universal waste regulations. States can modify the universal waste rule or add additional universal wastes in state regulations. The EPA recently proposed adding hazardous pharmaceutical waste to the Universal Waste Rule.

Electronic Waste (E-Waste)

The use of electronic products continues to grow at a phenomenal pace. According to the Consumer Electronics Association, each American household contains about 24 electronic products. Donating used electronics for reuse extends the lives of valuable products. Recycling electronics prevents valuable materials from going into the waste stream. Many states currently enforce laws on disposal and recycling of electronics. The EPA encourages all electronics recyclers to become certified and all customers to choose certified recyclers. Some electronic devices such as color CRTs, computer monitors, color CRT TV tubes, cell phones, and other *handheld* devices could test as *hazardous* under Federal laws. EPA encourages reuse and recycling of used electronics, including those that test *hazardous*. The EPA does not consider computer monitors and televisions sent for continued

use such as resale or donation as hazardous wastes. The EPA encourages recycling of CRTs, and those sent for recycling become subject to streamlined handling requirements. For more information on the CRT rule, including export requirements and frequent questions, please refer to the EPA Cathode Ray Tubes Final Rule. Circuit boards receive a special exemption from federal hazardous waste rules. Whole used circuit boards meet the definition of spent materials but also meet the definition of scrap metal. EPA exempts recycled whole used circuit boards from hazardous waste regulation. EPA also excludes shredded circuit boards from the definition of solid waste if containerized prior to recovery. Shredded circuit boards cannot contain mercury switches, mercury relays, nickel cadmium batteries, or lithium batteries. Refer to 40 CFR 260–262 for rules governing hazard waste generation. All facilities generating more than 100 kg or 220 lb per month fall under federal hazardous waste regulations. EPA considers all CRTs coming from such facilities as permit-required hazardous waste. The EPA will exempt CRTs from businesses generating less than 100 kg or 220 lb per month of hazardous waste. If a *small quantity generator* wishes to dispose of a small quantity of CRTs or other used electronics that does test hazardous under federal law, these materials can go to any disposal facility authorized to receive solid waste unless state law requires more stringent management. State regulatory requirements for e-waste can be more stringent than the federal requirements and vary from state to state. Some states may develop universal waste exemptions for CRT. This action would streamline the management of CRTs bound for recycling. When planning to dispose of used CRTs or other electronics that test "hazardous" under state or federal law, check state requirements to ensure compliance.

Proper Hazardous Waste Marking and Labeling

The critical step in safe handling of a hazardous waste relates to marking and labeling of all containers. To ensure uniformity in the marking and labeling of containers while the waste is being accumulated to its ultimate disposal, both the US DOT and US Environmental Protection Agency offer specific regulatory guidance (49 CFR 172, 173, 178, and 179) for hazardous waste generators to follow. These requirements differ from the OSHA Hazardous Communication Standard (29 CFR 1910.1200), which offers labeling guidance for hazardous materials not designated as a waste.

DOT Labels

Locate labels near any markings and on the same surface. Never place labels on the bottom of containers. Ensure all labels remain visible. If the waste contains multiple hazards, display multiple labels next to each other. The DOT recommends a 6 in. space between labels. The label designating the primary hazard should be above and to the left of the label designating the subsidiary hazard. When overpacking hazardous material packages, properly label the inner containers. The same labeling applies to the overpacked container. For example, paint containers packed in shrink-wrap require both individual labels and a label on the shrink-wrap. Marking remains a critical process in preparing hazardous materials for transportation. While no standardized hazardous waste marker format exists, both the DOT and EPA publish specific marking requirements (Table 7.16).

HAZARDOUS WASTE OPERATIONS AND EMERGENCY RESPONSE STANDARD

The HAZWOPER Standard, 29 CFR 1910.120, requires placement of DOT-specified salvage drums or containers with suitable quantities of proper absorbent materials in areas where spills, leaks, or ruptures may occur. OSHA requires the development of spill procedures to contain and isolate the entire volume of the hazardous substance. Responders must meet the training requirements of the OSHA standard. OSHA also mandates the use of appropriate PPE when responding to a spill or supporting decontamination activities. Responders must know the types of chemicals, level of exposure risk, and physical characteristics of the chemical hazard. Responders must know about

TABLE 7.16
Sources for More Information

- 49 CFR 172.101 Subpart B, Purpose and Use of Hazardous Materials Table and Table of Hazardous Materials
- 49 CFR 172.102, Special Provisions
- 49 CFR 172.300 Subpart D, Marking and Applicability
- 49 CFR 172.400 Subpart E, Labeling
- 49 CFR 172.400(b), General Labeling Requirements Table
- 49 CFR 172.402, Additional Labeling Requirements
- 49 CFR 173, Definitions, Classifications, Packing Group Assignments and Exceptions for Hazardous Materials Class 1 and Class 7
- 40 CFR 260, Hazardous Waste Management System

potential hazards to the body. These hazards include toxicity, carcinogenic, asphyxiate, or corrosive nature of the chemicals. The EPA's Office of Emergency and Remedial Response defines four levels of protection for chemical response operations. Level A provides the highest level of skin and respiratory protection available. Appropriate for possible threats to life and health and during operations dealing with an unknown hazard. This level requires the highest level of respiratory protection with air-supplied respirators. Level B offers protection from chemical splash, but does not prevent exposure to gases or vapors. Level B requires the highest level of respiratory protection. Level C provides the same as level B but with an air-purifying respirator. Level D refers to the lowest level of protection and offers minimal protection for nuisance exposure. Refer to OSHA 29 CFR 1910.120 Appendix B for more specific information.

Chemical Protective Clothing

When selecting chemical-resistant clothing, consider materials measured by permeation testing methods of ASTM Standard F739. Breakthrough time refers to the time it takes the test chemical to pass from the outside surface of clothing sample until detected on the inside surface of clothing. Permeation rate refers to the speed a chemical passes through the clothing once breakthrough occurs. 29 CFR 1910, Subpart I, Appendix B, recommends that for mixtures and formulated products (unless availability of specific test data), select a glove with the shortest breakthrough time. Protective eyewear should match the work application. Goggles provide the most protection since they form a seal around the eye area. Goggles come in vented and nonvented styles. Vented goggles offer protection from impact hazards only. Antifog lens can help increase vision. Face shields provide secondary protection against liquid splash, gases, vapors, or flying particles. When wearing a face shield, require the wear of goggles or safety glasses.

HAZWOPER and Hospitals

Healthcare workers dealing with emergencies may experience exposure to chemical, biological, physical, or radiological hazards. Hospitals responding to these emergencies must prepare to carry out their missions without jeopardizing the safety and health of their staff. The OSHA established a comprehensive rule to protect employee health and safety during hazardous waste operations, including emergency responses to the release of hazardous substances. The HAZWOPER 29 CFR 1910.120 became effective in 1990. HAZWOPER requires varying levels of training for personnel involved in hazardous material releases or cleanup. HAZWOPER functions as a performance-based regulation allowing individual employers flexibility in meeting the requirements of the regulation in the most economical manner. After determining possible exposures through worst-case scenarios,

TABLE 7.17
Hazardous Materials Spill Response Actions

- Evacuate personnel from the immediate area.
- Identify the spilled substance.
- Implement the spill response plan.
- Block access to the spill area and cordon off.
- Notify personnel in nearby areas.
- Extinguish or disconnect all sources of ignition.
- Contact fire department for flammable or extremely hazardous materials.
- Ensure personnel use appropriate PPE.
- Contain the spill in accordance with local policies.
- Clean up the spill if trained and qualified to do so.
- Dispose of the spill materials in accordance with regulations.

TABLE 7.18
Types of Absorbent Materials

- Universal: This type of material absorbs any liquid including acids, solvents, cleaners, disinfectants, gasoline, and alcohols.
- Petroleum: Designed to absorb oil and petroleum-based liquids. These absorbents will not absorb water or water-based liquids.
- Maintenance: Absorbents used for maintenance operations including coolants, lubricants, oils, and cutting fluids. Maintenance absorbents will pick up water-based as well as oil-based fluids.

Note: Acquire the appropriate spill containment tools to include drain protectors, drain plugs, drum plugs, neutralizers, and sorbent materials.

train all employees how to perform their anticipated job duties without endangering themselves or others. Medical personnel who will decontaminate victims must be trained to the first responder operations level (1) with emphasis on the selection and use of PPE and decontamination procedures. For more information, refer to 29 CFR 1910.120(q)(6). Hospitals may develop an in-house training course on decontamination to prevent the spread of contamination to other portions of the hospital or provide additional training in decontamination after sending personnel to a standard first responder operations level course. Hospitals must establish PPE procedures that address PPE selection, use, duration, maintenance, storage, inspection, proper fitting, donning, and doffing procedures for employees that may encounter hazardous materials. Every member of the emergency room staff and other potentially exposed employees should know how the hospital intends to respond to hazardous substance incidents. Train these personnel on how to use PPE and require their participation in scheduled drills. This staff could consist of physicians, nurses, aids, and support personnel such as respiratory therapist, security, and maintenance. Hospital employees, including ancillary personnel such as housekeeping and laundry staff, must receive training on how to perform their assigned job duties in a safe manner. If ancillary personnel will clean up the decontamination area, they must receive training in accordance with 29 CFR 191.120(q)(11) (Tables 7.17 and 7.18).

Spill Response Personal Protective Equipment

OSHA mandates the use of appropriate PPE when responding to a spill or supporting decontamination activities. Responders must know the types of chemicals, level of exposure risk, and physical

characteristic of the chemical hazard. Responders must know about potential hazards to the body. These hazards include toxicity, carcinogenic, asphyxiate, or corrosive nature of the chemicals. The EPA's Office of Emergency and Remedial Response defines four levels of protection for chemical response operations.

RESPIRATORY PROTECTION (29 CFR 1910.134)

Respirators prevent the inhalation of harmful airborne substances and provide fresh air in oxygen-deficient environments. An effective respiratory protection plan must address the following: (1) hazards encountered, (2) type and degree of protection needed, (3) medical evaluation for respirator usage, (4) selection and fit requirements, (5) training on use and care, and (6) methods to ensure continued effectiveness.

Types of Respirators

Air-purifying respirators come in either full-face or half-mask versions. These types of respirators use a mechanical or chemical cartridge to filter dust, mists, fumes, vapors, or gaseous substances. Only use disposable air-purifying respirators once or until the cartridge expires. These respirators contain permanent cartridges with no replaceable parts. Reusable air-purifying respirators use both replaceable cartridges and parts. The replaceable cartridges and parts must come from the same manufacturer to retain a NIOSH approval. Disposable or reusable air-purifying respirators contain no replaceable parts except cartridges. Gas masks designed for slightly higher concentrations of organic vapors, gases, dusts, mists, or fumes use a volume of sorbent much higher than a chemical cartridge. Powered air-purifying respirators use a blower to pass the contaminated air through a filter. The purified air then enters into a mask or hood. They filter dusts, mists, fumes, vapors, or gases like other air-purifying respirators. Never use air-purifying respirators in any oxygen-deficient atmosphere.

Oxygen levels below 19.5% require either a source of supplied air or a supplied-air respirator (SAR). Consider levels below 16% as unsafe, and death could result. SARs provide the highest level of protection against highly toxic and unknown materials. Supplied air refers to self-contained breathing apparatuses (SCBAs) and airline respirators. Airline respirators contain an air hose connected to a fresh air supply from a central source. The source comes from a compressed air cylinder or air compressor that provides breathable air. Emergency Escape Breathing Apparatuses provide oxygen for short periods of times such as 5 or 10 min depending on the unit. Only permit these devices for emergency situations such as escaping from environments IDLH. Determine the correct cartridge for air-purifying respirators by contacting a respirator professional or referring to the SDS of the substance needing filtering. Cartridges use a color scheme designating the contaminant needing filtering. Replace the cartridge any time a wearer detects odor, irritation, or taste of a contaminant. The proper selection and use of a respirator depends upon an initial determination of the concentration of the hazard or hazards present in the workplace or area with an oxygen-deficient atmosphere. IDLH atmospheres pose the most danger to workers. Use a full-face piece pressure demand SCBA or a combination full-face piece pressure demand (SAR) for dangerous atmospheres. Respirator selection requires matching the respirator with the degree of hazard and needs of the user. Choose only devices that fully protect the worker and permit job accomplishment with minimum physical stress (Table 7.19).

Persons assigned tasks requiring the use of a respirator must possess the physical ability to work while using the device. OSHA requires employers to ensure the medical fitness of individuals that must wear respirators. The fitness evaluation considers the physical and psychological stress imposed by the respirator. It must also evaluate the stress originating from job performance. Employers must ensure that employees pass the evaluation prior to fit testing or permitting the use of the respirator for the first time. A physician or other licensed healthcare professional must

TABLE 7.19
Respirator Selection Considerations

- Physical and chemical properties of the air contaminant
- Concentration of the contaminant
- Permissible exposure limits
- Nature of the work operation or process
- Length of time respirator worn
- Work activities and physical/psychological stress
- Fit testing, functional capabilities, and limitations of the respirator
- Consider the characteristic or form of gas, dust, organic vapor, fume, mist, oxygen deficiency, or any combination

determine medical eligibility for respirator wear. A qualified healthcare provider includes physicians, occupational health nurses, nurse practitioners, and physician assistants (PAs) if licensed to do so in the state in which they practice.

The OSHA standard requires the fit testing of all tight-fitting respirators. OSHA does not exclude disposable particulate respirators from fit-testing requirements. Some employees may not achieve an adequate fit with certain respirator models or a particular type of respirator. Provide alternative respirator choices to ensure worker protection. Employers must provide a sufficient number of respirator models and sizes from which employees can choose an acceptable respirator with a correct fit. Quantitative fit test (QNFT) refers to the assessment of the adequacy of respirator fit by numerically measuring the amount of leakage into the respirator. A QNFT uses an instrument to take samples from wearer's breathing zone. Adhere to the OSHA protocol for a QNFT as detailed in Appendix A of 29 CFR 1910.134. A qualitative fit test (QLFT) refers to a pass/fail test that assesses the adequacy of respirator fit that relies on the individual's response to a test agent. A QLFT, according to 29 CFR 1910.134, applies only to negative pressure air-purifying respirators that must achieve a fit factor of 100 or less. Since the QLFT relies upon the subjective response of the wearer, accuracy may vary.

The proper fit, usage, and maintenance of respirators remain the key elements that help ensure employee protection. Train employees about the proper use of respirators and the general requirements of the Respiratory Protection Standard. Training must address employer obligations such as written plans, respirator selection procedures, respirator use evaluation, and medical evaluations. Employers must ensure proper maintenance, storage, and cleaning of all respirators. They must also retain and provide access to specific records as required by OSHA. Employees must know basic employer obligations as related to their protection. OSHA requires annual training of all workers expected to wear a respirator. New employees must attend respirator training prior to using a respirator in the workplace.

Employers must conduct workplace evaluations to ensure that the scope of the written respirator plan protects those required to use respirators. Employers must also evaluate the continued effectiveness of the written respirator plan. Proper evaluations help to determine if workers use and wear respirators correctly. The evaluations can also indicate the effectiveness of respirator training. Employers must solicit employee views about respirator plan effectiveness and determine any problem areas.

OSHA requires employers to retain written information regarding medical evaluations, fit testing, and the respirator plan effectiveness. Maintaining this information promotes greater employee involvement and provides compliance documentation. Employers must retain a record for each employee subject to medical evaluation. This record includes results of the medical questionnaire and, if applicable, a copy of the healthcare professional's written opinion. Maintain records related to recommendations including the results of relevant examinations and tests. Retain the records

of medical evaluations and make them available as required by 29 CFR 1910.1020, "Access to Employee Exposure and Medical Records." Retain fit test records for users until the administration of the next test.

REVIEW EXERCISES

7.1 List at least five issues to consider when evaluating hazardous material risks.
7.2 How does OSHA define a hazardous substance?
7.3 What does the EPA add to the OSHA definition?
7.4 How does the DOT define a hazardous substance?
7.5 Define the following acronyms:
- PEL
- STEL
- REL
- TLV

7.6 Explain in your own words the purpose of the OSHA Additive Formula found at 29 CFR 1910.1000.
7.7 List the seven elements required by OSHA in an organization's respirator plan.
7.8 Describe the following respirators:
Air-purifying respirator
Supplied-air respirator
Self-contained breathing
7.9 Explain the difference between quantitative fit testing (QNFT) and a qualitative fit testing (QLFT) of a respirator.
7.10 List at least five physical properties of a chemical substance.
7.11 Define the following terms:
- Vapor
- Vapor density
- Flash point
- Ignition source
- Grounding
- Bonding

7.12 What two organizations work to publish consensus eyewash and shower standards?
7.13 List at least four of the basic requirements for eyewash and shower facilities.
7.14 What is the foundational consideration when storing hazardous substances?
7.15 In your own words, explain the impact of GHS requirements on the OSHA HAZCOM standard.
7.16 List and describe the elements in the new GHS labeling system.
7.17 List at least five HAZCOM training topics mandated by OSHA.
7.18 List the nine primary DOT hazard classes.
7.19 Which federal agency regulates pesticides including registered disinfectants?
7.20 Define the following EPA terms:
- Ignitable solid waste
- Universal waste
- Medical waste

8 Infection Control and Prevention

INTRODUCTION

Healthcare-associated infections pose significant risks to both patients and healthcare personnel. Healthcare organizations must adhere to current CDC guidelines concerning infection prevention and control. OSHA mandates that organizations take specific actions to minimize employee exposures to bloodborne pathogens. Healthcare safety personnel should work closely with the infection control and prevention staff on issues of joint concern such as compliance with the OSHA Bloodborne Pathogens Standard (29 CFR 1910.1030). Healthcare personnel must strive to minimize their exposure risks to blood, sputum, aerosols, and other body fluids by following proper work practices and using PPE/clothing. The use of appropriate PPE along with relevant education and training provides the foundation for infection prevention. Any effective infection control and prevention function should stress personal hygiene, individual responsibility, surveillance monitoring, and investigation of infectious diseases and pathogens. Efforts should emphasize identifying infection risks, instituting preventive measures, eliminating unnecessary procedures, and preventing the spread of infectious diseases through the healthcare facility. Facilities should develop and implement plans to prevent and control infections by focusing on

- Integrating infection control into safety and performance improvement efforts
- Assessing risks for the acquisition or transmission of infectious agents within the facility
- Using an epidemiological approach to focus on surveillance and data collection data
- Implementing infection prevention and control processes based on sound data
- Coordinating plan design and implementation with key leaders
- Establishing coordinated processes to reduce the risks of organization-acquired infections
- Appointing one or more qualified individuals to lead facility efforts
- Reporting information about infections both internally and to public health agencies
- Designing processes to reduce rates or trends of epidemiologically significant infections
- Implementing strategies to reduce risks and prevent transmission of infections
- Adopting strategies that consider scientific knowledge, practice guidelines, laws, or regulations
- Considering endemic rates and epidemic rates when analyzing data
- Ensuring management systems support infection control objectives
- Stressing risk identification using surveillance, prevention, and control activities
- Coordinating with external organizations to reduce infections from the environment (Table 8.1)

HEALTHCARE IMMUNIZATIONS

Healthcare organizations should establish a comprehensive written policy regarding immunizing personnel, develop a listing of all required and recommended immunizations, and refer all staff to the employee health function to receive education needed for their positions. The employee health

TABLE 8.1
Infection Control Plan Development Considerations

- Device-related, intravascular devices, ventilators, and tube feeding infections
- Surgical site infections and healthcare-acquired infection in special care units
- Infections caused by organisms that are antibiotic resistant
- Tuberculosis and other communicable diseases
- Infections in the neonate population
- Geographic location of the facility
- Volume of patient or resident encounters
- Patient populations served
- Clinical focus of the facility
- Number of employees and staff

TABLE 8.2
Healthcare Vaccine Categories

- Strongly recommended: Diseases posing special *risks*, which include hepatitis B, influenza, measles, mumps, rubella, and varicella
- Recommended in some situations: Active and/or passive immunizations as indicated in job circumstances to prevent occurrences of tuberculosis, hepatitis A, meningitis, and typhoid fever
- Recommended for all adults: Immunization of all adults for tetanus, diphtheria, and pneumonia disease

function should consider medical history and job position exposure risk to determine needed vaccinations (Table 8.2).

Guidelines of the Advisory Committee for Immunization Practice

Healthcare personnel should meet the Advisory Committee for Immunization Practice (ACIP) guidelines for immunization against mumps, rubella, diphtheria, and measles. Consider the need for the following vaccinations:

- Rubella—Require for individuals considered at risk including those with direct contact with pregnant patients.
- Hepatitis B—Offer the vaccine within 10 days of their job assignment as mandated by OSHA to all staff members with any potential exposure to bloodborne pathogens.
- Measles—Consider immunization for persons susceptible by history or serology.
- Influenza—Healthcare personnel should receive flu immunization to help prevent the spread of influenza.

Other Vaccination Considerations

Healthcare organizations must develop comprehensive policies and protocols for the management and control of outbreaks of vaccine preventable diseases as described in the ACIP Guidelines. Healthcare employees working abroad should consider vaccinations for diseases such as hepatitis A, poliomyelitis, encephalitis, meningitis, plague, rabies, typhoid, and yellow fever. Healthcare organizations should develop written policies regarding work restrictions or exclusion from duty

for immunization and infection control reasons. Require healthcare staff members to report any illnesses, medical conditions, or treatments that could make them susceptible to opportunistic infections.

CENTERS FOR DISEASE CONTROL AND PREVENTION

The CDC publishes guidelines, advisories, and recommendations that do not carry the force of law. The CDC bases their guidance and recommendations on scientific studies. However, some infection control practices applicable to one setting may not apply in all healthcare situations. The guidance offered by the CDC gives healthcare infection control personnel the information necessary to make informed decisions. Organizations must provide proper education and training on current infection control and prevention practices including the latest OSHA requirements and CDC recommendations.

The continuous evaluation of care practices under the supervision of the infection control staff can help ensure continued adherence to correct practices. The Association for Professionals in Infection Control and Epidemiology publishes up-to-date articles and guidelines on healthcare infection control.

CDC Guidelines for Hand Hygiene in Healthcare Settings

CDC guidelines highly recommend the placement of alcohol-based hand-rub solutions in convenient locations of patient care areas of healthcare organizations. Clinical studies indicate that the frequency of hand washing relates to the accessibility of hand-hygiene facilities. Installing hand-rub dispensers immediately outside patient or resident rooms or within suites of rooms improves the overall efficacy of staff use by over 20%.

Guidelines for Environmental Infection Control in Healthcare Facilities

The guidelines provide excellent information on maintaining a safe healthcare environment and include infection control tips to follow during inspection, construction, or renovation activities in patient care and treatment areas. The guidelines provide a comprehensive review of the relevant literature with a focus on conducting a risk assessment before undertaking any activities that could generate dust or water aerosols. The guidelines also review infection control measures for catastrophic events such as flooding, sewage spills, and loss of utilities, including ventilation. Environmental infection control procedures must consider disease transmission via surfaces, laundry, plants, animals, medical wastes, cloth furnishings, and carpeting. These guidelines do not apply to sick buildings, terrorism, or food safety. Key suggestions include

- Evaluating the impact of activities on ventilation and water systems
- Creating a multidisciplinary team to conduct infection control risk assessment (ICRA)
- Using dust-control procedures and barriers during construction activities
- Implementing special control measures in any areas with patients at high risk
- Using air sampling to monitor air filtration and dust-control measures
- Controlling tuberculosis risks in operating rooms when infectious patients require surgery
- Culturing water as part of a control plan for *Legionella* if appropriate
- Recovering from water system disruptions, leaks, and natural disasters
- Disinfecting surfaces to control antibiotic-resistant microorganisms
- Developing specific infection-control procedures for laundries
- Establishing control procedures for using animals in activities and therapy

- Managing the use of all service animals in healthcare facilities
- Developing strategies for animals receiving treatment in human facilities
- Measuring water use from main lines for dialysis, ice machines, hydrotherapy, dental water lines, and automated endoscope reprocessing equipment

Other CDC Infection Control Guidelines

- CDC Position Statement on Reuse of Single Dose Vials (2012)
- Basic Infection Control and Prevention Plan for Outpatient Oncology Settings (October 2011)
- Guide to Infection Prevention in Outpatient Settings: Minimum Expectations for Safe Care (July 2011)
- CDC Issues Checklist for Infection Prevention in Out-Patient Settings to Accompany New Guide (July 2011)
- Guideline for the Prevention and Control of Norovirus Gastroenteritis Outbreaks in Healthcare Settings (2011)
- Guideline for Disinfection and Sterilization in Healthcare Facilities (2008)
- Guideline for Isolation Precautions: Preventing Transmission of Infectious Agents in Healthcare Settings (2007)
- Guideline-Management of Multidrug-Resistant Organisms in Healthcare Settings (2006)
- Public Reporting of Healthcare-Associated Infections (2005)
- Bloodstream Infection: Guideline for the Prevention of Intravascular Catheter-Related Infections (2011)
- Dialysis–Multi-Dose Vials Infection Control (2008)
- Environmental Infection Control (2003)
- Hand Hygiene (2002)
- Infection Control-Healthcare Personnel (1998)
- Occupational Exposures (2005)
- Pneumonia (2003)
- Surgical Site Infection (1999)
- Guidelines for Preventing Transmission of *Mycobacterium tuberculosis* in Healthcare Facilities (2005)
- Urinary Tract Infection (2009)

CDC Standard Precautions

Consider hand washing as the first line of defense in preventing exposures to diseases, bloodborne pathogens, and infections. The CDC's Standard Precautions provide the major features of blood and body fluid precautions designed to reduce the risk of transmission of bloodborne pathogens. Use Standard Precautions to reduce the risk of transmission of microorganisms from both recognized and unrecognized sources of infection in hospitals. After using the Standard Precautions, facilities should then apply the appropriate Tiered Precautions for airborne, droplet, and contact routes of infection. Facilities should learn to recognize the pathogenic risk of body fluids, secretions, and excretions and should take precautions against the various routes of transmission by designing processes that eliminate confusion with regard to infection control or isolation requirements. Facilities should refer to the guidelines for information on clinical syndromes and empiric precautions. They should also adhere to specific transmission precautions for patients colonized with pathogens. CDC's tier precautions provide guidelines with regard to

- Hand washing, glove use, and patient placement procedures, including transport
- Use of masks, gowns, and other protective apparel

- Procedures for patient care equipment, linen, and laundry
- Cleaning dishes, glasses, cups, and eating utensils

Disease and Infection Transmission Routes

Federal, state, and local health agencies publish rules and guidelines that define isolation procedures. Healthcare organizations should follow these guidelines because infectious agents can be transmitted by several routes:

- Contact—Contamination due to close proximity with persons with a contagious disease
- Indirect contact—Contamination by contacting an object contaminated by an infected person
- Droplet—Contamination caused by a person sneezing, coughing, or talking
- Common vehicle—Disease spread by food, water, drugs, devices, or equipment
- Airborne—Air-suspended infectious nuclei or dust that could be inhaled or digested
- Vector-borne—Organisms carried by animals or insects

Airborne Precautions

Airborne precautions reduce the risk of airborne transmission of infectious agents disseminated by airborne droplet nuclei (small-particle residue 5 μm or smaller), evaporated droplets that may remain suspended in the air for long periods of time, or dust particles containing the infectious agent. Microorganisms disperse widely by air currents and may become inhaled or deposited on a susceptible host within the same room. Depending on environmental factors, use special air handling and ventilation to prevent airborne transmission. Airborne precautions apply to patients with known or suspected pathogens such as measles, varicella, and tuberculosis.

Droplet Precautions

Droplet precautions reduce the risk of droplet transmission of infectious agents. Droplet transmission involves contact of the conjunctive or mucous membranes of the nose or mouth of a susceptible person with large-particle droplets (larger than 5 μm). The droplets contain microorganisms generated from a person with a clinical disease or who serves as a carrier of the microorganism. Droplets generated from the source person during coughing, sneezing, or talking and during performance of certain procedures such as suctioning and bronchoscopy can result in exposure risks. Transmission of a disease via large-particle droplets requires close contact between the source and the recipient. Droplets do not remain suspended in the air and generally travel only short distances (3 ft or less). Special air handling and ventilation are not required to prevent droplet transmission. Droplet precautions apply to any patient with known or suspected infections such as meningitis, pneumonia, sepsis, pharyngeal diphtheria, mycoplasma pneumonia, pertussis, streptococcal group A pharyngitis, scarlet fever, Rubella, and pneumonic plague.

Contact Precautions

Contact precautions reduce the risk of transmission of epidemiologically important microorganisms by direct or indirect contact. Direct contact transmission involves skin-to-skin contact or the physical transfer of microorganisms to a susceptible host. This can occur when caregivers turn patients, bathe patients, or perform other patient-related activities with physical contact. Direct contact transmission can also occur between patients. Indirect contact transmission involves contact of a susceptible host with a contaminated object or surface in the patient environment. Contact precautions apply to specific patients with a known or suspected infection with

epidemiologically important microorganisms transmitted by contact via gastrointestinal tract, respiratory system, skin surface, wounds, and multidrug-resistant bacteria. Use contact precautions for hepatitis A, contagious skin infections, herpes simplex viruses, scabies, and viral or hemorrhagic infections.

New Infection Risk

The CDC recently released information that 4% of US hospitals and 18% of nursing homes had treated at least one patient with the bacteria, called carbapenem-resistant enterobacteriaceae (CRE) during the first 6 months of 2012. CRE are in a family of more than 70 bacteria called enterobacteriaceae, including *Klebsiella pneumonia* and *Escherichia coli* that normally live in the digestive system. In recent years, some of these bacteria became resistant to last-resort antibiotics known as carbapenems. Most CRE infections occur in patients with prolonged stays in hospitals, long-term facilities, and nursing homes. These bacteria can kill up to 50% of infected patients. According to CDC, these bacteria can easily spread from patient to patient on the hands of caregivers according to CDC. CRE bacteria can transfer their antibiotic resistance to other bacteria of the same type. To reduce the spread of these bacteria, the CDC wants hospitals and other healthcare facilities to take the following steps:

- Enforce infection-control precautions.
- Group together patients with CRE.
- Segregate staff, rooms, and equipment with CRE patients.
- Inform facilities about the transfer of patients with CRE.
- Use antibiotics carefully.

CMS HOSPITAL-ACQUIRED CONDITIONS AND PRESENT ON ADMISSION INDICATORS

On February 8, 2006, the president signed the Deficit Reduction Act (DRA) of 2005, which required that there be an adjustment in Medicare diagnosis-related group (DRG) payment for certain hospital-acquired conditions (HACs) with a component that addresses new present-on-admission (POA) coding. CMS uses the name of Hospital-Acquired Condition and Present on Admission Reporting (HAC and POA). Section 5001(c) of the DRA required the secretary to identify, by October 1, 2007, at least two conditions for which hospitals under the inpatient prospective payment system would not receive additional payment beginning on October 1, 2008, if the condition was not POA. The conditions must involve high cost or high volume or both and result in the assignment of a case to a DRG with a higher payment when present as a secondary diagnosis. Preventing the incident could reasonably occur through the use of evidence-based guidelines. For discharges occurring on or after October 1, 2008, hospitals would not receive additional payment for cases in which one of the selected HACs was not POA. HACs for potential reduced payment include the following infections:

- Catheter-associated urinary tract infections. Note: ICD-9 code does not distinguish between catheter-associated infection and inflammation.
- Vascular catheter-associated bloodstream infection (BSI). CMS developed a specific code for central line vascular catheters (CVC), and CVC-BSI is not limited to the ICU.
- Surgical site infection mediastinitis occurring after CABG surgery.
- Orthopedic surgeries involving spinal fusion and other surgeries of the shoulder and elbow.
- Bariatric surgery for morbid obesity including laparoscopic gastric bypass and gastroenterostomy.

DISINFECTANTS, STERILANTS, AND ANTISEPTICS

We can divide chemical germicides into three general categories:

- Sterilizing agents, used to eliminate all microbial life on objects or surfaces, including bacterial spores that can survive other germicides
- Disinfectants, classified as high, medium, or low, depending on the strength required, and which can destroy nearly all microbial life on objects or surfaces except for bacterial spores
- Antiseptics, used to inactivate or destroy organisms on skin or living tissue

Germicidal Effectiveness

Bacterial spores exhibit the most resistance to germicides followed by mycobacteria, nonlipid viruses, fungi, and vegetative bacteria. Lipid viruses exhibit the least resistance. Facilities should use FDA- or EPA-approved cleaning agents and should read and follow the manufacturer's instructions to ensure proper use. Their effectiveness depends on

- Shape and texture of surface
- Amount of contamination on the surface
- Resistance of contaminants to the germicide
- Amount of soil buildup, including blood, mucus, or tissue
- Chemical composition of the germicide
- Time of exposure to the germicide
- Temperature of the germicide

Regulatory Approval of Disinfectants

The EPA oversees the manufacture, distribution, and use of disinfectants. Manufacturers must use preestablished test procedures to ensure product stability, determine toxicity to humans, and assess microbial activity. If the product passes these requirements, the EPA registers the substance for use. The EPA regulates disinfectants under the authority of the FIFRA. The FDA regulates liquid chemical sterilants and high-level disinfectants such as hydrogen peroxide and peracetic acid under the authority of the Medical Devices Amendment to the Food, Drug, and Cosmetic Act of 1976. The FDA regulates the chemical germicides if marketed for use on specific medical devices. Regulatory authority requires the manufacturer to provide instructions for the safe and effective use of substances with that device. The FDA uses the same basic terminology and classification scheme as does the CDC, which categorizes medical devices as critical, semicritical, and noncritical. The scheme classifies antimicrobial effectiveness or sterilization as high, intermediate, and low levels.

The EPA registers environmental surface disinfectants based on the manufacturer's microbiological activity claims. The EPA does not use the terms *intermediate level* and *low level* when classifying disinfectants. The CDC designates any EPA-registered hospital disinfectant without a tuberculocidal claim as a low-level disinfectant. Consider an EPA-registered hospital disinfectant effective against tuberculosis as an intermediate-level disinfectant. The EPA also lists disinfectant products according to their labeled use against certain organisms. The Occupational Safety and Health Administration requires the use of EPA-registered hospital tuberculocidal disinfectants or EPA-registered hospital disinfectants labeled effective against human immunodeficiency virus (HIV) and hepatitis B virus (HBV) for decontaminating work surfaces. Hospital can use disinfectants with HIV and HBV claims if surfaces contain no contamination requiring the use of a higher-level disinfectant.

EPA's Registered Sterilizers, TB, and Antimicrobial Products

All EPA's registered pesticides must possess an assigned EPA registration number. Alternative brand names possess the same EPA registration number as the primary product name. The EPA product registration number remains the key way to identity of the substance. An EPA establishment number refers to the production location. The formulation or a device uses a set of codes that consist of the registrant's ID number followed by the state where they were produced including the facility number. The EPA updates their registered disinfectant lists periodically to reflect label changes, cancellations, and transfers of product registrations. Information on the earlier list does not constitute a label replacement. Inclusion of products in these lists does not constitute an endorsement of one product over another. The EPA organizes the lists alphabetically by product names and by numerical order of their EPA registration numbers (Table 8.3).

CDC Recommendations

The CDC does not test, evaluate, or otherwise recommend specific brand-name products of chemical germicides. The CDC recommends disinfecting environmental surfaces or sterilizing or disinfecting medical equipment with products approved by EPA and FDA. When no registered or approved products are available for a specific pathogen or use situation, the CDC suggests following specific guidance regarding unregistered uses for various chemical germicides. No antimicrobial products hold registered status for use against SARS, Norwalk virus, or Creutzfeldt–Jakob disease agents (Table 8.4).

Selecting a Disinfectant

Healthcare facilities use a number of disinfectants, including alcohol, chlorine, chlorine compounds, hydrogen peroxide, phenolic substances, and quaternary ammonium compounds. Never

TABLE 8.3
EPA Registration Categories

- List A: EPA's Registered Antimicrobial Products as Sterilizers
- List B: EPA's Registered Tuberculocide Products Effective against *Mycobacterium* TB
- List C: EPA's Registered Antimicrobial Products Effective against Human HIV-1 Virus
- List D: EPA's Registered Antimicrobial Products Effective against Human HIV-1 and HBV
- List E: EPA's Registered Antimicrobial Products Effective against TB, HIV-1, and HBV
- List F: EPA's Registered Antimicrobial Products Effective against HCV
- List G: EPA's Registered Antimicrobial Products Effective against Norovirus
- List H: EPA's Registered Antimicrobial Products Effective against MRSA and VRE
- List J: EPA's Registered Antimicrobial Products for Medical Waste Treatment
- List K: EPA's Registered Antimicrobial Products Effective against Clostridium Difficile Spores

TABLE 8.4
CDC Disinfecting Levels

- High-level disinfection processes can expect to destroy all microorganisms with the exception of high numbers of bacterial spores.
- Intermediate-level disinfection, which inactivates *M. tuberculosis*, vegetative bacteria, most viruses, and most fungi but does not necessarily kill bacterial spores.
- Low-level disinfection, which can kill most bacteria, some viruses, and some fungi but does not kill resistant microorganisms such as tubercle bacilli or bacterial spores.

routinely interchange disinfectants. Proper selection and use of disinfectants provide the key to effective safety and quality control. Alcohols demonstrate variable effectiveness against some bacteria and fungi. Alcohols act fast, leave no residue, and can compatibly combine with other disinfectants such as quaternaries, phenolic substances, and iodine to form tinctures. Aldehydes can prove effective against a wide spectrum of bacteria and viruses including spores when used properly. They also demonstrate activity against other pathogens, including vegetative bacteria and viruses. Chlorine works very well for cleaning up blood or body fluid spills. Chlorine compounds work as effective biocides on tuberculosis and vegetative bacteria. Chlorine compounds prove effective against HIV after 10–20 min and demonstrate effectiveness at a 1:5 dilution against bacterial spores and mycobacteria. Diluted chlorine neutralizes rapidly in the presence of organic matter. Chlorine compounds work very well for the decontamination of HBV, HCV, and cleanup of biohazardous spills.

OSHA BLOODBORNE PATHOGENS STANDARD (29 CFR 1910.1030)

On November 6, 2000, President Clinton signed the Needlestick Safety and Prevention Act (Pub. L. 106–430). The act required OSHA to revise the OSHA Bloodborne Pathogens standard within 6 months of enactment of the act. To facilitate expeditious completion of this directive, Congress explicitly exempted OSHA from procedural requirements generally required under the rule-making provision of the act (paragraph 6(b)) and from the procedural requirements of the Administrative Procedure Act (5 USC 500 et seq.). The Bloodborne Pathogens standard sets forth requirements for employers with employees exposed to blood or other potentially infectious materials. In order to reduce or eliminate the hazards of occupational exposure, an employer must implement an exposure control plan for the worksite with details on employee protection measures. The plan must also describe how an employer will use a combination of engineering and work practice controls, ensure the use of personal protective clothing and equipment, and provide training, medical surveillance, hepatitis B vaccinations, and signs and labels, among other provisions.

Engineering controls provide the primary means of eliminating or minimizing employee exposure and include the use of safer medical devices, such as needleless devices, shielded needle devices, and plastic capillary tubes. Many different medical devices can now reduce the risk of needlesticks and other sharps injuries. These devices replace sharps with nonneedle devices or incorporate safety features designed to reduce injury. Despite advances in technology, needlesticks and other sharps injuries continue to occur at high rates. The revised OSHA standard became effective on April 18, 2001, adding new requirements for employers, including additions to the exposure control plan and keeping a sharps injury log. It did not impose any new requirements for employers to protect employees from sharps injuries. The original standard already required employers to adopt engineering and work practice controls that would eliminate or minimize employee exposure from hazards associated with bloodborne pathogens. The revision requires organizations to implement engineering controls such as using safer medical devices to reduce or eliminate exposure risks. Exposure control plan requirements must make clear that employers must implement safer medical devices proven appropriate, commercially available, and effective. Organizations must get input on selecting devices from those responsible for direct patient care. The updated standard also requires employers to maintain a log of injuries occurring from contaminated sharps.

Exposure Control Plan

The revision included new requirements regarding the employer's exposure control plan, including an annual review and update to reflect changes in technology that eliminate or reduce exposures to bloodborne pathogens. The employer must

- Consider new innovations in medical procedures and technology that reduce the risk of exposure to needle sticks
- Consider and document use of appropriate, commercially available, and effective safer needles
- Realize that no single medical device can prove effective for all circumstances
- Identify devices used, the method in place to evaluate those devices, and justification for the eventual selection
- Select devices based on reasonable judgment but never jeopardize patient or employee safety
- Select devices that will make an exposure incident involving a contaminated sharp less likely to occur

OSHA Hand Hygiene Requirements

The OSHA Bloodborne Pathogen Standard requires that personnel to wash their hands immediately or as soon as feasible after removal of gloves or other PPE. OSHA requires employees to wash their hands and any other skin with soap and water or flush mucous membranes with water immediately or as soon as feasible following contact of such body areas with blood or other potentially infectious materials. Personnel removing gloves after exposure to blood or other potentially infectious materials must wash their hands using an appropriate soap and running water. Staff members with no access to a readily available sink after an exposure may decontaminate hands with a hand cleanser or towelette. However, staff must wash their hands with soap and running water as soon as feasible. If no exposure or contact occurs with blood or other potentially infectious materials, consider the use of alcohol-based hand cleansers as appropriate. Use alcohol-based sanitizing solutions when the location does not support hand washing facilities. Use a sanitizer with an alcohol concentration of 62% or greater. It is important to note that hand sanitizers are effective against common diseases but they are ineffective against certain organisms such as bacterial spores. Never use sanitizers as a substitute for soap and water. Research shows that with just three applications of an alcohol-based sanitizer, the effectiveness of the sanitizer decreases. The reason for the decreased effectiveness is alcohol in the sanitizers can remove natural oils from your hands, which will cause your hands to dry out and crack.

Employee Involvement

Employers must solicit input from nonmanagerial employees responsible for direct patient care regarding the identification, evaluation, and selection of effective engineering controls, including safer medical devices. Employees selected should represent the range of exposure situations encountered in the workplace, such as those in geriatric, pediatric, or nuclear medicine and others involved in the direct care of patients. OSHA will check for compliance with this provision during inspections by questioning a representative number of employees to determine if and how their input was requested. Employers must document in the exposure control plan how they received input from employees. Organizations can meet this obligation by listing the employees involved and describing the process used to obtain their input. Employers can also present other documentation, including references to the minutes of meetings, copies of documents used to request employee participation, or records of responses received from employees.

Recordkeeping

Employers with employees experiencing occupational exposure to blood or other potentially infectious materials must maintain a log of occupational injuries and illnesses under existing recordkeeping rules but must also maintain a sharps injury log. This log must be maintained in a manner that

protects the privacy of employees. The sharps injury log may include additional information on how the employer protects the employee's privacy. Employers can determine the format of the log. At a minimum, the log must contain the following:

- Type and brand of device involved in the incident
- Location of the incident
- Description of the incident

Engineering Controls

Engineering controls include all control measures that isolate or remove a hazard from the workplace, such as sharps disposal containers and self-sheathing needles. The original Bloodborne Pathogens standard was not specific regarding the applicability of various engineering controls (other than the earlier examples) in the healthcare setting. The revision now specifies that safer medical devices, such as sharps with engineered sharps injury protections and needleless systems, constitute an effective engineering control. The phrase "sharps with engineered sharps injury protection" describes nonneedle sharps or needle devices containing built-in safety features used for collecting fluids and administering medications or other fluids. It can also describe other procedures involving the risk of sharps injury. This description covers a broad array of devices including

- Syringes with a sliding sheath that shields the attached needle after use
- Needles that retract into a syringe after use
- Shielded or retracting catheters
- IV delivery systems that use a catheter port with a needle housed in a protective covering

Needleless Systems

The term *needleless systems* refers to any devices that provide an alternative to needles for procedures with a risk of injury involving contaminated sharps. Examples include IV systems that administer medication or fluids through a catheter port using nonneedle connections. Consider jet injection systems that deliver liquid medication beneath the skin or through a muscle as another example.

Exposure Determination

Exposure determination involves listing all job classifications in which employees could encounter potential exposure. This includes physicians, nurses, and other clinical personnel. Maintenance, environmental services, and laundry personnel can work in situations that could pose exposure risks. List any specific procedures or tasks in which exposure could occur without regard to the use of PPE.

Control Measures

Employers should take appropriate preventative measures against occupational exposure. These include engineering controls and work practice controls. Examples of engineering controls include biohazard hoods, puncture-resistant sharps containers, mechanical pipette devices, and other devices that permanently remove the hazard or isolate individuals from exposure. Organizations must evaluate and incorporate new safer devices including needleless devices, needles with sheaths, and blunt suture needles. Work practice controls must include hand washing policies, sharps handling procedures, proper waste disposal techniques, and other actions that would reduce the likelihood of exposure.

Personal Protective Equipment

Employers must provide PPE to all personnel with occupational exposure. Select PPE that does not permit blood or other potentially infectious materials to pass through or reach a person's outer clothing, undergarments, skin, eyes, mouth, or other mucous membranes. Ensure that personnel wear gloves when hand contact occurs with blood or other potentially infectious materials. Replace disposable gloves as soon as possible when contaminated or no longer in a condition to provide barrier protection. Decontaminate reusable utility gloves and discard immediately if cracked, discolored, or punctured, or when they show signs of deterioration. Require personnel to wear masks, eye protection, and face protection when exposed to potentially infectious splashes, spray, or droplets. Require the use of gowns, aprons, and other clothing to protect against anticipated exposure to the body, head, and feet.

Housekeeping, Laundry, and Waste Practices

Employers should create a schedule for periodic cleaning and appropriate disinfecting to ensure that the worksite remains clean and sanitary. Personnel should place and transport contaminated laundry in properly labeled or color-coded bags and containers. They should disinfect contaminated work surfaces after completing the task. Clean surfaces contaminated by splashes or spills and when surfaces come into contact with blood or other potentially infectious materials. Clean the area at the end of the work shift. Place all blood or infectious materials, contaminated items that could release infectious materials, or contaminated sharps in appropriate sharps containers or closable, color-coded, or properly labeled leakproof containers or bags. Dispose of infectious waste in accordance with federal, state, and local regulations. Attach warning labels to all containers used for the storage or transport of potentially infectious materials. Use labels of orange or red-orange color with the biohazard symbol in a contrasting color. Employers can substitute red containers or bags for warning labels.

Hepatitis B Virus

HBV causes an estimated 2 million deaths annually worldwide, establishes a carrier state in many victims, and generally produces some jaundice along with many of the acute symptoms such as (1) painful joint aches, (2) significant skin rashes, and (3) serve liver damage mediated by host immune reactions to the presence of HBV particles. If jaundice appears, it can persist for 2–6 weeks. HBV infection can cause severe fatigue and weakness, brown urine, and pale stools. The virus that causes HBV is found in blood and other body fluids, including semen, vaginal secretions, urine, and even saliva. Most people recover, but up to 10% become chronic carriers. These chronic carriers can spread the disease to others for an indefinite period of time and create a high risk for other diseases including cirrhosis of the liver and primary liver cancer. Although the blood and blood products provide the key transmission vehicle, viral antigen can also appear in tears, saliva, breast milk, urine, semen, and vaginal secretions. The virus can survive for 7 days or more on environmental surfaces exposed to body fluids containing the virus. Infection may occur when the virus transmitted by infected body fluids or implanted via mucous surfaces becomes introduced through breaks in the skin.

Hepatitis B Vaccination

All healthcare personnel with potential exposure to blood, blood-contaminated body fluids, other body fluids, or sharps should receive vaccination. Administer the hepatitis B vaccine using the intramuscular route in the deltoid muscle. The OSHA Bloodborne Pathogens standard requires employers to offer the hepatitis B vaccine free of charge to all potentially exposed employees within

10 days of hire. Administer postexposure prophylaxis with hepatitis B immunoglobulin (passive immunization) and/or vaccine (active immunization) when indicated after percutaneous or mucous membrane exposure to blood known or suspected to contain hepatitis B. Needlestick or other percutaneous exposures of unvaccinated persons should lead to initiation of the hepatitis B vaccine series. HBV vaccination requirements are as follows:

- OSHA requires employers to offer the HBV vaccination series to all personnel with potential occupational exposure to blood or other potentially infectious material within 10 days of hire.
- Employers should always follow US Public Health Service and CDC recommendations for hepatitis B vaccination, serologic testing, follow-up, and booster dosing.
- Employers should test personnel for anti-HBs 12 months after completion of the three doses.
- Healthcare staff members should complete a second three-dose vaccine series or receive evaluation to determine if HBV positive (if no antibody response occurs to the primary vaccine series).
- Retest personnel for anti-HBs at the completion of the second vaccine dose. If no response to the second three-dose series occurs, retest nonresponders for HBV.
- Before vaccinating HBV-negative nonresponders, counsel them regarding their susceptibility to HBV infection and precautions.
- Employers should provide employees with appropriate education regarding the risks of HBV transmission and the availability of the vaccine. Employees who decline the vaccination should sign a declination form. Employers must maintain the form.
- Make the vaccination available without cost to the employee, at a reasonable time and place for the employee, by a licensed healthcare professional and according to recommendations of the US Public Health Service, including routine booster doses.
- Provide the healthcare professional designated by the employer to implement this part of the standard with a copy of the Bloodborne Pathogens standard.
- The healthcare professional must provide the employer with a written opinion stating whether the hepatitis B vaccination is indicated for the employee and whether the employee received the vaccination (Table 8.5).

Hepatitis C Virus

Hepatitis C, a contagious liver disease, results from infection with the hepatitis C virus (HCV). It can range in severity from a mild illness lasting a few weeks to a serious lifelong illness that damages the liver. Hepatitis C can occur in *acute* or *chronic* forms. Consider acute hepatitis C

TABLE 8.5
When the Hepatitis B Vaccination Is Not Required

- Employees previously completing the hepatitis B vaccination series
- Immunity confirmed through antibody testing
- Vaccine contraindicated for medical reasons
- Following participation in a prescreening plan
- Employees who decline the vaccination

Note: Employees who decline to accept the hepatitis B vaccination must sign a declination form indicating the employer offered the vaccination.

infection as a short-term illness that occurs within the first 6 months after exposure. Approximately 75%–85% of people who become infected with the HCV develop chronic infection. For reasons unknown, 15%–25% of people *clears* the virus without treatment and do not develop chronic infection. Chronic HCV infection can progress into a long-term illness that occurs when the virus remains in a person's body. Over time, it can lead to serious liver problems, including liver damage, cirrhosis, liver failure, or liver cancer. Before widespread screening of the blood supply began in 1992, hepatitis was also commonly spread through blood transfusions and organ transplants. Although rare, outbreaks of hepatitis C do occur from blood contamination in medical settings. Most people with hepatitis C present no symptoms. Symptoms can appear 2 weeks to 6 months after exposure. Symptoms can include fever, fatigue, no appetite, nausea, vomiting, abdominal pain and dark urine, clay-colored bowel movements, joint pain, and jaundice.

Human Immunodeficiency Virus

HIV affects the immune system, rendering the infected individual vulnerable to a wide range of disorders. Infections typically lead to the death of the patient. Symptoms can occur within a month and can include fever, diarrhea, fatigue, and rash. Exposed persons may develop antibodies and not present symptoms for months to years. The infected person may finally develop a wide range of symptoms depending on the opportunistic infections against which the body's immune system cannot defend (Tables 8.6 through 8.8).

Other Key Topics

Employees should know what to do when confronted with an emergency involving blood or other potentially infectious materials, postexposure evaluations, the HBV vaccine, and the use of signs and labels. After training, make vaccinations available to those who run the risk of exposure. Employers should establish a medical record for each employee with occupational exposure. Keep this record confidential and keep it separate from other personnel records. Employers can keep

TABLE 8.6
HIV Exposures and Transmission Routes

- Contact with blood, semen, vaginal secretions, and breast milk
- Sexual intercourse
- Using needles contaminated with the virus
- Contact with HIV-infected blood under the skin, mucous membranes, or broken skin
- Mother-to-child contact at the time of birth
- Blood transfusions or organ transplants

TABLE 8.7
Workplace Transmission of HIV

- Body fluids such as saliva, semen, vaginal secretions, cerebrospinal fluid, synovial fluid, pleural fluid, peritoneal fluid, pericardial fluid, amniotic fluid, and any other body fluids visibly contaminated with blood
- Saliva and blood contacted during dental procedures
- Unfixed tissue or organs other than intact skin from living or dead humans
- Organ cultures, culture media, or similar solutions
- Blood, organs, and tissues from experimental animals infected with HIV or HBV

TABLE 8.8
Means of Transmission

- Accidental injury with a sharp object contaminated with infectious material, such as needles, scalpels, broken glass, and anything that can pierce the skin
- Open cuts, nicks, skin abrasions, dermatitis, acne, and mucous membranes
- Indirect transmission, such as touching a contaminated object or surface and transferring the infectious material to the mouth, eyes, nose, or open skin

these records on-site or healthcare professionals providing services to the employees can retain the records. The medical record contains the employee's name, Social Security number, HBV vaccination status, date of the HBV vaccination (if applicable), and the written opinion of the healthcare professional regarding the hepatitis B vaccination. Note any occupational exposure in the medical record to document the incident and include the results of testing following the incident. The postevaluation written opinion of the healthcare professional becomes a part of the medical record. The medical record must document what information was provided to the healthcare provider. Maintain medical records for 30 years past the last date of employment of the employee. Ensure confidentiality of medical records. Never disclose a medical record or part of a medical record without direct written consent of the employee or as required by law. Keep training records for 3 years. Training records must include the date, content outline, trainer's name and qualifications, and names and job titles of all persons attending the training sessions. Employers who cease to do business should transfer the medical and training records to the successor employer. Upon request, make both medical and training records available to the assistant secretary of labor for Occupational Safety and Health. Make training records available to employee upon request. The employee or anyone given the employee's written consent may obtain medical records.

Latex Allergies

OSHA's Bloodborne Pathogens standard requires hand washing after the removal of gloves or other PPE to help minimize the amount of powder or latex remaining in contact with the skin. Employees can develop latex sensitivity or latex allergy from exposure to latex in products such as latex gloves. NIOSH estimates that 8%–12% of healthcare personnel may experience latex reactions ranging from contact dermatitis to possibly life-threatening sensitivity. Among the alternatives include synthetic, low-protein, and powder-free gloves. Powder-free gloves may reduce systemic allergic responses. Employees should never wear latex gloves when no risk of exposure to blood or other potentially infectious materials exists. Never assume hypoallergenic gloves, glove liners, or powder-free gloves as latex free. Use good housekeeping practices to remove latex-containing dust from the workplace.

Frequently clean areas contaminated with latex dust such as upholstery, carpets, and ventilation ducts. Frequently change ventilation filters and vacuum bags used in latex-contaminated areas. Employ appropriate work practices to reduce the chance of reactions to latex such as not using oil-based hand creams or lotions that can cause glove deterioration unless shown to reduce latex-related problems and maintain glove barrier protection. After removing latex gloves, wash hands with a mild soap and dry thoroughly.

Information and Training

All employees with occupational exposure must receive initial and annual training on the hazards associated with exposure to bloodborne pathogens. The training must also address the protective measures taken to minimize the risk of occupational exposure. Employers must conduct retraining

when changes in procedures or tasks occur. Consider OSHA employee training requirements as performance oriented. However, employers may tailor their presentations to the employees' backgrounds and responsibilities. Ensure that the training addresses the topics listed in paragraph (g)(2)(vii) of 29 CFR 1910.1030.

Employers must provide training at the time of initial employment and at least annually thereafter. Provide annual retraining for employees within 1 year of their original training date. Refresher training must cover topics listed in the standard to the extent needed and must emphasize new information or procedures. Employers must train part-time employees, temporary employees, and those referred to as *agency* or *per diem* employees. OSHA requires training to include an explanation of the use and limitations of methods that will prevent or reduce exposure, including appropriate engineering controls, work practices, and PPE. Training must include instruction on any new techniques and practices. Use hands-on training if possible.

Training Methods and Interactive Question Opportunities

Training employees solely by means of a film or video without the opportunity for a discussion period would constitute a violation of 29 CFR 1910.1030(g)(2). Never consider a computer program, even an interactive one, as appropriate unless the employer supplements such training with site-specific information required. Provide trainees with direct access to a qualified trainer during all training sessions. OSHA permits employers to meet the requirement if personnel can directly access a trainer by way of a telephone hotline. OSHA does not consider the use of electronic mail systems to answer employee questions unless a trainer answers e-mailed questions at the time the questions arise.

Trainer Qualifications

OSHA requires persons conducting training to possess knowledge in the subject matter covered by the elements contained in the training plan. The trainer must demonstrate expertise in the area of the occupational hazard of bloodborne pathogens and know local procedures. Trainers, such as infection control practitioners, registered nurses (RAs), occupational health professionals, PAs, emergency medical technicians, industrial hygienists, and professional trainers, may conduct the training provided they know the subject matter covered in the training plan as it relates to the workplace. In dentist and physician offices, individual employers may conduct the training, provided they understand bloodborne pathogen exposure control and the subject matter required by the standard.

Medical Recordkeeping

Medical recordkeeping, covered by 29 CFR 1910.1020(h), requires employers to keep medical and training records for each employee. OSHA permits employers not to retain medical records of employees working for less than a year need if given to the employee upon termination of employment. Keep medical records confidential except for disclosures permitted by the standard or by other federal, state, or local laws. Make all medical records required by the standard available to OSHA. The compliance officer must protect the confidentiality of these records. If copied for the case file, follow the provisions of 29 CFR 1913.10. Consider records about employee exposure to bloodborne pathogens and documenting their HIV/HBV status as medical records.

Training Recordkeeping

OSHA requires accurate recordkeeping of training sessions, including titles of the employees who attend. The records assist the employer and OSHA in determining whether the training plan

adequately addresses the risks involved in each job. Additionally, this information can prove helpful in tracking the relationship between exposure incidents and the corresponding levels of training. Store training records on-site to permit easy access. Do not consider training records as confidential. Retain training records for 3 years from the training date.

Hazardous Waste Operations and Emergency Response (29 CFR 1910.120)

The standard covers all personnel expected to respond to emergencies caused by the uncontrolled release of a hazardous substance. The definition of hazardous substance includes any biological agent or infectious material that may cause disease or death. Potential scenarios where the Bloodborne Pathogens and HAZWOPER standards may interface include healthcare staff members responding to an emergency caused by the uncontrolled release of infectious material. Employers of employees engaged in these types of activity must comply with the requirements in 29 CFR 1910.120 as well as the Bloodborne Pathogens standard. If there is a conflict or overlap, the provision that is more protective of employee safety and health applies.

Postexposure Evaluation and Follow-Up

Employers should provide a confidential medical evaluation for any employees involved in an exposure incident. The evaluation documents the exposure route and all circumstances related to the incident including blood testing, HIV/HBV status of source, and appropriate medical/psychological treatment. An exposure incident can occur to a specific eye, the mouth, mucous membranes, nonintact skin, or any other contact with potentially infectious material that results from the performance of an employee's duties. Employees should immediately report exposure incidents to permit timely medical evaluation and follow-up by a healthcare professional. The employer can request testing of the source individual's blood for HIV and HBV. Consider a source individual as any patient whose blood or body fluids provide the source of an exposure incident to an employee. At the time of exposure, the exposed employee must report to a healthcare professional. The employer must provide the healthcare professional with a copy of the Bloodborne Pathogens standard and a description of the employee's job duties as they relate to the incident. The employer must also provide a report of the specific exposure, including route of exposure, relevant employee medical records (including hepatitis B vaccination status), and results of the source individual's blood tests, if available. Draw a baseline blood sample if the employee consents. If the employee elects to delay HIV testing of the sample, the healthcare professional must preserve the employee's blood sample for at least 90 days. Never repeat testing for known HIV- or HBV-positive individuals. Most states require written consent before testing. Treat the results of the source individual's blood test as confidential. Make the results available to the exposed employee through consultation with the healthcare professional. The healthcare professional will provide a written opinion to the employer. The opinion can provide only a statement that the employee received the results of the evaluation. The employer must provide a copy of the written opinion to the employee within 15 days. This requirement remains the only information shared with the employer following an exposure incident. Treat all other employee medical records as confidential. Provide all evaluations and follow-up visits at no cost to the employee. They must take place at a reasonable time and place. Perform evaluations and follow-up visits under the supervision of a licensed physician or another licensed healthcare professional. All evaluations must follow the US Public Health Service guidelines current at the time. Conduct all laboratory tests by using an accredited laboratory and at no cost to the employee (Table 8.9).

TUBERCULOSIS

Every healthcare setting should conduct initial and ongoing evaluations for the risk of TB transmission. The TB risk assessment determines the types of administrative, environmental, and respiratory

TABLE 8.9
Evaluating the Circumstances Surrounding an Exposure Incident

- Engineering controls in use at the time
- Work practices followed
- Description of the device being used
- Protective equipment or clothing used at the time of the exposure incident
- Where the incident occurred
- Procedure being performed when the incident occurred
- Employee's training

protection controls needed for a setting and serves as an ongoing evaluation tool of the quality of TB infection control and for the identification of needed improvements in infection-control measures. Review the community profile of TB disease in collaboration with the state or local health department. Consult the local or state TB-control plan to obtain epidemiologic surveillance data necessary to conduct a TB risk assessment for the healthcare setting. Review the number of patients with suspected or confirmed TB disease encountered in the setting during at least the previous 5 years. The screening plan should consist of four major components: (1) baseline testing for TB infection, (2) serial testing for TB, (3) serial screening for symptoms or signs of TB disease, and (4) TB training and education. Surveillance data from HCWs can protect both HCWs and patients. Screening can prevent future transmission by identifying lapses in infection control and expediting treatment for persons with LTBI or TB disease. Test for TB and document the TB screening according to procedures in the 2005 CDC Guidelines. Maintain the protection of privacy and confidentiality of all test results.

TB Screening Procedures for Settings Classified as Low Risk

All employees should receive baseline TB screening upon hire, using two-step tuberculin skin test (TST) or a single blood assay for *Mycobacterium tuberculosis* (BAMT) to test for infection. After baseline testing, do not conduct additional screening if an exposure to TB occurs. Individuals with a baseline positive or newly positive test result for TB or documentation of treatment for latent TB infection (LTBI) or TB disease should receive one chest radiograph result to exclude TB disease or provide an interpretable copy within a reasonable time frame, such as 6 months. Do not repeat radiographs unless symptoms or signs of TB disease develop or as recommended by a clinician.

TB Screening Procedures for Settings Classified as Medium Risk

All healthcare personnel should receive baseline TB screening upon hire, using two-step TST or a single BAMT to test for infection. After baseline testing, personnel should receive TB screening annually. Personnel with a baseline positive or newly positive test result or documentation of previous treatment for LTBI or TB disease should receive one chest radiograph result to exclude TB disease. Instead of participating in serial testing, personnel should receive a symptom screen annually. This screen should be accomplished by educating the employees about symptoms of TB disease and instructing them to report any such symptoms immediately. Conduct treatment for LTBI in accordance with CDC guidelines.

TB Screening Procedures for Settings Classified as Potential Ongoing Transmission

Perform testing for TB infection every 8–10 weeks until correcting lapses in infection control and no additional evidence of ongoing transmission exists. Consider the classification of potential ongoing

TABLE 8.10
TB Training and Education Topics

- Basic concepts of transmission, pathogenesis, and diagnosis
- Explanation of the difference between latent and active tuberculosis
- Signs and symptoms of active tuberculosis
- Increased risk for those infected with HIV
- Potential for occupational exposure
- Information about prevalence of tuberculosis in the community
- Situations that increase the risk of exposure
- Principles of infection control
- Importance of skin testing and significance of a positive test
- Principles of preventive therapy for latent tuberculosis
- Drug therapy procedures for active tuberculosis
- Importance of notifying the facility
- Information about medical evaluation for symptoms of active tuberculosis

transmission as a temporary classification only. It warrants immediate investigation and corrective steps. After a determination that the ongoing transmission ceased, reclassify the setting as medium risk. Recommend maintaining the classification of medium risk for at least 1 year (Table 8.10).

OSHA Tuberculosis Exposure Enforcement Guidelines

These guidelines address patient and healthcare staff testing, source control methods, decontamination techniques, and prevention of tuberculosis-contaminated air. This enforcement policy refers to CDC guidelines and the OSHA general duty clause. OSHA conducts inspections in response to complaints and during routine compliance visits in the following workplaces:

- Healthcare settings
- Correctional institutions
- Homeless shelters
- Long-term care facilities
- Drug treatment centers

OSHA Citations for TB Exposures

OSHA can issue citations to employers as a result of exposure or potential exposure to the exhaled air of a suspected or confirmed case of tuberculosis. Exposure can occur during a high-hazard procedure performed on an individual with suspected or confirmed tuberculosis. OSHA can issue citations under the respirator standard (29 CFR 1910.134) when employers fail to provide respirators and fit testing to potentially exposed employees.

OSHA Abatement Methods

Strive to identify persons with active tuberculosis. Provide medical surveillance at no cost to the employee, including preplacement evaluation, tuberculosis skin tests, annual evaluations, and twice-yearly exams for those exposed. Evaluate and manage individuals with a positive skin test. Use acid-fast bacilli isolation rooms for those with active or suspected TB infection. Maintain such rooms under negative pressure and use outside exhaust or high-efficiency particulate air (HEPA)-filtered ventilation. Develop an employee information and training plan.

OSHA Tuberculosis Respirator Requirements

OSHA requires healthcare organizations to meet the provisions of 29 CFR 1910.134, which covers respiratory protection for general industry. OSHA enforces all provisions, including annual fit testing with regard to TB exposures. When using disposable respirators, never permit reuse unless maintaining the functional and structural integrity of the respirator. Maintaining functionality depends on adherence to the manufacturer's instructions. Facilities should address the conditions under which a disposable respirator is considered contaminated. Whenever using reusable or disposable respirators, employers must implement a respiratory protection plan to meet the requirements of 29 CFR 1910.134. This entails creating a written respiratory protection plan for managing respirator selection and use, employee instruction and training, surveillance of work area conditions, and respirator fit testing. 29 CFR 1910.134 provides specific guidance on appropriate fit testing procedures. CDC guidelines, NIOSH recommendations, and selection criteria in the OSHA standard indicate that most facilities should use half-mask, N-95, air purifying, filtering face piece respirators for TB protection. This type of respirator contains a securely fitting face piece. Effective protection requires a good seal between the face and the face piece to ensure individual protection. The OSHA Respiratory Protection standard does not require annual medical evaluations. However, employers must conduct annual fit tests for all respirator users. Never consider respirator fit testing as a hazard-specific or industry-specific activity. Annual fit testing provides the opportunity for employees to receive feedback on how well they don their respirator. Employees should receive fit testing annually as part of training.

TB Exposure Control Plan

Every healthcare setting should implement a TB infection control plan as a part of their overall infection control and prevention efforts. The specific details of the TB infection control plan can differ depending on patients encountered. Administrators making this distinction should obtain medical and epidemiologic consultation from state and local health departments. The TB infection-control plan should consist of administrative controls, environmental controls, and a respiratory protection plan. Every setting providing services to persons with suspected or confirmed infectious TB disease, including laboratories and nontraditional facility-based settings, should develop a TB infection control plan. Take the following steps to establish a TB exposure-control plan: (1) assign supervisory responsibility for the TB infection-control plan to a qualified person or group; (2) delegate authority to conduct a TB risk assessment, implement, and enforce TB infection-control policies; (3) ensure the completion of education and training; (4) develop a written TB exposure control plan that outlines control procedures; and (5) update the plan annually. Employers must develop procedures for evaluating suspected or confirmed TB disease when not promptly recognized or appropriate precautions or controls fail. Collaborate with the local or state health department to develop administrative controls consisting of the risk assessment, the written TB infection-control plan, management of patients with suspected or confirmed TB disease, training and education, screening and evaluation, problem evaluation, and coordination. Create a plan for accepting patients with suspected or confirmed TB disease when transferred from another setting.

Administrative Controls

The first and most important level of TB controls is the use of administrative measures to reduce the risk for exposure to persons with TB disease. Administrative controls consist of the following activities: (1) assigning responsibility for TB exposure control in the setting, (2) conducting a TB risk assessment of the setting, (3) developing and instituting a written TB exposure control plan to ensure prompt detection, (4) use of airborne precautions, (5) treatment of persons with suspected

or confirmed TB disease, and (6) ensuring the timely availability of recommended laboratory processing, testing, and reporting of results to the ordering physician and infection-control team. Other administration controls include implementing effective work practices for the management of patients with suspected or confirmed TB disease and ensuring proper cleaning and sterilization or disinfection of potentially contaminated equipment such as endoscopes. Provide training and education with specific focus on prevention, transmission, and symptoms. Conducting screening and evaluation of at risk for TB disease remains a key administrative action.

Environmental Controls

Environmental controls provide the second line of defense in the TB infection-control plan, after administrative controls. Environmental controls include technologies for the removal or inactivation of airborne TB. These technologies include local exhaust ventilation, general ventilation, HEPA filtration, and ultraviolet germicidal irradiation (UVGI). These controls help to prevent the spread and reduce the concentration of infectious droplet nuclei in the air. CDC provides a summary of environmental controls and their use in the prevention in the 2005 CDC TB Guidelines. Primary environmental controls consist of controlling the source of infection by using local exhaust ventilation (hoods, tents, or booths) and diluting and removing contaminated air by using general ventilation. Secondary environmental controls consist of controlling the airflow to prevent contamination of air in areas adjacent to the source (AII rooms) and cleaning the air by using HEPA, filtration, or UVGI.

Respiratory Protection Controls

The first two control levels minimize the number of areas in which exposure to *M. tuberculosis* might occur and, therefore, minimize the number of persons exposed. These control levels also reduce, but do not eliminate, the risk for exposure in the limited areas in which exposure can still occur. Because persons entering these areas might be exposed to *M. tuberculosis*, the third level of the hierarchy is the use of respiratory protective equipment in situations that pose a high risk for exposure. Use of respiratory protection can further reduce the risk for exposure from droplet nuclei expelled into the air from a patient with infectious TB disease. Take the following measures to reduce the risk of exposure: (1) implement a respiratory protection plan, (2) train employees on respiratory protection, and (3) educate patients about respiratory hygiene and cough etiquette procedures.

Engineering Controls

Engineering controls prove critical in preventing the spread of tuberculosis within a facility. The CDC guidelines recommend exhausting air from possibly infected areas to the outside. Healthcare facilities can develop isolation rooms with negative pressure. Recommend a rate of six air changes per hour. New construction requires 12 air changes per hour. Some facilities use germicidal ultraviolet lights to supplement ventilation and isolation efforts.

HEALTHCARE OPPORTUNISTIC INFECTIONS

Bacteria

Once classified as a member of the plant kingdom, we classify bacteria as a totally separate kingdom. Bacteria adapt remarkably and survive in diverse environmental conditions. They exist in the bodies of all living organisms and in all parts of the world even in hot springs and the stratosphere. Bacteria normally exhibit one of three typical shapes: (1) rod shaped (bacillus), (2) round (cocci), and (3) spiral (spirillum). An additional group (vibrios) appears as incomplete

spirals. We can characterize bacteria by growth patterns such as the chains formed by streptococci. *Bacillus* and *Spirillum* exhibit motile or swimming motions similar to the whip-like movements of flagella. Other bacteria possess rod-like appearances (called pili) that serve as tethers. Aerobic forms of bacteria function only in the presence of free or atmospheric oxygen. Anaerobic bacteria cannot grow in the presence of free oxygen but obtain oxygen from other compounds. Bacteria do not make their own food and must live in the presence of other plant or life. Bacteria grow when they find food and favorable conditions. A cough or sneeze releases millions of bacteria from the body.

Methicillin-Resistant *Staphylococcus aureus*

Staphylococcus aureus can live on the skin or in the nose of healthy people. During the past 50 years, these infections became resistant to various antibiotics, including penicillin-related antibiotics. Infection control personnel refer to these resistant bacteria as methicillin-resistant *S. aureus* (MRSA). Colonization can occur when the staph bacteria survive on or in the body without causing illness. Staph bacteria causes a variety of illnesses, including skin infections, bone infections, pneumonia, and severe BSIs. MRSA occurs more commonly among persons in hospitals and healthcare facilities. The infection usually develops in elderly hospitalized patients with serious illnesses or in an open wound such as a bedsore. Factors that place some patients at risk include long hospital stays, receiving broad-spectrum antibiotics, and being kept in an intensive care or burn unit. Keep cuts and abrasions clean and covered with a proper dressing or bandages and to avoid contact with wounds or material contaminated by wounds. Implement contact precautions when identifying MRSA, and infection control believes that it indicates special clinical or epidemiologic significance.

Viruses

Smaller than bacteria, viruses contain a chemical compound with protein. They must infect a host to survive for long periods. Viruses depend on the host cells to reproduce. Outside of a host cell, a virus exists as a protein coat or capsid that can enclose within a membrane. While outside the cell, a virus remains metabolically inert. A virus can insert genetic material to take over the functions of the host. An infected cell begins to produce more viral protein and genetic material instead of its usual products.

Some viruses may remain dormant inside host cells for long periods and cause no obvious change in the host cells. When stimulated, a dormant virus enters a phase that results in new viruses bursting and infecting other cells. Viruses cause a number of diseases, including smallpox, colds, chickenpox, influenza, shingles, hepatitis, polio, rabies, and AIDS. Disinfectants destroy viruses very easily.

Aspergillus

The mold spore produced by *Aspergillus* can create pathogenic infection opportunities. *Aspergillus* exists worldwide and can thrive at elevated temperatures. Ideal growth conditions include damp areas with decaying vegetation. *Aspergillus* appears initially as a flat thread-like white growth that soon becomes a powdery blue–green mold spore. Most infections result from inhaling these spores. Most people possess natural immunity and do not develop any disease. Patients with serious ailments tend to experience a greater risk of infection. The severity of *Aspergillus* depends on the individual's immune system. *Aspergillus* infection can range from sinusitis conditions to pulmonary infections, including pneumonia. Ventilation plays a key role in maintaining an *Aspergillus*-free environment in healthcare settings. Establish procedures to control dust during renovations that occur near patient areas.

Anthrax

Exposure to the spore-forming bacterium results in black coal-like skin lesions. In the naturally occurring forms, anthrax passes on by contact with anthrax-infected or anthrax-contaminated animals and animal products. Anthrax does not spread from one person to another person. Humans can host three forms of anthrax: inhalation, cutaneous, and gastrointestinal. Inhalation anthrax occurs when the anthrax spore is inhaled. Cutaneous anthrax, the most common naturally occurring form, is contracted by handling contaminated hair, wool, hides, flesh, blood, or excreta of infected animals and from manufactured products such as bonemeal. It is introduced through scratches or abrasions of the skin. Gastrointestinal anthrax occurs as a result of ingesting insufficiently cooked infected meat or from flies. The spores enter the lungs, migrate to the lymph nodes, change to the bacterial form, multiply, and produce toxins.

Severe Acute Respiratory Syndrome

Severe acute respiratory syndrome (SARS) is an emerging, sometimes fatal, respiratory illness. The first identified cases occurred in China during 2002. Some experts believe that a virus causes SARS; however, the specific agent remains unidentified. No laboratory or other test can definitively identify cases. Most suspected SARS cases occurring in the United States involved individuals returning from travel to Asia and healthcare staff members in contact with patients. Casual contact does not appear to cause SARS. Transmission appears to occur primarily through close contact with a symptomatic patient. Signs of illness include a decreased white blood cell count in most patients as well as below-normal blood platelet counts, increased liver enzymes, and electrolyte disturbances in a number of patients.

Pseudomonas

Pseudomonas, a motile rod-shaped organism, uses glucose in an oxidative manner. These bacteria pose a clinically important risk because of their resistance to most antibiotics. They can survive conditions that few other organisms can tolerate, aided by their production of a protective slime layer. The key targets include immune-suppressed individuals, burn victims, and individuals on respirators or with indwelling catheters. Additionally, these pathogens colonize the lungs of cystic fibrosis patients, increasing the mortality rate of individuals with the disease. Infections can occur at many sites and can lead to urinary tract infections, sepsis, pneumonia, and pharyngitis.

Rarely does *Pseudomonas* cause infection in healthy individuals. Its noninvasive nature limits its pathogenic capabilities. *Pseudomonas* prefers to inhabit moist environments, but it can survive in a medium as deficient as distilled water.

Legionella

Studies link a majority of outbreaks to cooling towers and domestic water systems. Other sources include evaporative condensers, respiratory equipment, showers, faucets, whirlpool baths, humidifiers, and decorative fountains. Hot water systems provide a perfect breeding habitat as *Legionella* grows best in temperatures ranging from 95°F to 115°F. Uncontrollable incidents that can cause *Legionella* problems include surges in water pressure that may disburse dirt into the water system or dislodge *Legionella*-laden scale and sediment from the walls of water pipes. *Legionella* can enter cooling towers, air intakes, or water pipes. In addition, new or renovated water lines not properly flushed prior to opening may contain *Legionella*. Idle plumbing can hold heavy contamination due to stagnant water. Current human treatment includes the antibiotics erythromycin and rifampin for severe cases.

Infection Control Risk Assessment

ICRA functions best as a multidisciplinary process that focuses on reducing risk from infection throughout facility planning, design, construction, and renovation activities. A multidisciplinary team considers environment, infectious agents, human factors, and impact of a proposed project on controlling infections. The team includes, at a minimum, experts in infectious disease, infection control, patient care, epidemiology, facility design, engineering, construction, and safety, as circumstances dictate.

Educate both the construction team and healthcare staff about high-risk patient areas with regard to the airborne infection risks associated with construction projects, dispersal of fungal spores during such activities, and methods to control the dissemination of fungal spores. Incorporate mandatory adherence agreements for infection control into construction contracts, with penalties for noncompliance and mechanisms to ensure timely correction of problems. Establish and maintain surveillance for airborne environmental disease such as *Aspergillus* during construction, renovation, repair, and demolition activities to ensure health and safety of high-risk patients.

MEDICAL WASTE

Defined in 40 CFR 259.10 and 40 CFR 22 as any solid waste that generated in the diagnosis, treatment, or immunization of human beings or animals, in related research, biological production, or testing. Currently, medical waste is regulated by most states. Segregate infectious waste from other waste at the point of generation within the facility. Ensure packaging contains the infectious waste from the point of generation up to the point of proper treatment or disposal. Place contaminated sharps immediately in rigid, leakproof, puncture-resistant containers. Conspicuously identify all containers used for the disposal of infectious waste. Handle and transport infectious waste to maintain integrity of the packaging. Do not transport plastic bags containing infectious waste using chutes or dumbwaiters. Establish procedures for storing infectious waste that would inhibit rapid microbial growth and minimize exposure potential. Isolate the area after a spill, discovery of ruptured packaging, or other incident involving potentially infectious materials. When practicable, repackage all spilled waste and containment debris. Disinfect all containment equipment and surfaces appropriately. Complete the appropriate incident report.

Regulated medical waste, a subset of all medical wastes, includes several categories, which can vary depending on the state or locality (Table 8.11).

Sharps Containers

Red or clear biohazard sharps containers can also contain regulated medical or infectious waste, but will more specifically hold items that could potentially puncture the skin and transmit an infectious disease. Needles and syringes make up the first type of sharps people correlate sharps

TABLE 8.11
Some Categories of Regulated Biomedical Wastes

- Cultures and stocks of infectious agents
- Human pathological wastes such as tissues and body parts
- Human blood and blood products
- Sharps (needles and syringes used in care areas)
- Certain animal wastes
- Certain isolation wastes (e.g., wastes from patients with highly communicable diseases)
- Unused sharps (suture needles, scalpel blades, hypodermic needles)

containers. Other items can become sharps hazards including pipettes, scalpels, and lancets. Contents can consist of used or unused sharps that could potentially contain pourable, squeezable, or dried flaky blood. Since the primary components placed of sharps containers include needles and syringes, sharps containers in some states may require incineration to prevent misuse of these items.

Separating Medical and Hazardous Wastes

Medical facilities and pharmaceutical companies bear an enormous task of segregating and disposing of the wastes that accumulate during the development of medicines and treatment of patients. These wastes pose very different hazards and impacts on the environment and human beings.

Many types of containers can assist with proper segregation of wastes. Proper training on the use of containers not only protects the environment and humans but also reduces disposal costs by identifying what should go into specified containers. Use red Biohazard Bags only for regulated medical waste consisting of solid, liquid, or semiliquid blood or other potentially infectious material and contaminated items that, if compressed, could release blood or infectious material during normal handling. This includes waste generated during the treatment or diagnosis of humans or animals or in the testing of biologicals. Common contents could include empty IV bags and tubing, gloves, gowns, or other materials containing pourable, squeezable, flaking, or dripping blood including bodily fluids. Use red bags or bags clearly identified with the international biohazard symbols to contain materials requiring disinfection. Rendering materials noninfectious could permit disposal in a nonhazardous landfill. When red bag waste requires incineration, send the materials to regulated medical waste incinerator permitted by the EPA. Consider incineration for all pathological waste.

Infectious Wastes

Blood and body fluids include bulk laboratory specimens of blood tissue, semen, vaginal secretions, cerebrospinal fluid, synovial fluid, pleural fluid, peritoneal fluid, pericardial fluid, and amniotic fluid. Precautions do not apply to feces, nasal secretions, sputum, sweat, tears, urine, or vomit unless they contain visible blood. Handle free-flowing materials or items saturated to the point of dripping liquids containing visible blood or blood components. Pathological waste includes all discarded waste from renal dialysis contaminated with peritoneal fluid or blood visible to the human eye. Consider solid renal dialysis waste as medical waste if saturated and demonstrate the potential to drip/splash blood or other regulated body fluids. Waste sharps include any used or unused discarded article that may cause punctures or cuts.

Medical Waste Best Practices

Provide medical waste spill response and cleanup training. Educate staff to properly identify all nonregulated waste and how to dispose of it. Inform local regulators and involve them in the effort to reduce waste and properly regulated medical waste. Establish and post guides for identifying regulated medical waste at every site of generation and disposal. Weigh each container, log them, and compare totals from each generator; retrain departments with high utilization. Provide PPE to facilitate alternative disposal methods. Date sharps containers when first used and remove only when 75% full or when meeting an established time limit of use. Place medical waste receptacles in such a way as to avoid indiscriminate use.

Waste Handling for Off-Site Transfer

The outermost layer of packaging for medical containers, excluding sharps, should be of a red background color or use red lettering with a contrasting color. Clearly label the container with warnings

such as *Infectious Waste*, *Medical Wastes*, or *Biohazardous*. The container should also bear the universal biohazard symbol. Print wording on the container or securely attached to the label on two or more sides. Ensure that the symbol measures at least 6 in. in diameter and contains print with a contrasting color to the background. Ensure the use of impermeable containers of sufficient strength to resist ripping, tearing, or bursting under normal conditions of use. Place sharps in rigid, leakproof, puncture-resistant sealed containers to prevent loss during handling. Clearly label all containers. Place small containers used to collect untreated medical waste inside larger containers during storage, transportation, and disposal activities.

Containers

During collection, storage, and transportation, use containers constructed of materials compatible with the treatment methods utilized. Ensure the use of burnable single-use containers for waste destined for incinerators. Containers destined for steam sterilizers should allow proper treatment of the waste.

Decontaminate reusable containers after each use by applying only approved methods. Never reuse containers unless decontaminated and, before use, remove all medical waste labeling.

Medical Waste Disposal

Medical and Infectious Waste Incinerators (40 CFR 60, Subparts C and E)—the EPA promulgated new source performance standards (NSPS) and emission guidelines in 1997 (62 FR 48347) to reduce air emissions from new and existing medical and infectious waste incinerators. Refer to 40 CFR 60, Subparts E and C, for standards on new and existing incinerators. Existing sources include those for which construction was commenced on or before June 20, 1996. Hospitals, clinics, and clinical research laboratories operating a medical incinerator must comply with the NSPS as defined in 40 CFR 60, Subpart C. Steam sterilization uses saturated steam within a pressure vessel at temperatures high enough to kill infectious agents. Steam sterilization works effectively with low-density materials such as plastics. Containers effectively treated can include plastic bags, metal pans, bottles, and flasks.

Never sterilize materials with high-density polyethylene and polypropylene because they do not allow steam penetration. Refer to 40 CFR 60.51 for classification information on waste streams such as hospital waste, medical and infectious waste, and pathological waste. Consider other methods such as (1) shredding or compacting with steam autoclaving, (2) microwave irradiation, (3) thermal treatment, and (4) chemical/biological treatment. Discharge into the sewer system suctioned fluids, waste in liquid apparatus, bodily discharges, and dialysis waste. Sterilize substances such as cultures, etiologic agents, and other laboratory wastes. Use chemical disinfection methods in dialysis equipment and for specimen spills prior to cleaning. Never use compactors or grinders to process infectious wastes. When shipping waste off-site, collect, transport, and store in a manner prescribed by the contractor. Require contractors to pick up wastes only in leakproof and fully enclosed containers. Require contractors to maintain all required permits relevant to medical waste disposal. Contractors must also maintain regulatory documentation and records relevant to disposal actions including incinerated waste.

DOT Infectious Shipping Requirements

The PHMSA develops and issues hazardous materials regulations (49 CFR 100–180). The regulations govern the classification, hazard communication, and packaging of hazardous materials for transportation. DOT classified infectious substances, including regulated medical waste in Division 6.2 of the hazardous materials rules. Shippers of infectious substances must meet all standards related to commerce by rail, water, air, or highway. Regulated medical waste packaging (49 CFR 173.197) must meet certain requirements. Ensure the use of rigid, leak-resistant, impervious to

TABLE 8.12
DOT Training and Reporting Requirements

- All hazardous material employees must be trained IAW 49 CFR 172.
- Training must address general awareness, function-specific, and safety rules.
- Test each employee and maintain record of testing.
- Retrain hazardous materials employees every 2 years.
- Report any infectious substance spill to the CDC according to 49 CFR 171.15.
- For other reportable hazardous material spills, contact the DOT National Response Center.

moisture, and strong packing materials to prevent tearing or bursting under normal conditions of use and handling. Properly seal all waste containers to prevent leakage during transport. Ensure the use of puncture-resistant sharps containers. Ship waste materials in break-resistant containers, tightly lidded, or stopper closed for fluids. Package and mark with the *Biohazard* marking in accordance with OSHA standard, 29 CFR 1910.1030. Diagnostic specimens and biological products do not qualify for regulation except when transported as regulated medical waste. An infectious substance consists of a viable microorganism, or its toxin, that causes or may cause disease in humans or animals. Consider a regulated medical waste as any waste or reusable material that contains an infectious substance and generated in the diagnosis, treatment, or research of humans or animals. This definition does not include discarded cultures or stocks.

A biological product refers to any material prepared and manufactured in accordance with certain regulations of the Department of Agriculture or the DHHS. A diagnostic specimen refers to any human or animal material being shipped for purposes of diagnosis. It includes but is not limited to excreta, secreta, blood, blood components, tissue, and tissue fluids (Table 8.12).

REVIEW EXERCISES

8.1 List at least seven infection control plan development considerations.
8.2 List the three healthcare vaccine categories.
8.3 Healthcare employees should meet the ACIP guidelines for immunization of which four diseases?
8.4 The Guidelines for Environmental Infection Control in Healthcare Facilities would not apply to which three broad categories of biological risks?
8.5 List the six types of disease and infection transmission routes.
8.6 What three diseases or pathogens can be transmitted by airborne routes in healthcare facilities?
8.7 List three HACs that could qualify for potential reduced payments.
8.8 List the three types of chemical germicides.
8.9 What type of pathogen exhibits the most resistance to chemical germicides?
8.10 Which federal agency regulates liquid chemical sterilants and high-level disinfectants?
8.11 Describe in your own words the three CDC-defined disinfecting levels.
8.12 What actions does OSHA require employers to take to help reduce risks associated with needle usage?
8.13 What three types of information does OSHA require on sharps injury logs?
8.14 List at least seven HBV vaccination requirements mandated by the OSHA Bloodborne Pathogen Standard.
8.15 Describe the CDC recommended TB screening procedures for settings classified as low risk.
8.16 List five types of workplaces, with potential TB exposures, that can be inspected by OSHA.
8.17 Describe the process known as an ICRA.

9 Fire Safety Management

INTRODUCTION

Facilities contain many fire-related hazards including medical equipment, combustible gases, chemicals with low flash points, and electrical hazards of all types. Planning should consider proper design to include prevention features and egress safety. Fire response planning remains a key element of any emergency management process.

Fire begins with no visible smoke, flames, or significant heat. However, a large amount of combustion particles generate over time. The particles created by chemical decomposition possess both weight and mass but remain too small for the eye to see. They behave according to gas laws and quickly rise to the ceiling. As this incipient stage continues, the combustion particles increase until they become visible and create a condition called *smoke*. As the fire continues to develop, ignition occurs and flames begin. The level of visible smoke decreases and heat levels increase. At this point, the process produces large amounts of heat, flame, smoke, and toxic gases.

The life safety concept began in 1963 with the publication of the Building Exits Code. NFPA published its first edition of the Life Safety Code® in 1966. Building codes provide design criteria but NFPA 101® addresses the general requirements for fire protection and system safety necessary to assure the safety of building occupants during a fire. The code provides minimum requirements for the design, operation, and maintenance of healthcare organization buildings and structures. NFPA 101 requires that new and existing buildings allow for prompt escape or provide occupants with a reasonable degree of safety through other means. It defines hazards and addresses general requirements for egress and covers fire protection features such as fire doors. The code also addresses building service and fire equipment such as HVAC systems, sprinkler systems, fire detection systems, and localized extinguishers. New editions of the code build on the prior editions.

Life Safety Code Comparisons

The 2012 edition of the Life Safety Code offers new design and compliance options for healthcare facilities. Since all jurisdictions do not use the same edition of the code, CMS and the Joint Commission permit the use of the 2012 edition in its entirety or on a single-element basis. ASHE developed a monograph in 2013 that provided summary changes in the new code. The monograph also provided a comparison of the 2012 code with the 2000 and 2009 editions. The monograph presented three different options for upgrading from the 2000 edition to the 2009 or 2012 edition. The monograph provided guidance about waivers and equivalencies for using the newer editions of the code (Table 9.1).

OCCUPANCIES DEFINED BY NFPA 101 LIFE SAFETY CODE AND NFPA 5000™ BUILDING CODE

Healthcare

Healthcare is an occupancy used for purposes of medical or other treatment or care of four or more persons where most occupants could not help their self-preservation due to age and physical or mental disability or because of security measures not under occupants control. Healthcare occupancies would include hospitals, limited care facilities, and nursing homes.

TABLE 9.1
2012 Life Safety Code Chapters

1. Administration
2. Referenced Publications
3. Definitions
4. General
5. Performance-Based Option
6. Classification of Occupancy and Hazard of Contents
7. Means of Egress
8. Features of Fire Protection
9. Building Service and Fire Protection Equipment
10. Interior Finish, Contents, and Furnishings
11. Special Structures and High-Rise Buildings
12./13. New and Existing Assembly Occupancies
14./15. New and Existing Educational Occupancies
16./17. New and Existing Day-Care Occupancies
18./19. New and Existing Healthcare Occupancies
20./21. New and Existing Ambulatory Healthcare Occupancies
22./23. New and Existing Detention and Correctional Occupancies
24. One- and Two-Family Dwellings
25. Reserved
26. Lodging and Rooming Houses
27. Reserved
28./29. New and Existing Hotels and Dormitories
30./31. New and Existing Apartment Buildings
32./33. New and Existing Residential Board and Care Occupancies
34./35. Reserved
36./37. New and Existing Mercantile Occupancies
38./39. New and Existing Business Occupancies
40. Industrial Occupancies
41. Reserved
42. Storage Occupancies
43. Building Rehabilitation
Annex A: Explanatory Material
Annex B: Supplemental Evacuation Equipment
Annex C: Informational References

Ambulatory Healthcare

Ambulatory healthcare is a building or portion thereof used to provide services or treatment simultaneously to four or more patients that provides, on an outpatient basis, one or more of the following: (1) treatment for patients that renders the patients incapable of taking action for self-preservation under emergency conditions without the assistance of others, (2) anesthesia that renders the patients incapable of taking action for self-preservation under emergency conditions without the assistance of others, and (3) emergency or urgent care for patients that due to the nature of their injury or illness could not take actions for self-preservation under emergency conditions without the assistance of others.

Hazard Content Description

Low hazard: contents of such low combustibility that no self-propagating fire therein can occur

Ordinary hazard: contents likely to burn with moderate rapidity or to give off a considerable volume of smoke
High hazard: contents likely to burn with extreme rapidity or from which explosions are likely

Deficiencies

Determine fire safety deficiencies on a building-by-building basis and rated according to how a deficiency could affect overall fire safety efforts. Classify deficiencies as listed in the following:

Level I: A deficiency or series of deficiencies that indicate a lack of proper maintenance of building components that play a role in the unit concept.
Level II: A deficiency or series of deficiencies involving one or more unit-concept areas that would pose a threat to life or the significant deficiencies in a limited area.
Level III: A deficiency or deficiencies indicating pervasive violation of one or more of the unit-concept areas or correcting deficiencies not possible in less than 3 years.

FIRE SAFETY MANAGEMENT

Fire Safety Evaluation System

The Center for Fire Research at the National Bureau of Standards, through the support of the US DHHS, developed the system for determining how combinations of fire safety elements can meet the intent of NFPA 101. This quantitative evaluation system grades fire safety zone by zone in healthcare facilities. Score the following areas: (1) containment actions taken to control the fire and smoke, (2) extinguishing systems and procedures to effectively extinguish a fire, (3) moving occupants to safety from a fire or smoke zone, and (4) general safety procedures and policies that affect the overall safety of the fire and/or smoke zone (Tables 9.2 through 9.4).

Design Considerations

Design, construct, maintain, and operate a building to minimize the possibility of a fire requiring the evacuation of occupants. Develop procedures to address the following:

- Design, construction, and compartmentalization.
- Provision for detection, alarm, and extinguishments systems.
- Fire prevention planning and training.
- Develop procedures to address isolation of fire.
- Plan for evacuation of the building or the transfer of occupants to areas of refuge (Table 9.5).

TABLE 9.2
Basic Fire Plan Requirements

- Policies implemented to manage fire safety
- Processes developed to protect humans from fire and smoke
- Procedures for inspecting, testing, and maintaining fire protection systems
- Facility-wide fire response procedures
- Area-specific needs including fire evacuation routes
- Specific roles and responsibilities of staff at the fire's point of origin
- Specific roles and responsibilities of staff in preparing for building evacuation

TABLE 9.3
OSHA Fire Plan Elements (29 CFR 1910.38)

- Fire department notification and follow-up procedures
- Procedures for announcing the fire location using an appropriate method
- Locations for key personnel to assemble and manage the decisions
- Designated personnel who will meet and direct fire department personnel
- Procedure for holding nonemergency calls and giving an *all-clear* signal

TABLE 9.4
Topics to Consider when Developing Fire Response Planning

- Specific needs related to fire evacuation and egress routes
- Specific roles and responsibilities for all staff
- Specific roles and responsibilities for patient evacuation
- Information about alarm systems and signals
- Information related to the location and use of firefighting equipment
- Information related to fire containment procedures

TABLE 9.5
General Fire Drill Procedures

- Provide information on location of fire, type of fire, and equipment failures.
- Facilities should install an effective and convenient fire alarm system.
- Shut off oxygen and gas valves if possible and disconnect unnecessary equipment.
- Reassure patients and visitors about the implementation of emergency plans.
- Ensure a realistic implementation of the fire plan conduct drills at varied times.
- Critique drills to identify deficiencies and opportunities for improvement.

Fire Prevention

Buildings must contain a fire alarm/or fire detection system that should automatically activate an alarm in the event of a fire. Install air-conditioning, ducts, and any related equipment in accordance with NFPA 90A, Standard for Installation of Air-Conditioning and Ventilating Systems. Ensure people can hear fire alarms over normal operational noise levels. Locate manual fire alarm stations near each exit. Ensure the connection of electrical monitoring devices to automatic sprinklers must be connected to alarm. Inspect fire extinguishers at least monthly and ensure regular maintenance. Test fire alarm/detection systems once a quarter. Publish and enforce a smoking policy. Implement appropriate electrical safety policies and educate all personnel about fire safety and response plans.

Inspections

Conduct quarterly fire inspections for each fire zone. Accomplish the following:

- Assess all equipment including the testing of alarms, detectors, and pull stations.
- Evaluate housekeeping practices and sprinkler pressure inspection procedures.
- Check water availability and fire hydrant operation.

- Check suppression, detection, and activation systems annually.
- Coordinate inspections with local fire marshal and facility engineering.

Fire Warning and Safety

Ensure all systems meet NFPA standards and local requirements. All manually operated fire systems must be electrically supervised. The system must also automatically transmit an alarm to the fire department. Notify the local fire department by other means when the ALARM HAS BEEN ACTIVATED (Tables 9.6 and 9.7).

Manual Alarm Stations

Locate manual alarm stations throughout the facility. Position the alarms to ensure travel distances of no more than 200 ft when located on the same floor. Design audible alarms to exceed the level of any operational noise. Use audible alarms with visual alarm.

Electrically Supervised Systems

Monitor all components to ensure personnel become aware when the system needs repair. The system should signal trouble when the following occurs:

- A break or ground fault prohibits normal system operation.
- The main power source fails.
- A break occurs in the circuit wiring.

Special Requirements for Cooking Areas

Install approved systems to protect cooking surfaces, exhaust hoods, and ducts. Consider the following types of systems:

- Automatic carbon dioxide systems
- Automatic dry chemical systems
- Automatic foam water or wet chemical systems
- Automatic sprinkler systems approved by NFPA 13

TABLE 9.6
Fire Alarm Types

- Central Station Service (NFPA 71)
- Auxiliary Protective Signaling Systems (NFPA 72)
- Proprietary Protective Signaling System (NFPA 72)
- Remote Station Protective Signaling System (NFPA 72)

TABLE 9.7
General Requirements for Alarms

- Fire alarms must be received at a central location within the facility.
- Continuously man and supervise all locations.
- Protect supervised locations as hazardous areas.
- Signals received must be transmitted at once to the local fire department.
- Provide a copy of the master fire plan at all supervised locations.

Fire System Inspections

All systems should receive a visual inspection each quarter. Test or inspect each automatic system on an annual basis. Include all systems in the preventive maintenance plan. Test all supervisory signal devices except valve tamper switches on a quarterly basis. Test valve tamper switches and water flow devices semiannually. Test duct detectors, electromechanical releasing devices, heat detectors, manual fire alarm boxes, and smoke detectors on a semiannual basis. Test occupant alarm notification devices to include audible and visible devices at least annually. Maintain appropriate documentation on all fire-related system testing.

Fire Confinement

Confinement measures consist of dividing a building into small cells. To assure proper protection of openings, install fire doors in accord with NFPA 80, Standard for Fire Doors and Fire Windows. Evaluate the movement of smoke within a structure by evaluating many factors such as building and ceiling height, suspended ceilings, ventilation, and external wind force or direction. One method of smoke control uses a physical barrier, such as a door or damper to block the smoke's movement. Regardless of the type of building construction, stair enclosures must provide a safe exit path for occupants. Stair enclosures also retard the upward spread of fire.

EMERGENCY EXITS

Designing exits involves more than a study of numbers, flow rates, and population densities. Exits must provide alternative pathways to counter potentially exit blockage by fire. Each employee should recognize and report fire safety hazards.

Exit doors must withstand fire and smoke during the length of time for which they are designed. Provide alternative exits and pathways in case fire blocks an exit. Provide exits with adequate lighting and mark exits with readily visible signs. Protect exiting personnel and areas of a hazard that might spread fire and smoke. Develop plans to evacuate disabled or wheel chair employees to meet OSHA requirements. The ADA Title III requires organizations to develop plans to safely evacuate disabled visitors.

Exit Sign Illumination

The illuminated surface of the exit sign should possess a value of not less than 5 ft-candles to meet 29 CFR 1910.37 standards. NFPA 101 requires 5 ft-candles for internally and externally illuminated signs with some exceptions such as approved self-luminous or electroluminescent signs that provide evenly illuminated letters. Signs can never contain decorations, furnishings, or pieces of equipment that impair visibility of an exit sign. Never place other brightly illuminated signs, displays, or objects in the line of vision of a required exit sign (Table 9.8).

TABLE 9.8
NFPA 101 Defined Methods for Illuminating Exit Signs

- Externally illuminated: light source contained outside of the device or legend needing illumination
- Internally illuminated: light source contained inside the device such as incandescent, fluorescent, electroluminescent, light-emitting diodes, or self-luminous
- Self-luminous: sign illuminated by self-contained power sources such as tritium and operates independently of external power sources (batteries do not qualify) with the light source contained inside the device
- Electroluminescent: light-emitting capacitor with the light source contained inside the device

Emergency Lighting

NFPA 101 establishes requirements for emergency lighting. Emergency illumination as required must provide a minimum of 1.5 h of light. Arrange emergency lighting to provide initial illumination of not less than an average of 1 ft-candle. This level can decline to a minimum of 0.6 ft-candle average and 0.06 ft-candle at any one point at the end of emergency lighting time of 1.5 h. The maximum illumination at a single one point must not exceed more than 40 times the minimum illumination at any one point. This helps prevent excessively bright and dark spots. Measure the intensity of visible light using candle units. Measure the rate of flow of light or luminous flux in lumens. A single lumen refers to the flux on 1 ft^2 of a sphere, 1 ft in radius with a light source of one candle at the center, and radiating uniformly in all directions. One lux refers to a unit of illumination equal to 1 lumen/m^2. Consider a foot-candle as the direct measurement of visible radiation falling on a surface. Footlambert measures physical brightness on any surface emitting or reflecting visible light.

OSHA Egress Standards

OSHA defines a means of egress as a continuous and unobstructed way of exit that travels from any point in a building or structure to a public way and consists of three parts:

- Exit access: that portion that leads to the entrance of an exit
- Exit: that portion separated from all other spaces of a building or structure by construction or equipment to provide a protected way of travel to the exit discharge
- Exit discharge: that portion between the termination of an exit and a public way

OSHA Exit Sign Marking Standards

OSHA Standard 29 CFR 1910.37 requires marking of exits with a visible sign when the exit or egress route to an exit would not adequately direct occupants. Identify with a sign any door, passageway, or stairway not serving as exit to prevent those existing from mistakenly going the wrong way. The sign should read "Not an Exit" or something similar, or identified by a sign indicating its actual character, such as *To Basement or Storeroom*. Signs designating an exit or a way of exit access must appear distinctive in color and provide a contrast with decorations, interior finish, or other signs. Every sign must contain the word "Exit" in visible and legible letters not less than 6 in. in height with the principal stroke of letters 0.75 in. wide. When not immediately apparent, post the direction of travel to the nearest exit with a sign reading EXIT, or use similar designation with an arrow indicating the direction to the exit.

PORTABLE FIRE EXTINGUISHERS

The following are basic types of equipment used to fight and control fires. The first type of equipment known as a fixed system includes automatic sprinklers, standpipe hoses, and various pipes systems. Supplement fixed systems by providing appropriate types and sizes of portable extinguishers. Train personnel who are expected to use portable fire extinguishers on their operation and safe use (Table 9.9).

TABLE 9.9
Basic PASS Guidelines

- Pull the pin on the extinguisher.
- Aim the nozzle at the base of the fire.
- Squeeze the handle firmly.
- Spray in a sweeping motion.

How Fire Extinguishers Work

Portable fire extinguishers apply an existing agent that will cool burning fuel, displace or remove oxygen, or stop the chemical reaction so a fire cannot continue to burn. When the handle of an extinguisher is compressed, it opens an inner canister of high-pressure gas that forces the extinguishing agent from the main cylinder through a siphon tube and out the nozzle. Fire creates a very rapid chemical reaction between oxygen and a combustible material, which results in the release of heat, light, flame, and smoke.

Types of Fire Extinguishers

Equipment that passes a laboratory test receives a label and an alpha/numeric classification based on the type and size of fire it will extinguish. The letters A, B, and C represent the class of an extinguisher. The number preceding the A rating indicates how much water the extinguisher contains. Consider 1.25 gal of water for every unit of 1. For example, a 4-A rated extinguisher would equal to 5 (4 × 1.25) gal of water. The number preceding a B rating represents the area of square feet that the extinguisher should extinguish when used by a nonexpert user. Using the previous example, a nonexpert user should put out a flammable liquid fire as large as 10 ft^2 (Tables 9.10 through 9.13).

TABLE 9.10
Common Extinguishers

- Air-pressurized water extinguishers
- CO_2 (carbon dioxide) extinguishers
- Dry chemical extinguishers

TABLE 9.11
Extinguisher Classes

- Class A: For fires involving ordinary combustible materials, such as wood, paper, or clothing, where the quenching and cooling effects of water prove most effective, use a pressurized water extinguisher or ABC-type dry powder extinguisher.
- Class B: For fires involving flammable liquids and similar materials, use type BC or ABC dry powder extinguishers. Carbon dioxide (CO_2) extinguishers may also be used.
- Class C: For fires in or near energized electrical equipment where the use of a nonconductive extinguishing agent is of first importance, use CO_2 or dry powder (BC or ABC). NEVER USE WATER.
- Class D: Metal fires—combustible metals such as magnesium and sodium require special extinguishers labeled D.
- Class K: Grease fires—use a portable extinguisher designed especially for cooling these types of fire.

TABLE 9.12
Fire Extinguisher Placement and Travel Distances

- Class A: travel distance of 75 ft or less
- Class B: travel distance of 50 ft or less
- Class C: travel distance based on appropriate A or B hazard
- Class D: travel distance of 75 ft

TABLE 9.13
Monthly Extinguisher Inspections

- Determine proper location and type.
- Ensure accessibility to all extinguisher locations.
- Document the proper mounting of each extinguisher.
- Check gauges to determine adequate pressure.
- Verify proper placement of pins and seals.
- Look for evidence of damage or tampering.
- Ensure no blockage of nozzles.

Proper Maintenance

This includes a complete examination and involves disassembly and inspection of each part and replacement where necessary. Conduct maintenance at least annually or more often if conditions warrant. Accomplish hydrostatic testing of portable fire extinguishers to protect against unexpected in-service failure. Failure can occur due to internal corrosion, external corrosion, and damage from abuse. Perform hydrostatic testing using trained personnel with proper equipment and facilities. OSHA Standard 29 CFR 1910.157 (Table 1) provides test intervals for extinguishers.

Air-Pressurized Water Extinguishers

Water remains the commonly used extinguishing agents for type A fires. You can recognize this extinguisher by its large silver container. They contain ordinary water and pressurized with air. In some cases, added detergents can produce foam. They stand about two to three feet tall and weigh approximately 25 lb when full. Pressurized water extinguishes a fire by cooling the surface of the fuel to remove the *heat* element of the fire triangle. The extinguishers work well on wood, paper, cloth, rubber, and certain plastics. Never use water to extinguish flammable liquid fires. Water is extremely ineffective at extinguishing this type of fire and may make matters worse by spreading the fire. Never use water to extinguish an electrical fire. Water is a good conductor and may lead to electrocution if used to extinguish an electrical fire. De-energize or unplug electrical equipment before using a water extinguisher on an electrical fire.

Carbon Dioxide Extinguishers

This type of extinguisher is filled with carbon dioxide (CO_2), a nonflammable gas under extreme pressure. These extinguishers put out fires by displacing oxygen or taking away the oxygen element of the fire triangle. Because of its high pressure, when you use this extinguisher, pieces of dry ice shoot from the horn, which helps cool the fire. Recognize this type of extinguisher by its hard horn and absent pressure gauge. CO_2 red cylinder extinguishers range in size from about 5 to 100 lb. Use CO_2 extinguishers for class B and C (flammable liquid and electrical) fires. Never use CO_2 for class A fires because they may contribute to smoldering and reignite after the CO_2 dissipates. Never use CO_2 extinguishers in a confined space with people present without the proper respiratory protection. Area or locations with CO_2 extinguishers can include industrial vehicles, mechanical rooms, offices, computer labs, and flammable liquid storage areas.

Dry Chemical Extinguishers

This type of extinguisher puts out fires by coating the fuel with a thin layer of fire retardant powder, separating the fuel from the oxygen. The powder also works to interrupt the chemical reaction,

which makes these extinguishers extremely effective. Dry chemical extinguishers rated for class B and C fires and may contain markings for multiple purpose use on A, B, and C fires. They contain an extinguishing agent and use a compressed, nonflammable gas as a propellant. ABC fire extinguishers range in size from 5 to 20 lb. Dry chemical extinguishers should contain a label indicating their appropriate use on class A, B, and/or C fires. You can use these extinguishers in a variety of locations including public hallways, laboratories, mechanical rooms, break rooms, chemical storage areas, offices, commercial vehicles, and areas with flammable liquids.

Marking Extinguishers

NFPA 10 provides guidance for marking extinguishers and their extinguisher locations. Extinguishers suitable for more than one class of fire should contain multiple symbol markings. Apply decals or paintings to ensure legibility and durability. Apply markings to the front of the extinguisher using a size and form to ensure easy reading at a distance of 3 ft.

Extinguisher Ratings

Additional information on the label gives information about the water equivalency rating and the amount of square footage that the extinguisher can handle if operated by someone properly trained. A 4-A extinguisher should contain 5 gal of water. The B/C rating indicates square footage such as 25 BC. No rating exists for class C or D fires. OSHA requires selection of fire extinguishers based on the class and size of fires anticipated in the area. OSHA provides guidance on the classes of fires and travel distance to an extinguisher. Follow the recommendations of NFPA 10. Inspect extinguishers monthly and maintain to meet manufacturer requirements. Ensure to use fire extinguishers approved by a testing lab like FM or UL.

SPECIAL FIRE SAFETY CONSIDERATIONS

Electrical Equipment Installations

Maintain and install electrical equipment to meet NFPA/ANSI 70, NEC®, requirements. Use only UL-listed or FM-approved equipment in areas with flammable gases or vapors. Temporary or makeshift wiring, particularly if defective or overloaded, can cause electrical fires. Overloaded or partially grounded wiring may also heat up enough to ignite combustibles without blowing fuses or tripping circuit breakers. When using or storing flammable, ensure to provide proper bonding and grounding that meets NFPA/ANSI 70.

Flammable and Combustible Materials

Flammable and combustible liquids, vapors, and gases present a major fire hazard in all healthcare facilities. Many liquids generate flammable vapors that could ignite if exposed to a spark from a motor, friction, or static electricity. Classify a liquid as either combustible or flammable depending on its flash point. We define a flash point as the temperature at which a liquid gives off enough vapor to form an ignitable mixture with air. When a liquid reaches its flash point, contact with any source of ignition could cause the vapor to burst into flame. Mount appropriate fire extinguishers and make them easily accessible to employees. Ensure all fire extinguishers are inspected and recharged regularly and inspection tags documented. For a fixed extinguishing system, post warning signs to inform people of the hazards presented by the extinguishing medium. A combustible liquid has a flash point at or above 100°F (37.8°C). A flammable liquid possesses a flash point below 100°F (37.8°C).

General Precautions

Clan spills of flammable and combustible liquids immediately. Response personnel must use appropriate PPE. Flammable or combustible liquid storage and use containers must meet approval standards of NFPA 30, *Flammable and Combustible Liquids Code*. Store combustible waste material such as oily shop rags and paint rags in covered metal containers. Post storage areas with a sign reading "NO SMOKING" areas as required by OSHA Standard 29 CFR 1910.106, *Flammable and Combustible Liquids*. Piping systems including tubing, flanges, bolting, gaskets, valves, fittings, and all pressurized parts containing flammable and combustible liquids must meet the requirements of NFPA 30.

Inside Storage Areas

Each inside storage area should contain prominently posted signs indicating "NO SMOKING" area. The *Flammable and Combustible Liquids Code Handbook* published by NFPA serves as an essential reference for those involved in the distribution or use of flammable and combustible liquids. NFPA 30 covers general provisions, tank storage, piping systems, container and portable tank storage, and operational requirements. The code also contains information for the design, construction, and testing of flammable liquid safety cabinets and requirements of safety cans.

Fire and Chemical Hazard Symbols

NFPA 704, Standard System for the Identification of the Hazards of Materials for Emergency Response, helps identify the hazardous qualities of materials. This simple, recognizable, and easily understood marking system provides a general idea of the severity of the hazards of a material. The standard applies to industrial, commercial, and institutional facilities that manufacture, process, use, or store hazardous materials. NFPA 704 does not apply to transportation requirements, general public use, or occupational exposure. The system of categories, colors, and numbers provides users with basic hazard information. The system enables firefighters and other emergency personnel to easily decide whether or not to evacuate an area or to proceed with implementing emergency control operations. Two key categories of identification include health or flammability. A numerical range of "0–4" indicates the severity of the hazard. A "4" indicates the most severe and a "0" indicates a minimal hazard. Only people technically competent and experienced in interpreting the hazard criteria contained in the NFPA 704 standard can determine the correct numerical ratings for a specific material. The system is based on relative, rather than absolute, values.

Surgical Fires

Fires occurring on or inside a patient rarely occur rarely but can cause grave consequences. They can kill or seriously injure patients, injure surgical staff, and damage critical equipment. Flammable materials present in surgical suites range from alcohol-based prepping agent's drapes, towels, gowns, hoods, and masks. Common ignition sources found in operating rooms include electrosurgical or electrocautery units, fiber-optic light sources and cables, and lasers. High-speed drills can produce incandescent sparks that can fly off the target tissue and ignite some fuels, especially in oxygen-enriched atmospheres. Recommend that staff participate in special drills and training on the use of firefighting equipment. They should know the proper methods for rescue and escape.

Ensure each staff member knows the identification and location of medical gas, ventilation, and electrical systems including controls. Educate everyone how to use the hospital's alarm system

and contact the local fire department. Healthcare organizations can prevent fires by applying the following:

- Informing staff members including surgeons and anesthesiologists about the importance of controlling heat sources by following published safety practices.
- Managing fuels by allowing sufficient time for patient prep and establishing guidelines for minimizing oxygen concentration under the drapes.
- Developing, implementing, and testing procedures to ensure appropriate response of all members of the surgical team.
- Organizations should report any instances of surgical fires as a means of raising awareness and ultimately preventing the occurrence of fires in the future.

ASTM Surgical Fire Standard

Refer to ASTM Standard Guide to Surgical Fires: Fire Risk Assessment, Prevention, and Extinguishment. The guide was developed by ASTM Committee F29 on Anesthetic and Respiratory Equipment. The standard due offers instruction on the risks of potentially flammable materials used in surgery. The standard directed at doctors, nurses, anesthesiologists, technicians, engineers, risk managers, and health administrators should provide some well-needed guidance (Tables 9.14 and 9.15).

Fire Blankets

Never locate wool blankets treated with fire retardants in the operating room and never use for patient fires. Their use will likely cause more severe injuries to the patient. However, they could help when responding to use on a conscious person, such as a surgical team member.

TABLE 9.14
Preventing Surgical Fires

- Minimize ignition risks during use of electrosurgical devices and surgical lasers including the safe and appropriate use of electrosurgical pencils and the use of bipolar electrosurgery devices.
- Lessen ignition risks by selective wetting fuels present at the incision including gauze, sponges, and towel.
- Implement all general procedures established to minimize ignition risks.
- Specific procedures to minimize ignition risks in oropharyngeal surgery include gas scavenging and using wet gauze, sponges, or pledgets.
- Minimize oxidizer risks of oxygen and nitrous oxide used in general surgery and specifically during oropharyngeal surgery.
- Reduce fuel risks when using flammable surgical.
- Educate personnel on fire prevention and conduct drills for the operating room setting.

TABLE 9.15
Responding to Surgical Fires

- Extinguishing small fires with the hand.
- Response to large fires on or in the patient: stopping the flow of oxidizers, removing burning materials from the patient, extinguishing burning material, and caring for the patient.
- Correct procedures for using recommended type of fire extinguisher such as carbon dioxide.
- Do not use water-based and dry powder extinguishers.
- Rescue the patient, alert the staff, confine the smoke or fire, and evacuate the area.
- Recommend mounting a 5 lb CO_2 extinguisher just inside the entrance of each operating room.

Welding Fire Safety (29CFR 1910.252 and NFPA 51B)

Gas welding can join two metals by melting or fusing their adjoining surfaces. The energy for gas welding comes from the combustion of a fuel with oxygen or air. A few of the most popular fuels are acetylene and hydrogen. Since gas welding is slower and easier to control than electric arc welding, it is often used in applications such as general maintenance work, brazing, and soldering. Arc welding involves generating an electric arc between a covered metal electrode and the base metals and joining the two metals. The arc that in turn melts the metal and mixes the molten deposits of the coated electrode produces heat. A power supply unit that furnishes direct or alternating current provides the arc energy. The equipment needed for electric arc welding includes a power supply, electrode holder, ground clamp, protective shield, and welder's protective clothing. Metal cutting in welding is the severing or removal of metal by a flame or arc. During oxygen cutting, the metal heated by gas flames and an oxygen jet does the cutting. During arc cutting, the intense heat of electric arc melts away the metal.

Welding Personal Protective Equipment

Proper eye and face protection varies depending on the particular task being performed. Helmets, handshields, goggles, and safety glasses or a combination of these can provide acceptable protection in various applications. All filter lenses and plates must meet the test for transmission of radiant energy prescribed in the ANSI Standard Z87, Practice for Occupational and Educational Eye and Face Protection. According to OSHA 29 CFR 1910.252, "Helmets and hand shields shall protect the face, forehead, neck and ears to a vertical line in back of the ears, from the arc direct radiant energy, and weld splatter." Welding helmets with filter plates protect users from arc rays and from weld sparks and spatters that strike directly against the helmet. They do not protect against slag chips, grinding fragments, wire wheel bristles, and similar hazards that can ricochet under the helmet. Require personnel to wear spectacles, goggles, or other appropriate eye protection. When arc cutting or arc welding with open arms, operators must use helmets or handshields with filter lenses and cover plates. Nearby personnel viewing the arc must also wear proper protection. Recommend spectacles with a shade number two lenses as protection for viewers. When resistance welding or brazing, operators of resistance welding must use face shields, spectacles, or goggles depending on the particular job to protect their faces and eyes from welding hazards.

LIFE SAFETY REQUIREMENTS

Healthcare facilities must design and manage the physical environment to comply with the Life Safety Code. Assign an individual(s) to assess compliance with the Life Safety Code. The facility must complete the electronic SOC and manage the resolution of deficiencies. The hospital must maintain a current electronic SOC. When the hospital plans to resolve a deficiency through a plan for improvement (PFI), the hospital must meet the time frames identified in the PFI accepted by the Joint Commission. For hospitals that use Joint Commission Accreditation for *deemed status*, the organization hospital must maintain documentation of any inspections and approvals made by state or local fire control agencies. The hospital must protect occupants during periods when the Life Safety Code is not met or during periods of construction. The hospital must notify the fire department or other emergency response group and initiate a fire watch when a fire alarm or sprinkler system is out of service more than 4 h in a 24 h period in an occupied building.

Interim Life Safety

Healthcare facilities must implement written interim life safety measures (ILSM) to address situations when the organization cannot immediately correct deficiencies. The policy should include

criteria for evaluating when and to what extent the hospital follows special measures to compensate for increased life safety risk. The facility must inspect exits in affected areas on a daily basis. It must provide temporary but equivalent fire alarm and detection systems for use during fire system impairment. Use smoke tight temporary construction partitions made of noncombustible or limited-combustible material that would not contribute to development or spread of a fire. Increase surveillance of buildings, grounds, and equipment, giving special attention to construction areas and storage, excavation, and field offices. Enforce storage, housekeeping, and debris-removal practices that reduce the building's flammable and combustible fire load to the lowest feasible level. Provide additional training to those who work in the hospital on the use of firefighting equipment. Conduct one additional fire drill per shift per quarter. Inspect and test temporary systems monthly. The hospital must train those who work in the hospital to compensate for impaired structural or compartmental fire safety features.

Compartmentalization

This concept uses various building components to prevent the spread of fire and the products of combustion so as to provide a safe means of egress through an approved exit. The presence of these features varies, depending on the building occupancy classification. Building and fire protection features must be designed and maintained to minimize the effects of fire, smoke, and heat. Design, construct, and maintain buildings to minimize danger from the effects of fire, including smoke, heat, and toxic gases. The structural characteristics of the building, as well as its age, determine the types of fire protection features necessary. The features covered in this standard include the structure, automatic sprinkler systems, building separations, and doors. When remodeling or designing a new building, the facility must meet many more stringent requirements of other codes and standards enforced at the local, state, or federal level.

New buildings must contain approved automatic sprinkler systems. Existing buildings must contain approved automatic sprinkler systems as required by the construction type. Fire walls must rate for 2 h. These include common walls between buildings and occupancy separation walls within buildings. They must extend from the floor slab to the floor or roof slab above and extend from exterior wall to exterior wall. Openings in 2 h fire-rated walls must fire-rate for 1½ h. Fire-rated doors must contain functioning hardware including positive latching devices and self-closing or automatic-closing devices. Ensure gaps of no more than ⅛ in. wide between meeting edges of door pairs with undercuts no larger than ¾ in. Fire-rated doors must contain any unapproved protective plates that are higher than 16 in. above the bottom of the door. Doors for hazardous rooms may not contain nonrated protective plates located more than 48 in. from the bottom of the door. Doors requiring a fire rating of ¾ h or long must contain no coverings, decorations, or other applied objects with the exception of informational signs. Ducts that penetrate a 2 h fire-rated separation must contain protected dampers with a 1½ h fire rating. The space around pipes, conduits, bus ducts, cables, wires, air ducts, or pneumatic tubes that penetrate fire-rated walls and floors requires protection with an approved fire-rated material. Never use polyurethane expanding foam for this purpose.

Integrity of Egress

Design and maintain buildings that house patient care activities to protect patients in place or when moved to safe places in the building instead of requiring evacuation to a location outside. Hospitals should ensure sufficient number of exits exist and so configured to provide protection from fire. Never lock egress doors in any way that restricts passage to safety. Means of egress can include corridors, stairways, and doors that allow individuals to leave a building or to move between specific spaces in a building. They must permit individuals to escape from fire and smoke and also serve as an integral part of a fire protection strategy. The Life Safety Code does permit locking of selected doors when clinical reasons exist to restrict the movement of patients.

Doors

Keep doors used as a means of egress unlocked in the direction of the egress route. Doors used as means of egress must swing in the direction of the egress route. Walls containing horizontal exits must contain a fire rating of 2 or more hours and must extend from the lowest floor slab to the floor or roof slab above and extend continuously from exterior wall to exterior wall. Design outside exit stairs to separate them from the interior of the building by walls with the same fire rating as required for enclosed stairs. The wall must extend vertically from the ground to a point 10 ft or more above the top landing of the stairs or roofline (whichever is lower). It must also extend 10 ft or more horizontally. Doors in new buildings that serve as a part of horizontal exits must contain approved vision panels and installed without a center mullion. When horizontal exit walls in new buildings terminate at outside walls at an angle of less than 180°, the outside walls must fire-rate for 1 h for a distance of 10 or more feet. Openings in the walls in the 10 ft span must fire-rate for ¾ of an hour. Stairs and ramps serving as a required means of egress must contain handrails and guards on both sides in all new buildings. Exits must discharge to the outside at grade level or through an approved exit passageway. The discharge route must terminate at a public way or at an exterior exit discharge. When stair doors hold open and the sprinkler or fire alarm system activates the release of one door in a stairway, all doors serving that stairway close. Doors to new boiler rooms, new heater rooms, and new mechanical equipment rooms located to serve as a means of egress must not hold open by any automatic release device.

Corridors

Design exit corridors in new buildings at least 8 ft wide. In existing buildings, exit corridors must measure at least 4 ft wide. If modifying existing buildings with exit corridors that exceed 8 ft, the exit corridors can never measure less than 8 ft. The corridor width must never become obstructed by any wall projections. When corridors measure 6 ft wide or more, the Joint Commission does permit certain objects to project into the corridor. These objects can include hand sanitizing dispensers or retractable computer desks. They must not measure more than 36 in. wide and cannot project more than 6 in. into the corridor. Install or place these items such that they must be at least 48 in. apart and above the handrail height. Exits, exit accesses, and exit discharges must remain clear of obstructions or impediments to the public way. Ensure no equipment, carts, furniture, construction material, snow, or ice blocks access routes. Keep exit access doors and exit doors free of mirrors, hangings, or draperies that might conceal, obscure, or confuse the direction of exit. Floors or compartments in a building must contain two or more approved exits remotely located from each other.

Patient Sleeping Rooms

Suites of patient sleeping rooms larger than 1000 ft^2 must contain at least two exit access doors remotely located from each other. Rooms or suites not used as patient sleeping areas but larger than 2500 ft^2 must contain at least two exit access doors remotely located from each other. Limit the size of suites of patient sleeping rooms to 5000 ft^2. Limit the size of suites used for other purposes to 10,000 ft^2. Arrange suites so that no intervening rooms serve as hazardous areas. Limit to 100 ft of less the travel distance to an exit access door from any point in a suite of patient sleeping rooms. In suites not used as patient sleeping rooms but with one intervening room, limit to 100 ft or less the travel distance to an exit access door from any point in the suite. In suites containing two intervening rooms, the limit reduces to 50 ft or less. Patient sleeping rooms must open directly to an exit access corridor. Never lock doors to patient sleeping rooms. Limit to 50 ft or less the travel distance to a room door from any point in a patient sleeping. In existing buildings, limit the travel distance between any room door and an exit to 100 ft or less. Limit the distance to 150 ft or less when equipped with approved automatic sprinkler system. In new buildings, limit the travel distance

between any room door and an exit to 150 ft or less. In existing buildings, limit the travel distance between any point in a room and exits to 150 ft or less. The distance can increase to 200 ft or less if equipped with an approved automatic sprinkler system. In new buildings, limit the travel distance between any point in a room and an exit to 200 ft or less. In new buildings, no dead-end corridor can measure longer than 30 ft.

Signs

Adequately illuminate all points including angles, intersections of corridors, passageways, stairways, stairway landings, exit doors, and exit discharges. Arrange the illumination in the means of egress, including exit discharges, so that failure of any single light fixture or bulb does not leave an area in darkness. Install signs on each floor landing for stairs serving five or more stories. Signs must identify the story level, the stairwell, and the direction of exit discharge. Place signs 5 ft above the floor landing in a position to ensure visibility when the door opens or closes. Post signs reading "No Exit" on any door, passage, or stairway that does not serve as an exit or as an access to an exit. The signs prevent egress confusion. Ensure the visibility of exit signs on all routes not readily apparent. Adequately light all signs and ensure signs contain letters of 4 or more inches in height. Make letters 6 in. in height if externally lit.

Protection from Fire and Smoke

The hospital must provide and maintain building features to protect individuals from the hazards of fire and smoke. Fire and smoke pose special concerns in healthcare organizations because of the inability of some patients to evacuate without assistance from staff. If not properly protected, the building can put patients at risk. Smoke and fire can travel through openings in a building. To facilitate safe evacuation, contain effects of fire and smoke through separating the building into multiple compartments. In addition, interior finishes need controlling to minimize smoke and toxic gases. Use openings as necessary to accommodate features as HVAC systems, elevator shafts, and trash and laundry chutes. Facilities should design and maintain these openings to contain fire in a compartment or floor. Existing vertical openings, other than exit stairs, must enclose with a 1 h fire-rated construction. In new construction, vertical openings, other than exit stairs, must enclose with 1 h fire-rated walls when connecting three or fewer floors and 2 h fire-rated walls when connecting four or more floors. These vertical openings include, but not limited to, communicating stairs, ramps, elevator shafts, ventilation shafts, light shafts, trash chutes, linen chutes, and utility chases.

Hazardous Areas

Protect all hazardous areas with walls and doors in accordance with NFPA 101. Existing boiler/fuel-fired heater rooms must contain sprinkler systems, resist the passage of smoke, and be equipped with doors containing self-closing or automatic-closing devices, or the rooms must contain 1 h fire-rated walls and ¾ h fire-rated doors. New boiler/fuel-fired heater rooms must contain sprinkler systems and 1 h fire-rated walls and ¾ h fire-rated doors. Existing central/bulk laundries larger than 100 ft^2 must contain a sprinkler system to resist the passage of smoke, and doors must include self-closing or automatic-closing devices or contain 1 h fire-rated walls and ¾ h fire-rated doors.

New central/bulk laundries larger than 100 ft^2 must contain sprinkler systems and 1 h fire-rated walls and ¾ h fire-rated doors. Existing flammable liquid storage rooms must contain 2 h fire-rated walls with 1½ h fire-rated doors. New flammable liquid storage rooms must contain sprinkler systems and 2 h fire-rated walls with 1½ h fire-rated doors. Existing laboratories that do not classify as severe hazard areas must contain sprinkler systems, resist the passage of smoke, and contain doors with self-closing or automatic-closing devices. Laboratories can also contain walls fire-rated for 1 h with ¾ h fire-rated doors. New laboratories that are not severe hazard areas must contain

sprinkler systems, resist the passage of smoke, and be equipped with doors containing self-closing or automatic-closing devices. Existing laboratories with severe hazard areas must contain 2 h fire-rated walls with 1½ h fire-rated doors. When a sprinkler system exists, the walls must be fire-rated for 1 h with ¾ h fire-rated doors. New laboratories with severe hazard areas must contain sprinkler systems and 1 h fire-rated walls with ¾ h fire-rated doors. Existing flammable gas storage rooms in laboratories must contain 2 h fire-rated walls with 1½ h fire-rated doors. New flammable gas storage rooms in laboratories must contain sprinkler systems and 2 h fire-rated walls with 1½ h fire-rated doors. Existing maintenance repair shops must contain sprinkler systems, resist the passage of smoke, and contain doors with self-closing or automatic-closing devices or contain 1 h fire-rated walls with at least ¾ h fire-rated doors. New maintenance repair shops must contain sprinkler systems and 1 h fire-rated walls with ¾ h fire-rated doors. Existing piped oxygen tank supply rooms must contain 1 h fire-rated walls with ¾ h fire-rated doors. New piped oxygen tank supply rooms must contain sprinkler systems and 1 h fire-rated walls with ¾ h fire-rated doors. Existing paint shops not considered severe hazard areas must contain sprinkler systems, resist the passage of smoke, and contain doors with self-closing or automatic-closing devices or contain 1 h fire-rated walls with ¾ h fire-rated doors. New paint shops not considered severe hazard areas must contain sprinkler systems and 1 h fire-rated walls with ¾ h fire-rated doors. Existing soiled linen rooms must contain sprinkler systems, resist the passage of smoke, and contain doors with self-closing or automatic-closing devices, or the rooms must contain 1 h fire-rated walls with ¾ h fire-rated doors. New soiled linen rooms must contain sprinkler systems and 1 h fire-rated walls with ¾ h fire-rated doors.

Storage Rooms

Existing storage rooms for combustible materials larger than 50 ft^2 must contain sprinkler systems, resist the passage of smoke, and contain doors with self-closing or automatic-closing devices, or the rooms must contain 1 h fire-rated walls with ¾ h fire-rated doors. Install sprinklers for new storage rooms of 50–100 ft^2. Design the rooms to resist the passage of smoke and install doors with self-closing or automatic-closing devices. Install sprinklers for new combustible storage rooms larger than 100 ft^2 and en install h one our fire-rated walls.

Equip existing trash collection rooms with sprinkler systems. Design to resist the passage of smoke and equip with self-closing or automatic-closing devices, or design the rooms with 1 h fire-rated walls and ¾ h fire-rated doors. Sprinkle to new trash collection rooms and install 1 h fire-rated walls with ¾ h fire-rated doors. Equip any gift shop storing or displaying combustibles in quantities considered hazardous with 1 h fire-rated walls and ¾ h fire-rated doors.

You can use, in existing buildings, a combination of walls and doors to limit the passage of smoke and an approved automatic sprinkler system for gift shops storing or displaying combustibles in quantities considered hazardous. Existing wall and ceiling interior finishes must rate as class A or B for limiting smoke development and spread of flames. Newly installed wall and ceiling interior finishes must rate as class A. Newly installed interior floor finishes in corridors of smoke compartments without sprinkler systems must possess a class I radiant flux rating. Existing corridor partitions must contain a fire rating of ½ h and continuous from the floor slab to the floor or roof slab above. They must extend through any concealed spaces such as those above suspended ceilings and interstitial spaces. They must properly seal in a way that limits the transfer of smoke. In smoke compartments protected throughout, with an approved supervised sprinkler system, corridor partitions can terminate at the ceiling if the ceiling construction limits the passage of smoke. The passage of smoke can be limited by an exposed, suspended grid of acoustical tile ceiling.

New Buildings and Corridors

In new buildings, construct corridor walls to limit the transfer of smoke. In existing buildings, corridor doors must meet the 1¾ in. or thicker solid-bonded wood core requirement or contain

equivalent material. Doors must not contain ventilating louvers or transfer grills. The exceptions relate to bathrooms, toilets, and sink closets that do not contain flammable or combustible materials. Corridor doors must not contain protective plates placed higher than 48 in. above the bottom of the door. Corridor doors must contain positive latching hardware and be arranged to restrict the movement of smoke. Doors must hinge so that they swing. The gap between the meeting edges of door pairs must not exceed ⅛ in. with undercuts no larger than 1 in. Roller latches remain unacceptable. For existing doors, it is acceptable to use a device that keeps the door closed when a force of 5 ft-lb is applied to the door edge.

Openings

Install openings in vision panels or doors in corridor walls, other than in smoke compartments containing patient sleeping rooms, at or below one-half of the distance from the floor to the ceiling. These openings may not exceeds 80 in.^{2} in new buildings or larger than 20 in.^{2} in existing buildings. Openings may include, but not limited to, mail slots and pass-through windows in areas such as laboratories, pharmacies, and cashier stations. Corridors serving adjoining areas must never serve as any part of a supply-air, return-air, or exhaust-air plenum. The Joint Commission interprets the code to allow incidental air movement between rooms and corridors, such as isolation rooms, because of the need for pressure differentials in healthcare facilities. For the purpose of fire protection, air transfer should limit the amount necessary to maintain positive or negative pressure differentials.

Welding Fire Prevention and Protection

Keep welding environments free of flammable liquids and vapors. Protect combustible materials within a radius of 35 ft of the operation activity residue such as flame, heat, sparks, or slag. Implement firewatcher procedures whenever welding activities occur within 35 ft of combustible materials, regardless of protection provided. Assign qualified individuals in the operation of available fire extinguishing equipment. Maintain extinguishing consisting of pails of water, buckets of sand, and hose or portable extinguishers depending upon the nature and quantity of the combustible material exposed. When conducting welding or cutting operations within 3 ft of automatic sprinkler heads, use noncombustible sheet materials or damp cloth guards to temporarily shield the individual heads.

Ensure the proper ventilation of all welding and cutting operations occurring in confined spaces to prevent the accumulation of toxic materials, possible oxygen deficiencies, or explosive atmospheres.

NFPA 99-2012 FIRE PROTECTION FUNDAMENTALS

Flammable Liquids and Gases

Storage and handling of flammable liquids and gases should not occur in areas where the activities would create hazards that could hinder egress unless permitted by the following codes:

NFPA 30, Flammable and Combustible Liquids Code
NFPA 54, National Fuel Gas Code
NFPA 58, Liquefied Petroleum Gas Code

Laboratories

Labs that use chemicals should conform to the requirements found in NFPA 45, Standard on Fire Protection for Laboratories Using Chemicals.

Utilities

All equipment using gas and related gas piping should meet the requirements found in NFPA 54 or NFPA 58. Electrical systems including wiring and equipment should conform to the requirements of NFPA 70, NEC. Emergency generators and standby power systems, when required, should be installed and maintained in accordance with provisions of NFPA 110, Standard for Emergency and Standby Power Systems. Install and maintain all stored electrical energy systems as required by the provisions of NFPA 111, Standard on Stored Electrical Energy Emergency and Standby Power Systems.

Mechanical Heating, Ventilating, and Air-Conditioning

HVAC ductwork and related equipment should conform to the requirement of NFPA 90A, Standard for the Installation of Air-Conditioning and Ventilating Systems. Note that NFPA 90B referenced in NFPA 101 is not applicable to healthcare facilities.

NFPA 90A prohibits means of egress corridors in healthcare occupancies from being utilized as a portion of supply-air, return-air, or exhaust-air systems serving adjoining areas. Commercial cooking equipment should conform to requirements of NFPA 96, Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.

The requirement does not apply to consumer-type domestic appliances used for warming food or for limited cooking such as in break and nutrition rooms. Ventilating systems found in labs should conform to requirements found in NFPA 45.

Elevators, Escalators, and Conveyors

Elevator, escalator, and conveyor requirements should meet requirements of ASME A17.1/CSA B44, Safety Code for Elevators and Escalators, or ASME 17.3, Safety Code for Existing Elevators and Escalators. NFPA 101 outlines requirements for firefighter emergency operations including ventilation and testing. Refer to NFPA 101 or the handbook for additional information. All new elevators must conform to ASMEA17.1/CSA B44. All existing elevators with a travel distance of 25 ft or more above or below the level that best serves the needs of emergency response personnel should conform to the requirements of ASME 17.3. Elevator machine rooms with solid-state equipment, other than existing elevators, with a travel distance more than 50 ft above the level of exit discharge or exceeding 30 ft below the level of exit discharge should be equipped with independent ventilation or air-conditioning systems to maintain temperature during emergency operations. Conduct elevator inspections and tests as specified in ASME 17.1. Conduct monthly operation of all equipment with emergency firefighter operations, and maintain on the premises a written record of findings.

Rubbish Chutes, Incinerators, and Laundry Chutes

Maintain chutes and incinerators in accordance with NFPA 82, Standard on Incinerators and Waste and Linen Handling Systems and Equipment. Rubbish chutes should contain automatic extinguishing protection. NFPA 101 addresses requirements on protection of vertical openings. NFPA 82 requires service openings to provide a buffer between the chute and building space. Separate the room from the rest of the building by construction that provides a 1 h fire resistance rating if not protected with an automatic extinguishing system. NFPA 82 also requires the service opening room to contain at least a 6 in. clearance between the closed chute loading door and the closed room door.

Fire Detection, Alarm, and Communications Systems

Some provisions found in NFPA 99 are stricter than those found in NFPA 72, National Alarm and Signaling Code. Buildings and structures should meet requirements found in NFPA 101 or the codes acceptable to the authority having jurisdiction. Install, test, and maintain fire alarm systems

in accordance with NFPA 70 and NFPA 72. A complete fire alarm system would provide for the functions of initiation, notification, and control.

Smoke Alarms

Do not consider smoke alarms a part of the fire detection and alarm system initiation. When required, maintain smoke alarms in accordance with NFPA 72.

Defend In-Place and Notification

Carry out evacuation actions as part of the facility fire plan. Zoning of the fire alarm system remains the key action when defending in-place occupancies. Coordinate fire notification zones and publish in the fire plan. Note that fire alarm zones do not necessarily coincide with smoke compartment boundaries. NFPA 72 allows private mode operation of the fire alarm notification. This allows the staff to know the alarm origin and location. NFPA 72 modifies the requirement for placement of visible notification appliances when operating in the private operating mode. NFPA 101 now allows the use of *positive alarm sequence*. The sequence includes the following:

- Any signal received at an attended location must receive acknowledgment in 15 s or activate notification signals in accordance to facility fire plans.
- Require trained persons to investigate and evaluate the alarm in 180 s.
- If a second automatic fire detector is actuated during the investigation, then immediate activation of notification signals is required in accordance with facility plans.
- If any other device such as a manual fire box is actuated during the investigation, then immediate activation of notification signals is required in accordance with facility plans.
- The system must provide a means to bypass the positive alarm sequence.

The notification signal must readily identify the smoke zone or floor area, floor, and building needing staff response. The notification signal must also sound audibly in all locations as mandated by the facility plan. In critical care areas, facilities can use visible alarm appliances instead of audible alarm signals. Do not use visible alarms in surgery areas, patient sleeping rooms, or psychiatric care areas if their operation interferes with patient treatment. Requirements do mandate that the use of visible alarms is not required in exam rooms, special procedure areas, dressing rooms, and nonpublic toilet facilities.

Automatic Sprinklers

Install systems to meet the requirements of NFPA 13, Standard for the Installation of Sprinkler Systems. It is not the intent of the standard to require sprinkler systems but ensure installation meets the standard requirements. In new and existing facilities using defend-in-place procedures, sprinkler system zones should coincide with smoke compartment boundaries or meet the requirements addressed in the facility fire plan.

Manual Extinguishing Equipment

Select, install, inspect, and maintain portable fire extinguishers in accordance with NFPA 10, Standard for Portable Fire Extinguishers. Please note that special requirements do exist such as nonferrous components of extinguishers located in MRI rooms and the need for class K extinguishers in kitchen areas. Inspect, test, and maintain all water-based fire protection systems in accordance with NFPA 25, *Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems*. Facility owners retain responsibility for compliance

with NFPA 25. Inspect, test, and maintain all non-water-based systems in accordance with applicable NFPA standards listed below:

- NFPA 12, Standard on Carbon Dioxide Extinguishing Systems
- NFPA 12A, Standard on Halon 1301 Fire Extinguishing Systems
- NFPA 17A, Standard for Wet Chemical Extinguishing Systems
- NFPA 2001, Standard on Clean Agent Fire Extinguishing Systems

REVIEW EXERCISES

9.1 List the occupancies defined by NFPA 101 and NFPA 5000.
9.2 List and describe the three levels of hazard of contents.
9.3 List the four basic types of fire alarms.
9.4 Describe seven actions that can help prevent surgical fires.
9.5 List four NFPA 101 *defined* methods for illuminating exit signs.
9.6 Define or describe the following concepts:
- Compartmentalization
- Interim life safety
- Integrity of egress

9.7 Provide the titles to the following NFPA publications:
- *NFPA 12*
- *NFPA 13*
- *NFPA 30*
- *NFPA 54*
- *NFPA 58*
- *NFPA 70*
- *NFPA 72*
- *NFPA 90A*
- *NFPA 110*
- *NFPA 111*

9.8 Describe the major elements of an OSHA-mandated fire prevention plan.
9.9 Describe the four stages of fire development.
9.10 What is the purpose of NFPA 101?
9.11 List and describe the three levels of fire safety deficiencies.
9.12 List the four scoring areas of the Fire Safety Evaluation System (FSES).
9.13 List five priority emphasis areas of a quarterly fire inspection.
9.14 Define the concept known as *fire confinement*.
9.15 Define the following terms:
- Exit access
- Exit
- Exit discharge

9.16 What is the flash point that determines whether a substance is flammable or combustible?
9.17 Explain the purpose of NFPA 704.

10 Environmental Services and Food/Dietary Department Safety

ENVIRONMENTAL SERVICES AND LAUNDRY OPERATIONS

A healthcare facility environmental services function plays a key role in controlling infections. Environmental services professionals must learn to *clean for safety and health* first and then clean for appearance. Many times, the important role that environmental services personnel play in keeping healthcare facilities safe is overlooked. Cleaning processes simply remove contaminants from the environment. The major tasks for environmental service workers include the following:

- Daily tasks such as mopping, dusting, and disinfecting
- Cleaning patient care areas including rooms
- Maintaining common areas, corridors, and offices
- Cleaning windows, extracting carpets, and cleaning vents
- Assisting with movement of furniture and equipment
- Terminal cleaning of patient rooms after discharge
- Moving trash and refuse to containers or pickup points
- Cleaning and disinfecting contaminated areas
- Picking up of hazardous and infectious waste materials
- Cleaning up of chemical spills and releases

Basic Cleaning Guidelines

Patients, staff, and visitors entering healthcare facilities carry with them bacteria, viruses, and other microbes. The use of disinfectants in healthcare facilities reduces the number of microbes on a surface. The disinfection levels defined by Spaulding include noncritical, semicritical, and critical. These levels address the potential for infectious disease spreading via equipment, instruments, patient contact surfaces, or furniture. CDC further delineates disinfection levels for environmental surfaces in their publication *Guidelines for Environmental Infection Control in Health-Care Facilities*. Use the lowest cleaning level that meets the need. General surface cleaning physically removes all visible dirt, organic matter, and some bacteria. It is normally accomplished with water, mechanical action like scrubbing, and detergents. Conduct general surface cleaning before disinfecting.

Establish cleaning processes based on current needs, infection risks, equipment, and disinfectants used. Processes need to include information on why cleaning is done, what products and tools to use, and how to use them. Organic matter not removed can inactivate disinfectant solutions. High-level disinfection would work well for semi-invasive medical procedures such as endoscopic devices. Use lower levels of disinfection on high-touch surfaces in high-risk areas. Sterilizing eliminates or destroys bacteria and viruses. Sterilize objects if used in sterile areas or a body cavity. Accomplish sterilization using hot steam and pressure or toxic gases such as ethylene oxide or hydrogen peroxide plasma.

Contaminated Work Environments

The OSHA bloodborne pathogen standard requires clean and sanitary work environments to prevent contact with blood or other potential infectious materials. The employer must determine and implement an appropriate written schedule for cleaning and methods of decontamination. The written schedule must consider the facility location, type of surface needing cleaning, and contaminants present. The EPA oversees the registration of antimicrobial disinfectants. A list maintained by the EPA pesticide office provides current information on EPA-registered antimicrobial solutions. OSHA requires cleaning of work surfaces with an *appropriate disinfectant*. Appropriate disinfectants include diluted bleach solutions and EPA-registered products. Contact time for bleach is generally considered to be the time it takes the product to air dry. Products registered by the EPA as HIV effective can prove ineffective against tuberculosis or HBV. Disinfectant labels on registered products may contain safety instructions such as the following: (1) personal protection devices for the worker performing the task; (2) clean all blood thoroughly before applying the disinfectant; (3) dispose of the infectious waste is in accordance with federal, state, or local regulations; and (4) leave surface being cleaned wet with the disinfectant for 30 s for HIV and for up to 10 min for solutions used for HBV. OSHA expects use all disinfectants in accordance with their EPA-approved label instructions. Sanitizing consists of cleaning to the degree of protecting general health. Disinfecting eliminates 95% of targeted contaminants, pathogens, or pollutants. Sterilizing results in an environment or surface being 100% free of contamination.

Contaminated Equipment

Employee exposure to blood or OPIM can occur through contact with contaminated equipment, working surfaces, protective coverings, reusable containers, and glassware. Clean and decontaminate all equipment, environmental surfaces, and working areas after contact with blood or OPIMs. Contaminated devices, such as IV poles, will require labels or tags that identify the equipment is contaminated. Clean equipment, if extremely contaminated, with a soap and water solution prior to conducting decontamination. Some antimicrobial products will not work in the presence of blood. Remove and replace protective coverings such as plastic wrap or aluminum foil when they are contaminated. Regularly inspect and decontaminate all bins, pails, cans, and similar receptacles before reuse. Workers should never pickup any broken glassware directly with the hands. For cleaning up broken glass, use a brush, dustpan, and tongs or forceps. Facilities renting or leasing medical equipment or devices from third-party vendors or other institutions must ensure that these devices receive proper cleaning, disinfecting, and/or sterilizing prior to delivery to the healthcare facility.

Handling Contaminated Laundry

Employee exposure to blood or OPIMs can occur during handling of contaminated laundry during rinsing tasks. Some facilities allow employees to rinse contaminated laundry that might contain sharps if done in dirty utility *hopper* rooms. Bag and handle contaminated laundry, with a minimal amount of agitation, at the location where it was used. Never permit the sorting or rinsing of contaminated laundry in the location of use. Use color-coded or labeled containers to transport laundry. Facility can use alternative labeling or color coding if the process permits all employees to recognize the containers as requiring use of universal precautions. Some facilities may choose to use melt away bags that can go directly into washers without having to unload or remove contaminated laundry from bags. Rinsing soiled laundry in utility rooms is acceptable, if it is not contaminated with blood and OPIM or does not contain sharps. Ergonomic stressors can occur with lifting, reaching, rinsing, and transporting wet heavy laundry. A lift or transfer device for the lifting of these materials is recommended. To avoid punctures from improperly discarded syringes or sharps, never hold contaminated laundry bags close to the body or squeeze them during transporting.

Sharps and Containers

Exposure of housekeeping staff to contaminated sharps and containers can occur. Train workers on proper handling procedures. Sharps not discarded promptly and properly can remain in bedding and accidentally go to laundry. Improper handling or disposal of sharps containers includes allowing containers to overfill or transporting incorrectly. Dispose of sharps immediately or as soon as feasible into the appropriate containers. Place sharps in closable, puncture-resistant, leak-proof containers labeled with the biohazard symbol or color coded in accordance with the OSHA bloodborne pathogens standard. Train employees in proper handling/disposal of sharps and containers. When moving contaminated sharps or other regulated wastes, close containers prior to removal. This can prevent spillage or protrusion of contents during handling, storage, transport, or shipping. Dispose of sharps in accordance with federal, state, and local regulations.

Hazardous Materials

Soaps and detergents may cause allergic reactions and dermatitis. Broken skin from soap or detergent irritation may provide an avenue for infection or injury if exposed to chemical or biological hazards. Mixing cleaning solutions that contain ammonia and chlorine will form a deadly gas. The facility must implement a written hazard communication plan to provide for worker training, warning labels, and access to SDS. The OSHA HCS ensures employee awareness of the hazardous chemicals they are exposed to in the workplace. Provide appropriate PPE such as gloves, goggles, and splash aprons when handling hazardous detergents and chemicals. Where the eyes or body of any person could come into contact with injurious corrosive materials, provide suitable facilities in the work area for quick drenching or flushing of the eyes and body.

Latex Allergy

Exposure to latex allergy from wearing latex gloves can occur during housekeeping processes. Employers must provide appropriate gloves when exposure to blood or OPIMs exists. Make alternatives available to employees allergic to the gloves normally provided. Eliminate the unnecessary use of latex gloves when no risk of exposure to blood or OPIMs exists.

Environmental Safety

Exposure to wet floors can result in slips, trips, and falls. Maintain floors in a clean and, so far as possible, dry condition and provide mats where practicable. Provide warning signs for wet floor areas. Implement procedures to ensure safe, immediate cleanup of floor spills. Housekeeping procedures such as only cleaning one side of a passageway at a time and providing good lighting for all halls and stairwells can help reduce accidents. Instruct workers to use the handrail on stairs, to avoid undue speed, and to maintain an unobstructed view of the stairs ahead of them—even if that means requesting help to manage a bulky load. Use the proper type and amount of floor cleaner for each area being cleaned. Before cleaning floors, rope off corridors and public rooms. Place WET FLOOR signs at exits and near stairways. Never block doorways or elevator entrances with cleaning equipment. Store wet mops, brooms, electrical equipment, and supplies in their proper areas (Table 10.1).

Using Cleaning Solutions

Improper usage of cleaning products can result in failure to disinfect or cause overexposure, resulting in dermatitis, slipping hazards, or deterioration of floors and furniture. Workers must mix cleaning chemicals properly because some improper mixtures can create dangerous reactions or

TABLE 10.1
Cleaning Training and Education Topics

- Techniques on how to clean for safety and health
- Proper cleaning and disinfecting techniques
- General workplace safety principles and policies
- Basic infection control and prevention concepts
- Selection and usage of PPE
- Proper storage of equipment and chemical solutions
- Waste management and handling requirements
- Safe lifting and material handling techniques
- Ladder use, inspection, and safety procedures
- Electrical equipment safety
- Service cart operation and maintenance
- Slip, trip, and fall hazard identification and response
- Emergency action and injury reporting procedures

hazardous gases. Avoid mixing chlorine with substances such as vinegar, toilet bowl cleaners, or ammonia solutions. Never transfer cleaners to containers used for food or drink. Avoid skin contact when using caustics because even diluted solutions can cause burns. Do not leave cleaning, disinfecting, or polishing agents unattended in areas where patients or visitors might come in contact with them. Follow all precautions contained on the container label or listed on the SDS.

Equipment Carts

Carefully move equipment carts through corridors to avoid collision and tripping hazards. Reduce speed near stairways, corridor intersections, elevators, and down ramps. Workers should pull a cart through swinging doors, rather than pushing it. Never leave carts, equipment, or supplies in a location that creates a hazard or provides access to cart contents. Personnel must immediately report any cart needing repair or wheel replacement. Workers must never push one cart while pulling another (Table 10.2).

TABLE 10.2
How Disinfectants Work

- Protein coagulation: Most of the proteins in a cell consist of enzymes and exist in a dispersed state. Disinfecting chemicals that cause these proteins to precipitate and coagulate will make cells nonfunctional, with resulting death.
- Disruption of cell membrane: Cell membranes act as a selective barrier that does allow some solutions to pass through. Others solutions can absorb into the cell wall. Substantial concentration at the cell membrane may alter the physical and chemical properties of the membrane, which prevents normal function. This may result in inhibition or death of the cell.
- Removal of free sulfhydryl groups: Many of the enzyme proteins in a cell contain cysteine and side chains terminating in sulfhydryl groups. These enzymes cannot function unless the sulfhydryl groups remain free and reduced. If the sulfhydryl groups get tied down by an oxidizing agent, the result is damage to the cell and death.
- Chemical antagonism: Enzymes perform their catalytic function through their affinity for specific chemical compounds normally found within cells. If a disinfecting agent structurally resembles a known compound, the enzyme will demonstrate an affinity for that compound. If this affinity is strong enough, the compound will take the place of the normal compound of the enzyme and inhibit reproduction of the cell.

Cleaning for Safety and Health

The safety of patients, visitors, and staff must remain a priority during any cleaning process.

Make removal of contaminants a priority but strive to keep residues to a minimum. Evaluate cleaning processes as related to the organization mission or objectives. Handle and dispose of waste products and materials properly. A clean and safe facility can impact morale of everyone. The environmental services supervisor plays an important role in keeping custodial workers safe. Workers need a proactive supervisor who ensures that all personnel receive the proper tools, equipment, cleaning supplies, and training. Environmental services must integrate their processes into everyday operations. Workers must understand the hazards of chemical interactions and the importance of proper storage. Keep storage areas clean and disinfected.

Critical Instruments and Surfaces

Critical instruments come into direct contact with the patient's bloodstream or other sterile areas of the body. Examples of critical instruments include needles, surgical instruments used within the body, IV catheters, peritoneal endoscopes, and kidney dialysis membranes. Semicritical instruments must be free of pathogenic organisms. Examples of semicritical instruments are gastrointestinal endoscopes, bronchoscopes, vaginal speculums, respiratory care devices, and anesthesia equipment. Semicritical instruments must, at a minimum, require high-level disinfecting.

Noncritical Instruments and Environmental Surfaces

Examples of noncritical instruments or surfaces include floors, countertops, patient furniture, instrument housings and control knobs, blood pressure cuffs, diagnostic electrodes, wheelchairs, and most physical therapy equipment. Keep these surfaces clean and sanitary.

Sterilants and High-Level Disinfectants

Sterilizing solutions kill highly resistant bacteria spores, all types of viruses, waxy-coated mycobacterium (TB), all other vegetative bacteria, and fungi. Sterilants would include 2% alkaline glutaraldehyde, 6% hydrogen peroxide, and combinations of hydrogen peroxide and peracetic acid. Sterilizing solutions can kill microorganisms other than bacterial spores in about 20–30 min. Consider high-level disinfectants as sterilants used at a shorter exposure time.

Intermediate-Level Disinfectants

These agents can kill mycobacterium (TB), many, but not all, types of virus's fungi, and vegetative bacteria. These disinfectants can't kill bacterial spores in any practical exposure time. Examples of intermediate-level disinfectants include phenols, alcohols, iodophors, and combinations of isopropanol and QACs. Noncritical instruments and environmental surfaces may require disinfection with intermediate-level disinfectants. The correct application of intermediate-level disinfectants is for such noncritical items as floors and countertops, patient room furniture, instruments that contact only intact skin, and plastic or metal machine housings that do not directly contact patients.

Low-Level Disinfectants

These substances do not kill bacterial spores, mycobacterium (TB), or all viruses. Low-level disinfectants can kill vegetative bacteria, fungi, and some lipid-coated viruses such as HIV. Use low-level disinfectants such as QACs on floors, countertops, furniture, and plastic or metal housing of machines. QAC disinfectants contain their active ingredients as *n*-alkyl dimethyl ethylbenzyl

TABLE 10.3
Common Antimicrobial Solutions

Chlorine: The dilutions should fluctuate depending on the job. On a clean surface, a dilution of 1:10 works against many spores, mildews, viruses, molds, and bacteria. Bleach can pose risk for people with lung and heart problems.

Iodine: Iodine works against some bacteria and viruses but since iodine's use is limited and can lead to several health problems, avoid whenever possible.

Alcohols: These solutions can prove effective against some bacteria and fungus. When using concentrated alcohols, the user should use proper ventilation and protective equipment.

Quaternary ammonium compounds: *QACs*, such as benzalkonium chloride, are effective as sanitizers or disinfectants on a wide range of bacteria and some viruses. QAC solutions when combined with alcohols can prove corrosive when concentrated and users should wear goggles and gloves.

Phenols: Phenol substances kill more types of organisms, including tuberculosis, than QACs but do pose environmental and health consequences. They can destroy plastic, paint, and rubber surfaces.

Aldehydes: Medical professionals often use glutaraldehyde and formaldehyde in the form of disinfectants, but the materials can serve as sterilizers. Both types of aldehydes are extremely toxic and can cause headaches, nausea, vomiting, and skin, eye, and respiratory problems. People who use them should always wear protective equipment.

Oxidizers: These solutions, not the most common disinfecting ingredient, can in proper concentrations prove toxic than most alternatives.

TABLE 10.4
Sterilization and Disinfection Guidelines for Healthcare Settings

- Guideline for Disinfection and Sterilization in Healthcare Facilities (2008)
- Public Health Notification: Avoiding Hazards with Using Cleaners and Disinfectants on Electronic Medical Equipment (2007 FDA)
- Guidelines for Infection Control in Dental Healthcare Settings (2003 MMWR)
- Guideline for Environmental Infection Control in Healthcare Facilities (2003)
- Guideline for Hand Hygiene in Healthcare Settings (2002)
- Multi-Society Guideline for Reprocessing Flexible Gastrointestinal Endoscopes (ICHE 2003)
- Public Health Advisory: Infections from Endoscopes (FDA 1999)
- Prevention of HIV transmission in healthcare settings (MMWR 1987)

ammonium chloride, *n*-alkyl dimethyl benzyl ammonium chloride, or didecyl dimethyl ammonium chloride. QAC solutions can kill vegetative bacteria, fungi, and lipophilic viruses. QACs do not kill bacterial spores or hydrophilic viruses. The germicidal effectiveness increases with the pH factor. All disinfectant chemicals demonstrate some adverse effect when exposed to organic matter (Tables 10.3 and 10.4).

Green Cleaning

Thousands of institutions including many healthcare facilities now use some *green*, or environmentally preferable, cleaning practices. Human health and safety remain compelling reasons to move toward less harsh products. Cleaning products can contribute to indoor air quality. Healthy indoor air requires the use of appropriate cleaners and disinfectants, proper temperature and humidity control, sufficient air circulation and exchange, and regulation of airborne contaminants, dust, and odor. Cleaning solutions and disinfectants can cause (1) eye, nose, and throat irritation; (2) headaches; and (3) nausea. The EPA classifies all microbial solutions as pesticides and none truly *green*. Green

processes must focus on maintaining and improving cleanliness while supporting infection control. Green processes also attempt to reduce human risks posed by cleaning materials and processes. Green cleaning encompasses a broad set of practices and does not focus on switching one product for another. Any successful plan must focus on quality cleaning, standardized operations, effective tools, uniform dispensing systems, comprehensive training, proper protective equipment, and clearly written policies. Green cleaning also includes ongoing performance evaluation and improvement. With planning and oversight, green cleaning provides a high-performance cleaning process that prioritizes infection control but also reduces waste, risks to workers and building occupants, and negative impacts on the environment.

The Association for the Healthcare Environment (AHE) serves as a professional membership organization for thousands of directors and managers responsible for cleaning and disinfecting care environments. Members represent all types of facilities including hospitals, long-term care facilities, continuing care retirement communities, and ambulatory care organizations. AHE does support cleaning procedures friendly to the environment such as the use of HEPA filter vacuums, microfiber cleaning systems, recycling, improved medical and hazardous waste management, and minimizing solid waste production.

CDC Guideline for Disinfection and Sterilization in Health-Care Facilities (2008)

The *Guideline for Disinfection and Sterilization in Healthcare Facilities* presents evidence-based recommendations for health-care cleaning and disinfecting as well as preferred methods for cleaning, disinfecting, and sterilizing medical devices. The 2008 CDC Guideline emphasizes Spaulding's rational approach categorizing patient care items as critical, semicritical, and noncritical according to the degree of infection risk involved in their use. For example, it categorizes such surfaces as bed rails, bedside tables, patient furniture, and floors as noncritical. However, it also refers to them as high-touch surfaces that could contribute to secondary transmissions by contaminating hands of health-care workers or by contacting medical equipment that subsequently contacts patients. The EPA considers antimicrobial products to be pesticides and requires their registration under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA). There are no specific standards for antimicrobial products in the United States. However, the EPA does not permit manufacturers who add antimicrobials or fungicides to their products to make *health claims* unless registered as a pesticide under FIFRA.

System Methods

Any systems approach, program, or management system requires two crucial features. First, a total commitment of management, and second the involvement of workers or their representatives in transitioning to a new approach. The team should consist of representatives from administration, the clinical staff, infection prevention, environmental safety, facilities management, environmental services, materials management, and laboratories. It should help promote and move green cleaning forward in the organization. Most improvement activities consist of a series of successes with some barrier to overcome. Management must reinforce the process and provide resources that will permit the team to move forward. These resources include not only manpower and finances but also space, time, and moral support. A comprehensive systems approach can help a health-care facility to identify effective points of intervention to ensure a healthy, safe, and environmentally sound cleaning process. The idea behind the systems approach is that there are relevant interdependencies and interrelationships between representatives inside of and external to a workplace/organization that create change. Various scientists and policy makers have used a systems approach to conceptualize their cases.

LEED for Healthcare

One of the most visible and influential factors is the Leadership in Energy and Environmental Design (LEED) for healthcare certification offered by the US Green Building Council (USGBC). This process evolved from the USGBC's LEED green building rating system, which was developed in the mid-1990s. Efforts began in 2002 and eventually led to the development of the Green Guide for Healthcare. On April 8, 2011, the USGBC introduced its latest green building rating system, LEED for Healthcare. The rating system guides the design and construction of both new buildings and major renovations of existing buildings. The system can apply to inpatient, outpatient, and licensed long-term care facilities, medical offices, assisted living facilities, and medical education and research centers. It is expected that LEED for Healthcare will become a de facto standard for healthcare facilities.

Microfiber Mopping

The string mop was patented in the late 1800s and is still one of the most utilized floor cleaning tools. The flat mopping system was initially manufactured in Sweden more than 20 years ago. The construction of the microfiber flat mop enables the fibers to attract and hold dust, dirt, and bacteria, within the mop until laundered. These mops consist of a lightweight handle with a very maneuverable flat rectangular head. A microfiber pad attaches to the mop head with Velcro. Fresh microfiber pads are placed to soak in a basin of cleaning solution on the cleaning cart. A clean cloth is taken from the basin, hand wrung out, dropped flat on the floor, and the mop head is placed on it. The Velcro attaches the cloth to the mop. A worker uses one or two pads to clean a patient room. After use, the worker removes the soiled pad by placing a foot on the pad edge and lifting the mop handle away. The soiled pad is set aside for laundering. Used pads are not returned to the cleaning solution container. Microfiber materials are a blend of polyester and polyamide fibers that are split in such a way as to create microscopic *hooks* that act as claws to remove and hold dust, dirt, and grime. They are 1/16 the thickness of a human hair and can hold six times their weight in water. In a study conducted at the University of California at Davis Medical Center (UCDMC), bacteria cultures taken after a traditional wet mop cleaning revealed only a 30% reduction from precleaning. Bacteria cultures taken after microfiber mop cleaning revealed a 99% reduction. Researchers found in testing that microfiber materials were able to penetrate surface pores and remove dust particles that conventional mops missed. They also learned that room size affects the number of mop heads needed. Workers do not dip microfiber mops back in the cleaning solution once using the mop. Larger rooms may require more than one mop head. UCDMC had three motivations for changing the way its custodial staff maintained the floors in patient care areas: (1) reduce chemical use and disposal, (2) reduce cleaning times for patient rooms, and (3) reduce staff injuries and workers' compensation claims (Table 10.5).

Laundry Operations

Many healthcare facilities now use outside vendors for their laundry operations. Some hospitals may use a shared facility located at an off-site location. However, on-site laundries wash, distribute, and process all linen and other items at the facility. Laundry tasks can also include pressing, folding, and repairing. Laundry personnel must also accomplish special tasks such as inspection of surgical and sterile linen supplies. Train laundry personnel on how to process contaminated laundry items. Laundry personnel can experience exposure to both biological and chemical hazards. Sharps and needles left in linens can pose a real hazard during processing. Laundry personnel must follow universal precautions and take measures to protect themselves from exposure to bloodborne pathogens. Personal exposure to chemical substances can also come from conditioners, softeners, and detergents.

TABLE 10.5
Reasons to Use Microfiber Mopping

- Microfiber mopping is more efficient, easier, and less tiring.
- Microfiber mopping is effective because microfiber is a strong and lint synthetic fiber.
- The tiny fibers make the fabric very absorbent and it holds sufficient water for cleaning.
- Microfibers possess a positive charge that attracts and holds dust/dirt particles.
- Microfiber mopping completely eliminates rinsing and wringing a heavy loop mop.
- The wheeled cart is light and there is no need to repeatedly return to the sink.
- Microfiber mopping uses less water and disinfectant.
- Less potential for fatigue, back pain, neck strain, and other upper body injuries.
- Enables worker to largely avoid awkward and uncomfortable postures.
- Microfiber mops eliminate wringing of the heavy wet loop mop.
- Microfiber mops significantly reduce the amount of water and chemicals used.
- Cleaning solution preparation is reduced considerably because of lower volumes used.
- Useful life of a microfiber mop is about 10 times as long as a loop mop.
- Reduction in water use yields considerable savings to the facility.
- Never place soiled cloths back in the cleaning solution.
- Launder microfiber mops in standard washing machines.

Contaminated Laundry

OSHA defines contaminated laundry as that which has been soiled with blood or OPIM or may contain sharps. Handle contaminated laundry as little as possible with minimal agitation. Bag contaminated laundry at the location of use. Place wet contaminated laundry in leak-proof and color-coded or labeled containers at the location of use. Place contaminated laundry in bags or containers labeled with the biohazard symbol, red bags, or use laundry alternative labeling or color coding if employees recognize the containers. Remind workers to use universal precautions when handling these bags. Use red bags or bags marked with the biohazard symbol if the facility does not use universal precautions for all laundry. Never hold close to the body or squeeze contaminated laundry bags when transporting to avoid punctures from improperly discarded syringes. Use normal laundry cycles according to the washer and detergent manufacturer recommendations.

Personal Protective Equipment

Reduce exposure to bloodborne pathogens through contact with contaminated laundry by wearing appropriate PPE. Employers must ensure employees in contact with contaminated laundry wear appropriate PPE as discussed in the bloodborne pathogens standard when handling and/or sorting contaminated laundry. Employers must ensure that employees wear appropriate PPE such as gloves, gowns, face shields, and masks when sorting contaminated laundry. The use of thick utility gloves when sorting contaminated laundry may provide workers with additional protection. Decontaminate utility gloves for reuse if the integrity of the glove remains intact. Discard gloves when cracked, peeling, torn, punctured, exhibit other signs of deterioration, or when their ability to function as a barrier is compromised. Never wash or reuse disposable gloves.

Sharps Handling

Never bend, recap, or remove contaminate needles and sharps. Place sharps immediately or as soon as feasible place into appropriate containers. Make needle containers available during the sorting process.

Hazardous Chemicals

Broken skin from soap or detergent irritation may provide an avenue for infection or injury if exposed to chemical or biological hazards. Protect face and eyes from splattering when pouring from larger containers to smaller containers. Soaps and detergents may cause allergic reactions and dermatitis. Never mix cleaning solutions that contain ammonia and chlorine. Ensure laundry workers understand the requirements of the HCS. Provide worker training about the written plan, warning labels, and access to SDSs. Provide suitable facilities for quick drenching or flushing the eyes/body within the work area for immediate emergency use. Use appropriate gloves for latex sensitive employees.

Other Hazards

Laundries can produce high noise levels from loud machinery that can result in occupationally induced hearing loss, hearing impairment, hypertension, elevated blood pressure, and other health hazards. Workers may also experience exposure to excessive heat. Good work practices should include educating and training employees and supervisors to detect early signs of heat-related illness. Ensure adequate general ventilation and local exhaust ventilation at points of high heat production. Excessive reaching, pushing, and lifting of wet laundry can cause work-related musculoskeletal disorders in back or shoulder areas. Evaluate laundry areas for ergonomic stressors and identify ways to decrease worker risks. Require the use of proper lifting techniques. Teach workers to avoid awkward postures or twisting while lifting. Laundry areas pose an increased fire risk due to lint buildup on surfaces and a variety of heat-producing equipment. Routinely clean surfaces to remove lint and empty traps regularly. Prohibit the accumulations of flammable and combustible waste materials in all work areas.

Loading or Unloading Laundry

Using front-loading washers and dryers speeds the process for retrieving and placing items and minimizes wear and tear on linen. Washers with tumbling cycles separate clothes, making removal easier. For deep tubs, use a rake with long or extendable handle to pull linen closer to the door opening. Raise machines so that the opening is between hip and elbow height of employees. If using top loading washers, work practices that reduce risk include handling small loads of laundry, handling only a few items at a time, and bracing your body against the front of the machine when lifting. If items get knotted in the machine, brace with one hand while using the other to gently pull the items free. Ensure that items go into a cart rather than picking up baskets of soiled linen or wet laundry.

Linen Handling

Exposure can occur when handling contaminated linens. Provide spring loaded carts that automatically bring linen within easy reach. This can speed linen handling and reduce wear on linen due to excessive pulling. Select a spring tension that is appropriate for the weight of the load. Carts should contain wheel locks and height appropriate handles that can swing out of the way. Ensure heavy carts contain brakes (Table 10.6).

DIETARY AND FOOD SERVICES

Healthcare food service operations prepare meals for both patients and employees. Many organizations also operate snack bars, coffee shops, and cafeterias. The actual number of employees

TABLE 10.6
Laundry Safety Precautions

- Place linen in appropriate bags at collection locations.
- Use color-coded bags to alert laundry staff of potential hazards.
- Double bag linen from isolation rooms.
- Promote frequent hand washing and require workers to wear appropriate PPE.
- Require the use of universal or standard precautions during handling.
- Educate workers about the risks of needles being left in linen.
- Keep floors dry and label wet floors.
- Provide nonskid mats or flooring in wet areas.
- Require workers to wear nonskid boots or shoes.
- Handle laundry carefully; watch for sharps and needles.
- Handle soiled linens gently to prevent contaminating the air.
- Use caution when handling linen from radiation or chemotherapeutic drug areas.
- Place dirty linens in color-coded and impervious bags at collection site.
- Use a barrier to separate soiled linen areas from the other laundry areas.
- Workers who sort contaminated linens should wear proper protective clothing.
- Ensure that workers who handle soiled linen receive appropriate immunizations.

TABLE 10.7
Types of Food Service Operations

- Food service operation: The food service preparation function is normally managed by a professional with education or experience in hospitality, food, or hotel management.
- Nutrition and dietary management: The nutrition function is normally headed by a registered dietician. In many facilities, the registered dietician serves as the department head and supervises both the food preparation and nutrition planning functions.
- Contract food service management: Many facilities now employ professional contract firms to provide senior management personnel or manage the entire food service operation.

depends on size and type of facility, preparation equipment used, and the method of distributing prepared meals. Many food service departments also support special functions, meetings, and seminars. The nutrition function provides therapeutic meals, nutrition counseling, and educational sessions to support organizational and community goals. Many healthcare food service departments function as two entities operating under a single manager or department head. One entity prepares and delivers food and other addresses nutrition, meal planning, and therapeutic dietary planning (Tables 10.7 and 10.8).

Importance of Sanitation

Regardless of organization structure, food service operations require a number of workers including cooks, food handlers, and sanitation workers. These workers can experience a wide variety of safety and health risks. Food service departments must meet inspection standards of the local health department. They must also comply with state and federal safety requirements.

Sanitization provides an extra defense against the transfer of germs and allergens. Mix a capful of unscented bleach per 1 gal of water to create a sanitizing agent for most equipment, utensils, and surfaces. A well-designed orientation session can provide employees with the information

TABLE 10.8
Food Service Manager Responsibilities

- Coordinate safety-related issues with the hazard control manager, safety director, and organizational safety committee.
- Maintain a written hazard communication plan and a current SDS file.
- Ensure that all workers receive a safety orientation when assigned.
- Train workers on hazard communication procedures when initially assigned.
- Conduct hazard communication retraining when a new hazardous material is introduced into the workplace or a worker changes job position.
- Ensure proper storage, use, and labeling of all chemicals.
- Conduct regular safety meetings and give employees an opportunity to attend in-service training and education sessions.
- Conduct periodic safety self-inspections to identify and correct all hazards.

and motivation to work safely and avoid hazardous situations. Address the following during initial orientation and periodically during in-service training sessions:

- Principles of personal hygiene and wearing proper clothing
- How to handle, prepare, and serve food properly
- Selection, use, and care of PPE
- Good housekeeping procedures and principles of sanitary food handling
- Safe food transportation and service methods
- Preventive maintenance and safe operation of equipment
- Food spoilage prevention methods
- Chemical safety and hazard communication procedures

Health Inspections

The FDA Food Code outlines specific rules on which state and county health departments model their retail food regulations. Healthcare organizations can experience health inspections conducted by federal, state, or local officials. Most food inspectors possess a college degree and understand food quality standards, maintenance requirements, and food safety preparation practices (Table 10.9). The main tasks of a food inspector can include the following:

- Educating establishments and their staff on safe food handling and preparation
- Conducting inspections assure adherence to local, state, and federal health codes
- Issuing citations or fines in cases of egregious violations

TABLE 10.9
Types of Health Inspections

- Routine inspection: During this unannounced visit, the inspector looks at all aspects of an establishment to assure compliance with the local food regulations. Everything from employee hand washing practices to closed garbage dumpster can come under scrutiny.
- Complaint inspection: Usually, a customer has either become sick or filed a complaint about possible unsafe practices. Just because a complaint has been filed does not mean the condition exists.
- Follow-up inspection: This inspection will occur after an establishment has been given a certain amount of time to correct critical violations.

- Collecting samples as necessary to trace the possible sources of a food poisoning outbreak
- Preparing inspection reports to share findings with the public

Food Service Area Layout

The layout of food preparation and service areas can impact the safety of the entire operation. The relationship of worker tasks and the layout of work areas affect productivity and safety. Arrange areas to decrease handling time or distance. Unnecessary movement and unproductive arrangements increase chances for employee accidents or injuries (Tables 10.10 and 10.11).

Overview of Kitchen Hazards

Kitchen equipment poses special hazards to the dietary worker. Some of these hazards include hot surfaces, which may cause burns, cuts, and lacerations from the use of sharp objects, and becoming trapped in walk-in freezers or coolers. Electrical shocks from contact with frayed electrical cords and amputations from unguarded equipment can occur easily. Employers must assess tasks to identify potential hazards and provide and ensure employee use of appropriate PPE. Employers must require use of appropriate hand protection to reduce exposure to hazards such as cuts, lacerations, and thermal burns. Examples include the use of oven mitts when handling hot items, and steel mesh or Kevlar gloves when doing cutting tasks. Walk-in freezers must contain a panic bar or other means of exit on the inside of freezers to prevent trapping workers inside. Ensure all electrical equipment contains no recognized hazards. Equip food carts with

TABLE 10.10
Food Service Layout Suggestions

- Store supplies at locations of greatest use.
- Reduce heavy lifting tasks and uncomfortable work heights.
- Workers should not stand for extended periods in one place.
- Use assembly or straight lines whenever possible.
- Food service areas should ensure sufficient space to properly store supplies.
- Clean all dishes and utensils effectively.
- Provide dining room space to serve guests efficiently.
- House water heating equipment and other support systems.
- Store all cleaning and housekeeping supplies away from food.
- Allow for the orderly and sanitary handling/processing of food.
- Provide at least 3 ft between working areas.
- Provide a ceiling height of at least 8 ft.

TABLE 10.11
Dining Area Safety

- Consider safety and ease of serving when arranging the dining area.
- Ensure use of fire-resistant drapes and curtains.
- Securely anchor pictures and wall coverings.
- Inspect chairs and tables regularly for defects.
- Arrange tables systematically to allow for dish and tray removal.
- Keep bus carts and racks in good condition.

large, low-rolling, low-resistance wheels, which can travel easily over mixed flooring as well as gaps between elevators and hallways. Use appropriate PPE and training to avoid steam burns when working with hot equipment or substances.

Cutting Hazards

Keep cutlery sharpened and in good condition since dull knives tend to slip and may cause injuries. The direction of the cut should always go away from the body. Never store knives with the cutting edges exposed. Install knife holders on work tables to prevent worker injury. Never place knives and other sharp objects into sinks between periods of use. Purchase knives equipped with blade guards and knuckle guards that protect the hand from slipping onto the blade. Train workers in the safe handling and use of knives. Wipe knives with a towel, with cutting edge pointed away. Wash knives separately and never place them in soapy water.

Kitchen Electrical Safety

Electrocution or shock from unsafe work practices, faulty electrical equipment, or wiring can occur. Ensure that all electrical service near sources of water is properly grounded. Tag out and remove from service all damaged receptacles and portable electrical equipment. Repair all damaged receptacles and portable electrical equipment before placing them back into service. Educate employees to never plug or unplug energized equipment with wet hands. Employers should use GFCIs on all 120 V, single-phase, 15 and 20 A receptacles. Other shock and fire prevention suggestions are as follows:

- Ground or double insulate toasters, blenders, hand mixers, fans, and refrigerators.
- Check all personal items to ensure proper grounding for industrial application.
- Remove power before adjusting or cleaning equipment.
- Tag equipment being serviced or cleaned.
- Never plug in an electrical appliance or equipment with wet hands.
- Never stand in water while around electrical equipment.
- Disconnect power when servicing equipment.
- Follow prescribed lockout/tag out procedures.
- Install ground fault circuit interrupter in all wet areas.
- Install receptacle boxes made of nonconductive materials.
- Identify outlets and fixtures for each circuit breaker or fuse.
- Never use breakers as on and off switches.

Slip, Trip, and Fall Prevention

Employee exposure to wet kitchen floors or spills and clutter can lead to slips, trips, falls, and other possible injuries. In addition to causing a slip hazard, continually wet surfaces promote the growth of mold, fungi, and bacteria. Keep aisles and passageways clear and in good repair. Never permit placement of obstruction across or in aisles that could create a hazard. Provide floor plugs or ceiling plugs for equipment, so power cords do not run across pathways. Never use chairs, stools, or boxes as makeshift ladders. Provide safety stools or ladders for reaching high storage areas. Never block aisles, walkways, or exits with carts, boxes, or trash (Table 10.12).

Fire Safety and Burn Prevention

When uncovering a container of steaming materials, the worker should hold the cover to deflect steam from the face. Turn handles of cooking utensils away from the front of stoves. Avoid fires

TABLE 10.12
Kitchen Area Slip Prevention Tips

- Repair broken or missing tiles, cracked boards, and damaged floors.
- Treat or cover walkways with slip-resistant materials.
- Workers should wear shoes with slip-resistant soles.
- Immediately clean up all spills and breakages.
- Routinely inspect for hazards after each mealtime.
- Conduct floor cleaning at least three times weekly.
- Provide proper lighting in all work areas, corridors, and stairways.
- Ensure that electric cords and wires do not cross traffic paths.
- Provide nonslip matting in clipper and dishwashing areas.
- Immediately clean up spilled foods, liquids, and broken dishes.
- Identify all areas with appropriate signs until cleanup is complete.
- Require workers to wear shoes with slip-resistant soles.
- Repair or replace damaged floor mats promptly.
- Place appropriate mats in all wet areas.

from heat-producing equipment such as burners, ovens, and grills due to unemptied grease traps, dirty ducts, improperly stored flammable item, and faulty or frayed electrical cords. Provide appropriate and effective employee training for safe handling of equipment. Keep grill and grill duct work free from flammable residues. Ensure fixed dry chemical extinguishing systems used to fight grease fires and fixed extinguishing systems meet code requirements. Develop and educate workers on emergency action and fire prevention plans.

Chemical Hazards

Ammonia, used as a cleaning agent, and chlorine solutions used as disinfectants in dishwashing, can cause skin, eye, and nose irritations. Avoid mixing chlorine and ammonia solutions because it can result in release of chlorine gas. Drain cleaners, oven cleaners, and grill cleaners can pose risks due to the caustic nature of the solutions. Implement a written plan that meets the requirements of the HCS to provide for worker training, warning labels, and access to SDSs. Provide appropriate PPE such as gloves, goggles, and splash aprons when handling hazardous detergents and chemicals. Provide suitable facilities for quick drenching or flushing of the eyes and body. To avoid employee contact with dishwashing detergents, good work practice recommends using dishwashing machines with automated detergent dispensers. Workers must use caution and appropriate PPE when changing out the containers of detergent (Table 10.13).

TABLE 10.13
Kitchen Worker Safety Tip

- Exercise caution when using ammonia and avoid skin contact.
- Flush affected skin areas or eyes promptly with water.
- Wear gloves and face/eye protection when working with ammonia.
- Use ammonia only in areas with good ventilation.
- Make sure stove hoods are working when using ammonia to clean grease.
- Chlorine mixed with ammonia creates a toxic chlorine gas.
- Use protective clothing when working with caustic cleaning solutions.
- Workers in hot areas may need frequent water and rest periods.
- Regularly check microwaves for defective hinges, doors, and seals.

TABLE 10.14
Cutting or Mixing Equipment Safety

- Check and secure guards before starting.
- Use nonmetallic utensils to stir or test contents.
- Stir contents only when equipment is not in motion.
- Never remove food containers until all moving parts stop.
- Wear wire mesh gloves to clean machines with sharp blades.
- Disconnect all machines before cleaning or servicing.
- Restrict use of cutting equipment to authorized workers.

OSHA Machine Guarding Requirements (29 CFR 1910.212)

Commercial mixers, slicers, and other kitchen equipment can pose a hazard to workers. These machines must contain guards to protect the worker from reaching in, or being pulled into, these hazards. The OSHA machine guarding standard requires that machine guards to protect the operators and other employees in the area from hazardous exposures. Properly guard meat slicers and train personnel in safe work practices. Use tamps, push sticks, or other hand tools to feed or remove food from grinders, slicers, or choppers. Properly guard continuous feed dishwashers to prevent scalding incidents and possible nip point injuries from rollers and conveyors. Provide barrier guards over mixers when it is in use. Other methods of machine guarding include two-handed tripping devices. Refer to 29 CFR 1910.263 for guidance on equipment guarding (Table 10.14).

Ergonomics

Dietary employees must perform many lifting, reaching, and repetitive tasks as part of their job duties. Frequent elevated extended reaches for supplies or heavy containers can cause back and shoulder injury resulting in muscle strain, bursitis, tendinitis, and rotator cuff injuries. Rapid hand and wrist movements from frequent cutting, chopping, or scooping may lead to hand disorders such as tendinitis, carpal tunnel syndrome, and tenosynovitis. Assess work sites for ergonomic stressors and identify and address ways to decrease them. Provide height-adjustable work spaces appropriate for the task being performed, so that workers can keep elbows close to the body, for example, lower countertops, or use height-adjustable countertops or stands, or provide work stands for employees. Redesign or reposition tasks to allow elbows to remain close to the body. Avoid awkward postures such as reaching above or behind to get supplies. Keep most work activities within repetitive access area. Use mechanical aids to reduce the need to lift. Use a spring device to automatically lift a load such as with automatic plate and cup riser dispensers. Train workers to use proper lifting techniques. Rotate workers through repetitive tasks. Use mechanical aids for chopping, dicing, or mixing foods such as food processors and mixers. Select and use properly designed tools. Maintain a neutral or handshake wrist position. Restructure jobs to reduce repeated motions, forceful hand exertions, and prolonged bending.

Delivering Meals to Isolation Rooms

Dietary employees can experience exposure to respiratory and bloodborne hazards when required to take dietary trays to patients. Exposure to infectious materials may also occur when handling red-bagged contaminated food trays that come from isolation rooms to the kitchen to be sterilized. Universal precautions consider all human blood and OPIMs as infectious. The OSHA bloodborne pathogen standard requires workers exposed to blood and OPIMs to wear PPE such as gloves, masks, and gowns.

Use engineering and work practice controls to limit exposure. Educate and train all exposed employees to safely enter and exit isolation rooms and to safely handle food trays coming from isolation rooms. Encourage staff to use a special bag for contaminated trays coming from isolation rooms and label the bag with necessary precautions to take. Use only disposable trays and plastic ware when delivery to patient isolation rooms.

Importance of Hand Washing

Effective hand washing prevents the spread of harmful bacteria and only requires a few simple steps: (1) wet hands with warm water; (2) apply soap to hands and lather vigorously for at least 20–30 s; (3) pay particular attention to fingernails, finger tips, and in-between fingers; (4) rinse with warm water; and (5) dry hands with disposable towels or approve blow dryers (Tables 10.15 and 10.16).

Basics for Handling Food Safely

Safe steps in food handling, cooking, and storage can help prevent foodborne illnesses. People can't see, smell, or taste harmful bacteria that may cause illness. In all steps of food preparation, follow these basic recommendations:

- Clean—Wash hands and surfaces often.
- Separate—Don't cross contaminate.
- Cook—Cook to proper temperatures.
- Chill—Refrigerate promptly.

TABLE 10.15
Hand Washing Tips for Food Service Personnel

- Before starting work and after using the restroom.
- Before and after handling ice.
- Prior to and after using single-use gloves.
- While preparing food and as often as necessary.
- When switching between tasks such as preparing food and serving food.
- After handling nonfood items such as garbage bags or cleaning chemicals.
- After touching exposed parts of the body or clothes.
- Between handling money and handling food.
- Never consider hand washing without water as effective to remove soil, grease, and bacteria or viruses.

TABLE 10.16
Food Safety Tips for Commercial Kitchens

- Ensure proper training of all staff and management personnel.
- Recommend that key personnel obtain food safety certifications.
- Wash hands frequently since foodborne illness can spread through person to person contact.
- Wash all produce by hand to remove any bacteria on the surface.
- Properly store refrigerated foods and keep refrigerators at or below 40°F to minimize bacterial growth.
- Cook foods to appropriate temperatures.
- Clean and sanitize all food contact surfaces such as countertops, cutting boards, utensils, pots, and pans.
- Perform self-inspections to identify any potential food safety concerns.
- Know local health codes since state, county, or municipalities serve as enforcers.
- Check all incoming food shipments for contamination that could occur anywhere along the supply chain.

Storage

Always refrigerate perishable food within 2 h (1 h when the temperature is above 90°F). Check the temperature of your refrigerator and freezer with an appliance thermometer. Set refrigerator temperature at 40°F or below and the freezer at 0°F or below. Cook or freeze fresh poultry, fish, ground meats, and variety meats within 2 days; for other meats like beef, veal, lamb, or pork, cook or freeze within 3–5 days. Perishable food such as meat and poultry should be wrapped securely to maintain quality and to prevent meat juices from getting onto other food. To maintain quality when freezing meat and poultry in its original package, wrap the package again with foil or plastic wrap that is recommended for the freezer. In general, high-acid canned food such as tomatoes, grapefruit, and pineapple can remain fresh stored on the shelf for 12–18 months. Low-acid canned food such as meat, poultry, fish, and most vegetables will keep 2–5 years—if the can remains in good condition and stored in a cool, clean, and dry place. Discard dented, leaking, bulging, or rusted cans.

Preparation

Always wash hands with warm water and soap for 20 s before and after handling food.

Never cross contaminate food prep or serving surfaces. Keep raw meat, poultry, fish, and their juices away from other foods. After cutting raw meats, wash cutting board, utensils, and countertops with hot, soapy water. Cutting boards, utensils, and countertops can be sanitized by using a solution of one tablespoon of unscented, liquid chlorine bleach in a gallon of water. Marinate meat and poultry in a covered dish in the refrigerator.

Thawing

The refrigerator allows slow, safe thawing. Make sure thawing meat and poultry juices do not drip onto other food. Use cold water for faster thawing. Place food in a leak-proof plastic bag and submerge in cold tap water. Change the water every 30 min. Cook food immediately after thawing. Cook meat and poultry immediately after microwave thawing.

Cooking Temps

Cook beef, veal, lamb steaks, roasts, and chops at 145°F. Cook ground beef, veal, lamb, and pork at 160°F. All poultry should reach a safe minimum internal temperature of 165°F.

Serving

Hold cooked hot food at 140°F or warmer. Hold cold food at 40°F or colder.

When serving food at a buffet, keep food hot with chafing dishes, slow cookers, and warming trays. Keep food cold by nesting dishes in bowls of ice or use small serving trays and replace them often. Discard any food left out at room temperature for more than 2 h (1 h if the temperature was above 90°F). Place food into shallow containers and immediately put in the refrigerator or freezer for rapid cooling. Use cooked leftovers within 4 days. You can refreeze meat and poultry defrosted in the refrigerator before or after cooking. If thawed by other methods, cook before refreezing. Store and refrigerate raw foods separately from ready-to-eat foods. Keep raw meats in well-sealed containers. Store raw food shelves beneath ready-to-eat foods to minimize contamination from accidental drips or other contact.

Prepare Foods Separately

Prepare foods on clean, separate surfaces to minimize the spread of germs. Utilize clean cutting boards as safe surfaces for preparing foods. If possible, designate individual cutting boards for

different types of foods. Designate dedicated cutting boards for raw meats and vegetables. Proper cooking kills germs in meat but vegetables often served raw can contain bacteria from improper washing or cross containment. After each use, scrub cutting boards with hot, soapy water. Never leave cutting boards in standing water, which can facilitate bacterial growth. Periodically sanitize plastic cutting boards with a chlorine solution of one tablespoon per quart of water or vinegar and water solution (1:3 ratios) for wood boards. Spray the surface and allow sitting for several minutes and rinse with clean water and air dry. Allow the cutting board to dry completely; bacteria will die after a few hours when deprived of moisture and heat.

Store the cutting board in a dry place and away from raw foods to avoid contamination.

Plastic cutting boards are often available in different colors. Each color is designed for use with a specific food type. Adopting a color-coding system both increases easy employee training and reduces cross contamination.

Thermometers

When it comes to food preparation, visual cues often become the standard for determining when a food is actually cooked to perfection. Clear juices flowing from a hearty burger means it is time to take it off the grill. Many people believe that when a Thanksgiving turkey becomes golden brown, it is ready. Such visuals, although commonly used, should never serve as a standard for cooking. Storing, cooking, and serving food at proper temperatures remains critical to avoiding harmful bacteria. Bacterial growth can often relate to food storage or cooking temperatures. Bacteria multiply fastest in environments with temperatures between 40°F and 140°F, a window known as the *danger zone*. Ensuring that proper temperatures stay outside this danger zone eliminates potential bacterial growth.

Regular Equipment Maintenance

Clean equipment daily to prevent dirt buildup. Make a schedule for cleaning, calibrating commercial ovens, checking commercial refrigerator temperatures, and descaling dish machines and any other type of commercial equipment upkeep. Closely read and follow the cleaning directions in the manual and on the solvent bottles to avoid damaging your equipment. Contact the manufacturer if uncertain about proper way to clean any food service equipment. Establish a service contract for equipment with the manufacturer or a local service company to perform regularly scheduled fine-tuning of each piece. When choosing new equipment, select a model that can be cleaned easily. Store small equipment such as blenders and produce cutters in closets or cabinets whenever possible. This prevents them from being knocked over, dropped, or spilled on.

Safe Ice Handling

Adhere to established maintenance and cleaning schedules for ice machine to combat mineral deposits or slime buildup. Make sure employees wash hands before and after handling ice. Use a dedicated container such as an ice tote or caddie for transporting ice. Use NSF-approved scoops for ice handling. Store the scoop outside of the ice storage bin, preferably in a dedicated container or scoop caddie. Refreeze ice immediately if it begins to melt. Never handle or scoop ice by hand. Use sanitary buckets or ice scoops. Dump unused ice back into the ice bin. Clean picks, scoops, scoop caddies, and other small ice handling items by using a commercial dishwasher or other approved sanitizing procedures. Hand wash ice totes or caddies, inside and out, with warm soapy water. Store them hanging upside down to assure the interior stays dry when not in use.

Foodborne Illness

Research indicates more 250 different foodborne diseases caused by viruses, bacteria, parasites, toxins, metals, and prions. Symptoms of foodborne illness range from mild gastroenteritis to

life-threatening neurologic, hepatic, and renal syndromes. Foodborne diseases can include botulism, brucellosis, *Campylobacter enteritis*, *Escherichia coli*, hepatitis A, listeriosis, salmonellosis, shigellosis, toxoplasmosis, viral gastroenteritis, and trichinosis. Recognize foodborne disease outbreaks if illnesses occur within a short, but variable, period of time. Illness usually occurs within a few hours to a few weeks among individuals who ate the same food. You can't detect most food contaminants through taste, odor, texture, or appearance. Prompt and thorough laboratory evaluation of cases and suspected foods is essential. Most single cases of foodborne disease remain difficult to identify unless, as in botulism, distinctive clinical syndrome exists. Report any foodborne disease epidemics to local health authorities. Take the following steps when conducting an epidemiological investigation:

- Review reported cases to determine time and place of exposure and population at risk.
- Obtain a complete list of foods served.
- Hold and refrigerate all food still available.
- Collect samples of vomit and feces for laboratory testing and inform the laboratory of suspected contaminants.
- Compare illness rates for specific foods eaten and those not eaten.
- Investigate the source of suspected food and methods of preparation and storage.
- Look for possible sources of contamination and inadequate refrigeration or heating.
- Submit samples of suspected food for laboratory testing.
- Evaluate food handlers for sources of infections including culture of lesions, nasal swabs, and feces where appropriate.

Controlling Food Contamination

Control of food-related illnesses is based on the following principles: avoidance of contaminated food, destruction of contaminants, and prevention of further spread of contaminants. Prevention is dependent upon proper cooking and storing practices and personal hygiene of food handlers. Healthcare facilities should follow all local health regulations concerning sanitation. An excellent guide to avoiding food contamination is the US Public Health Service publication titled *Food Service Sanitation Manual*. Take precautions when handling potentially hazardous foods such as milk products, eggs, meat, and poultry. Fish, shellfish, and edible crustaceans need special attention. Maintain potentially hazardous foods at 38°F–40°F or lower unless being prepared or served. Reheating foods left at room temperature for some time will not protect individuals from illnesses (Table 10.17).

FDA Bad Bug Book

This handbook provides basic facts regarding foodborne pathogenic microorganisms and natural toxins. The book includes information from CDC, FDA, USDA Food Safety Inspection Service, and the National Institutes of Health.

TABLE 10.17
Common Foodborne Illnesses

- *Salmonella*: A bacteria found in intestinal tracts of humans and animals and can cause salmonellosis. It can transmit to humans through meat, fish, and eggs. The bacteria are destroyed by heat and certain chemical germicides.
- *Staphylococcus*: Bacteria that produces a toxin that causes food poisoning. Normal cooking temperatures do not destroy these organisms.
- *Escherichia coli*: These bacteria can cause serious illness and are common in undercooked ground beef. Cook all ground meat sufficiently to destroy these deadly bacteria.

Preventing Cross Contamination

Prevent cross contamination by properly handling and storing containers, utensils, glassware, and dishes. Never use the same cutting boards or preparations utensils. The dishwashing cycle should include cleaning with warm soapy water and rinsing in clear water to remove detergent residue. Consider the following sanitizing method: immerse in clean hot water (170°F) for 30–45 s or in hypochlorite water solution (50 ppm) for at least 1 min. Mechanical cleaning of dishes and utensils should adhere to the following water temperature requirements (Table 10.18):

- Wash cycle —140°F
- Initial rinse—160°F
- Final rinse —180°F

Hazard Analysis and the Critical Control Point System

We can't apply these principles to all aspects of the food industry including growing, harvesting, processing, distributing, merchandising, and preparing food for consumption. A successful plan requires a strong management commitment to implement its principles. This management commitment provides employees with a clear understanding of the importance in producing safe food. Hazard Analysis and the Critical Control Point System (HACCP) is a proactive plan based on preventing hazards. By monitoring and detecting potential problems throughout an entire process, the personnel can identify hazards and take corrective measure immediately. HACCP enables companies to apply prevention and detection methods to their specific applications, giving them the freedom to adopt new techniques and technologies more rapidly than previously possible. A successful HACCP plan is built upon a firm commitment from upper management with well-trained and motivated employees actively involved in the process (Table 10.19).

Foodborne Illness Primer for Healthcare

Recently, several agencies collaborated on a new publication to help increase awareness of foodborne illnesses among physicians. The primer, *Diagnosis and Management of Foodborne Illness: A Primer for Physicians and Other Health Care Professionals*, was produced by the AMA, the American Nurses Association (ANA), the CDC, the Center for Food Safety and Applied Nutrition

TABLE 10.18
Foodborne Illness Prevention Tips

- Wash hands frequently and after smoking or using restroom.
- Use antibacterial soap and wash for at least 30 s.
- Do not use common towels for hand drying.
- Cook/maintain hot foods at a temperature of 140°F or higher.
- Heat poultry and stuffed meat dishes to 165°F.
- Cook pork at 150°F or higher.
- Minimum heating temperature for rare roast beef is 130°F.
- Keep cold foods at 38°F–41°F or lower if possible.
- Exclude ill workers from food handling and preparation.
- Refrigerate food immediately.
- Reheat leftovers rapidly to 165°F before serving.
- Refrigerate potentially hazardous foods until used.
- Eliminate all pests from food preparation and storage areas.

TABLE 10.19
Seven Basic Principles of HACCP

- Identify and analyze workplace hazards: Identify potential food-related hazards and suggest appropriate control measures.
- Identify critical control points: Define a critical control point as any point, procedure, or step that provides the best time to eliminate, prevent, or reduce a food hazard.
- Establish critical limits: Critical limits to serve as maximum and/or minimum values that will prevent, eliminate, or reduce a biological, chemical, or physical hazard.
- Monitor the critical control points: Ensure continuous monitoring to assure accurate readings.
- Define corrective actions: Determine actions to correct the cause of deviation and establish procedures to decide discarding of a food product.
- Establish verification procedures: Verification activities determine the effectiveness of the plan and to ensure correct system operation.
- Establish recordkeeping and documentation procedures: Keep documentation for the entire food process and should include a summary of the hazard analysis.

Food and Drug Administration (CFSAN-FDA), and the Food Safety and Inspection Service (FSIS) of the US Department of Agriculture. This primer is intended to provide healthcare professionals with current and accurate information for the diagnosis, treatment, and reporting of foodborne illnesses.

REVIEW EXERCISES

10.1 What four basic criteria should guide the establishment of healthcare cleaning processes?
10.2 List Spaulding's three disinfection levels.
10.3 List at least seven key cleaning training and education topics.
10.4 Why do organizations make cleaning for safety and health a priority?
10.5 Describe four ways disinfectants do their work.
10.6 List the seven common types of antimicrobial solutions used in healthcare facilities.
10.7 Why is green cleaning so difficult to define?
10.8 List at least 10 reasons to use a microfiber mopping process.
10.9 Describe at least five key responsibilities of healthcare food service managers.
10.10 What type of machine guarding does OSHA mandate in food preparation areas?
10.11 What are the four elements of the Fight BAC food preparation process?
10.12 Foodborne bacteria multiply fastest in what temperature range?
10.13 List at least seven foodborne illness prevention tips.
10.14 Describe the seven basic principles of HACCP.

11 Support Department Safety

CENTRAL STERILE SUPPLY

Central sterile supply activities receive, package, process, sterilize, and distribute nondrug items for medical and patient care units. These supplies include items such as glassware, gloves, surgical accessories, and intravenous solutions. Central supply processes, inspects, and packages sterile linen for use in surgical and care delivery areas. Hazards existing in central sterile operations include those associated with material handling and sterilization processes. The improper use of equipment can result in burns from steam and exposure to sterilizing agents. The use of ethylene oxide (ETO) requires aeration of sterilized items and exhaust ventilation for the waste gas. Exhaust systems for ETO should be properly designed and labeled. Cuts, bruises, and puncture wounds can occur from blades, needles, knives, and broken glass. Establish policies for disposing of sharps or other hazardous instruments. Provide workers with appropriate carts, dollies, and other material handling devices. Ensure the use of approved step stools and ladders. Never permit personnel to use chairs, boxes, or other makeshift devices for climbing.

Autoclaves and Sterilizers

Establish preventive maintenance schedules in accordance with the manufacturer's suggestions. Maintain safety relief valves and sealing gaskets in good working condition. Instruct staff to never open devices until steam pressure drops to zero. Restrict the use of autoclaves to trained and authorized personnel. Ensure the presence of a main power switch or breaker for all autoclaves, sterilizers, glass washers, and other major electrical equipment. This would enable personnel to quickly remove power in case of an emergency or malfunction. ETO sterilizers present both toxic and fire hazards. Ensure personnel using aeration cabinets become thoroughly familiar with recommended minimum aeration time for various materials per manufacturer's instructions. Maintain a copy of the manufacturer's recommended aeration time schedule in the immediate area of the sterilizer. When sterilizers use ETO and aerators, vent the exhaust to the exterior of the building. Locate ETO sterilizers in a way that would minimize the length of exterior vent lines. In no case should vent lines deviate from the manufacturers' recommended specifications for vent diameter, length, vertical rise, or material. The Association for the Advancement of Medical Instrumentation (AAMI) publishes the *Comprehensive Guide to Steam Sterilization and Sterility Assurance in Healthcare Facilities* that outlines general techniques applicable to ETO systems.

Ethylene Oxide (ETO) Standard (29 CFR 1910.1047)

The OSHA PEL of 1 ppm for an 8 h TWA helps protect worker overexposure. Exposure usually results from improper aeration of the ETO chamber after the sterilizing process or during off-gassing of sterilized items or poor gasoline connections. ETO can cause eye irritation and injury to the cornea, frostbite, and severe irritation and blistering of the skin upon prolonged or confined contact. Ingesting ETO can cause gastric irritation and liver injury. Acute effects from inhaling vapors include respiratory irritation, lung injury, headache, nausea, vomiting, diarrhea, and shortness of breath. ETO can cause cancer in laboratory animals and is associated

with higher incidences of cancer in humans. Substitute other cold sterilants for ETO. However, use extreme care when selecting possible substitutes. Typical operations that could cause worker exposure to ETO include removing sterilized items from the sterilizer and moving items from the sterilizer to the aerator unit. Control airborne concentrations at the source of contamination by enclosing the operation and/or using local exhaust ventilation. Use appropriate PPE when changing cylinders including butyl apron, gloves, and a canister respirator. Install detector systems and room monitors to signal any leakage of gas. Use passive dosimeters for personal exposure monitoring. Conduct periodic personal monitoring and maintain a written log to document detected leaks and service work done on an ETO chamber.

Glutaraldehyde

Glutaraldehyde may also pose exposure risks to workers. Store these products in closed containers located in well-ventilated areas. Only use glutaraldehyde products in well-ventilated areas. Ensure the adequate dilution of vapors by ensuring a minimum air exchange rate of 10 air changes per hour. Ideally, install local exhaust ventilation such as a properly functioning laboratory fume hood to control vapors. Use appropriate PPE to minimize exposure including impervious gloves, splashproof goggles, or full-face shields. Provide emergency drenching stations if risks of eye or body exposure exist.

Safety Issues

Employee burns or cuts can occur from handling or sorting hot sterilized items or sharp instruments. Establish work practices to prevent or minimize hazardous exposures. Never remove items from sterilizers until cooled. Avoid handling sharp ends of instruments. Use forceps or other devices to remove sharp instruments from baskets or autoclaves. Provide workers with appropriate PPE. Require employees to use appropriate hand protection when exposed to hazards such as cuts or lacerations and thermal burns. Use oven mitts when handling hot items and appropriate gloves when handling or sorting sharp instruments. Employee exposure to bloodborne pathogens and other potentially infectious materials can happen when sorting or handling contaminated surgical instruments and sharps. Workers must properly discard any disposable sharps and recycle reusable instruments that need sterilizing. Require workers to wear gloves during times of hand contact with blood, mucous membranes, and other potentially infectious materials. Also wear gloves when handling contaminated items or surfaces. The wearing of thick utility gloves and gowns can offer additional protection to the employee sorting contaminated items. Take action to prevent musculoskeletal disorders by educating workers. Teach them to avoid repetitive, prolonged, and overreaching tasks. Evaluate all tasks that require lifting above shoulder height. Provide fatigue mats for workers standing in one position while sorting instruments. Contact trauma to the forearm area can occur if workers rest their wrists on hard sharp counter surfaces while sorting. Redesign workstations to permit reaching packaging and equipment while maintaining the elbows in close proximity to the body. Use carts with large and low-resistance casters and height-adjustable work surfaces or lift tables. Pad the edge of work surfaces that come into contact with the elbow or forearm that could cause contact trauma. Provide sit or stand stools at workstations. Require workers to wear shoes with well-cushioned insteps and soles. Provide a footrest bar so employees can continually alter their posture by raising one foot. OSHA requires employers to provide drenching stations for workers with exposure to eyes or body from injurious corrosive materials. The facilities for quick drenching or flushing the eyes and body must be located within the work area for immediate emergency use. Keep floors clean and dry. Maintain clear aisles and passageways without obstructions that could create a hazard. Provide floor plugs or ceiling plugs for equipment, so power cords need not run across pathways.

Disinfectants

Low-level quaternary ammonium compounds and intermediate-level disinfectants such as quaternary ammonium compounds containing 15% alcohol work well as cleaning agents. Detergents with enzymes can also be used as cleaning agents. Use a tight-fitting brush on interior channels of endoscopes. If the channels are too small for a brush, they should be flushed with a syringe. Cleaning not only removes visible soil but also removes at least 99.9% of the microbes on the instrument. The removal of visible soil helps the disinfectant finish the job of killing microbes. Some cleaning agents may prove incompatible with certain disinfectants. Enzymes found in cleaning agents will react to neutralize or partially neutralize some disinfectants. Rinse cleaning agents with potable water before placing the instrument into a disinfectant.

Disinfectants must contact the exterior and interior surfaces of an instrument for proper recommended exposure time and temperature. Some agitation and physical positioning may help fill the interior lumen of hollow instruments and dislodge air pockets. Disinfectants can kill microbes or cells of a mucous membrane. Therefore, rinse away all disinfectants from instruments with copious amounts of sterile water. Use a double- or triple-rinse technique with smaller volumes of sterile water. Each rinse removes about 90% of the disinfectant. A double-rinse removes 99%, and a triple-rinse removes 99.9% of the disinfectant. A flowing rinse where sterile water pours over an instrument is more effective than a static rinse where the instrument is soaked in a container.

Drying and Storage of Instruments

If instruments are stored wet, *Pseudomonas* or *Aspergillus* from the environment may multiply quickly to dangerous numbers. Dry all instruments by blowing filtered air through the interior channels, by using low-intensity heat lamps, or simply by hanging the instruments to drip dry. After drying, store the instruments in a cabinet to permit further drying and to protect them from dust or other environmental contaminants. Always store critical instruments in a sterile container or process them immediately before use. Always rinse sterile instruments with sterile water immediately prior to use.

Surfaces

Wipe floors, countertops, furniture, and machinery housing with an intermediate- or low-level disinfectant to remove soil. Then rewipe with fresh disinfectant to complete the killing of microbes. Never rinse environmental surfaces unless the label directs or a surface might come into contact with eyes.

International Association of Healthcare Central Service Materiel Management

The association offers professional certifications such as the Certified Registered Central Service Technician (CRCST), Certified Instrument Specialist (CIS), and Certified in Healthcare Leadership (CHL). In addition to the training publications available for any of these certifications, the association offers a wealth of supplemental education for further specializations or instructional purposes. Continuing education is the best way to evaluate and understand new procedures and products. International Association of Healthcare Central Service Materiel Management (IAHCSMM) serves as the leader in making this type of information readily available to its membership. The association's annual meeting offers more than 20 h of continuing education and allows attendees to learn about the newest innovations and advancements in the field with the largest exhibit show specializing in central service.

Association for the Advancement of Medical Instrumentation

AAMI serves as the primary source of consensus and timely information on medical instrumentation and technology. AAMI provides multidisciplinary leadership to enhance the ability of the professions, healthcare institutions, and industry to understand, develop, manage, and use medical instrumentation and related technologies. The AAMI mission focuses on providing global multidisciplinary leadership and enhances the capabilities of the profession, healthcare institutions, and other institutions involved in delivering, developing, and managing the use of safe and effective medical instrumentation and related technologies.

MATERIALS MANAGEMENT

Everyone involved in healthcare should work to ensure that patient care processes flow smoothly. *Crossing the Quality Chasm* defines evidence-based medicine as "the integration of best research evidence with clinical expertise and patient values." This definition includes three critical factors:

- Best research evidence derived from laboratory experiments, clinical trials, and epidemiological and outcomes research.
- Clinical expertise based on the ability of a clinician to utilize clinical skills and experience to rapidly evaluate each patient's unique health state to make a diagnosis and recommend interventions based upon knowledge of the respective risks and benefits.
- Patient values refer to each patient's unique preferences, concerns, and expectations that are part of each clinical encounter.

In 2001, the IOM published *Crossing the Quality Chasm: A New Health System for the 21st Century.* The IOM called upon the healthcare system to focus on care that is safe, timely, effective, efficient, equitable, and patient-focused. Patients should not be harmed by the care intended to help them nor should harm come to those working in healthcare. While the goal is to provide safe healthcare at all times, it is clearly recognized that humans provide care and that errors can and do occur. Thus, the goal must be to prevent harm from reaching patients and those involved in providing care to those patients. To do so, it requires everyone to be involved in identifying opportunities where patient care can be made safer. It also requires that everyone be continuously involved in learning from medical errors and *near-miss events* (Table 11.1).

TABLE 11.1
Material Management Safety Responsibilities

- Track and respond to recalls, alerts, and service bulletins for equipment, supplies, and purchased services.
- Take actions to remove recalled products from use.
- Ensure appropriate storage of supplies and equipment to meet regulatory and safety requirements.
- Assure the maintenance of proper temperature and humidity controls in storage facilities.
- Establish appropriate documentation and control procedures for in-house sterilization processes.
- Implement safety precautions for all distribution process and facilities.
- Manage dated products to ensure removal of expired or obsolete products and supplies.
- Develop vendor access and credentialing policies to meet organizational requirements.
- Report products received in poor condition, shipped in error, or with unclear labeling.
- Ensure safety data sheet receipt for all hazardous materials received at the facility.
- Take actions to ensure that safety requirements receive consideration when ordering supplies.

Cost, Quality, and Outcomes

The Association for Healthcare Resource & Materials Management (AHRMM) recently launched the Cost, Quality, and Outcomes (CQO) movement and continues to work with other organizations to lead the supply chain profession as it embraces the *intersection* of CQO. Hospitals and healthcare systems struggle in their effort to determine how the economy, reductions in revenue, and implementation of the ACA will impact operations. This confluence of changes creates pressure to lower costs and improve overall patient care without sacrificing quality. The emerging model for healthcare delivery presents unprecedented opportunities for materials management professionals to help achieve meet the requirements of healthcare reform. Materials managers must understand that the cost of supplies, procedures, and delivered care depend on quality and outcomes. All of these costs intersect to determine total costs and reimbursement levels.

Improving Healthcare Delivery

Fragmented healthcare delivery promotes wasted time, efforts, materials, medications, money, and trust. The term *efficiency* is often mistaken for cutting corners. There are two primary methods to increase the efficiency of the healthcare system. The first deals with reducing waste at all levels, and the second addresses lowering administrative and production costs. Healthcare must never reduce and/or eliminate services based on a patient's race, ethnicity, or gender. Patients must receive treatment on the basis of need and not on personal characteristics unrelated to their illness. While patients may vary in their desire to be involved in their healthcare, often, they feel excluded from discussions and decisions that affect them. As a consequence, patients may find their healthcare to be not only impersonal, but they are often left confused and unsure as to what they need to do in regard to participation in their care.

Healthcare materials management functions play a crucial role in providing efficient healthcare services. Materials management functions work to address the availability, safety, and affordability of medical supplies and equipment. The availability of a low-cost catheter can prove as critical as a high-value pacemaker when it comes to medical care. Inventory managers take on the huge responsibility of making thousands of diverse medical consumables available on time. The recent developments in automation and information technology and emerging trends in the medical supplies industry help materials managers better deal with time constraints. Materials management deals with the tangible components of a supply chain. This covers acquisition of spare parts and replacements, quality control of purchasing, and understanding the standards involved in ordering, shipping, and warehousing necessary supplies. A large component of materials management consists of ensuring that parts and materials used in the supply chain meet minimum requirements by performing quality assurance. It remains vital to test parts and material before purchase orders go out to ensure no short- or long-term issues would disrupt the supply chain. An effective materials management plan also means a more holistic approach to managing vehicle use and emissions, solid waste, hazardous waste, recycling, and utility services. As a result, this means a *greener*, more sustainable environment and a manifestation of the many demands today for institutions to become more environmentally friendly. Review and improve standards on an ongoing basis. Establish, implement, and supervise efforts to document the proper handling of requisitions, orders, receipt, and storage of stock. Ensure appropriate inventory levels by communicating with customers regarding stocking, ordering, and deliveries. Define responsibilities and functions of subordinate positions and assists in establishing staff requirements and scheduling. Serve as mentor to staff and identify efforts for recognition.

Association for Healthcare Resource & Materials Management (AHRMM)

AHRMM serves as the premier membership group for healthcare supply chain professionals. AHRMM strives to provide the education, information, and resources necessary for its members

to remain at the top of their field. With more than 4300 members worldwide, AHRMM offers numerous opportunities for professionals to reach their highest potential and network with the best. AHRMM began in the early 1950s as part of the AHA. Over the past 60 years, the association has continually grown and reinvented itself to become the leading professional organization for the healthcare resource and materials management field. Read through AHRMM's history to see how the organization developed into a vital part of the healthcare supply chain industry. In 2010, AHRMM launched four online certificate initiatives designed to teach all aspects of the responsibilities of the healthcare supply chain including purchasing, inventory control, negotiations, and logistics.

MEDICAL EQUIPMENT MANAGEMENT

Medical equipment management is also known as biomedical equipment management or as clinical engineering. It includes the business processes used in interaction and oversight of the medical equipment involved in the diagnosis, treatment, and monitoring of patients. The related policies and procedures govern activities from the selection and acquisition through the incoming inspection, acceptance, maintenance, and eventual retirement and disposal of medical equipment. Medical equipment management is a recognized profession within the medical logistics domain. The medical equipment management professional's purpose is to ensure that equipment used in patient care is operational, safe, and properly configured to meet the mission of the medical treatment facility. Some medical equipment professional functions include

- Equipment control and asset management
- Equipment inventories
- Work order management
- Data quality management
- Quality assurance
- Patient safety and risk management
- Hospital safety planning
- Radiation safety
- Medical gas systems
- In-service education and training
- Accident investigation
- Safe Medical Devices Act (SMDA) of 1990
- HIPAA

Healthcare facilities should implement a management plan that promotes the safe and effective use of medical equipment in support of patient care. This medical equipment management plan maintains complete and continuous compliance with the accreditation organization medical equipment management requirements. These requirements help assess and control the clinical and physical risks of fixed and portable equipment used for the diagnosis, treatment, monitoring, and care of patients. The medical equipment management policy includes all of the current medical equipment management requirements, as well as requirements from other care functions that pertain to medical equipment. The management plan consists of policies and procedures designed to address the following components and issues:

- Selecting and acquiring medical equipment
- Evaluating and identifying equipment to be included in the plan
- Determining scheduled maintenance intervals and procedures
- Repairing and maintaining patient care equipment

- Performance standards for equipment inspection, scheduled maintenance, and testing
- Scheduling inspections, maintenance, and tests on equipment included in plan
- Development of a policy to provide after hours service
- Coordinating and documenting services of manufacturers and third-party providers
- Acting on hazard alerts and recalls of medical equipment
- Complying with the provisions of the SMDA of 1990
- Reporting and investigating problems associated with failures and user errors
- Educating and training operators and maintainers about medical equipment issues
- Providing emergency procedures for medical equipment failures

Joint Commission Requirements

Establish criteria for identifying, evaluating, and inventorying all equipment before placing in use. Management should provide guidance on monitoring and acting during equipment recalls situations. Describe processes for managing effective, safe, and reliable equipment. Identify and implement all processes for selecting and acquiring medical equipment. Evaluate the condition and function of the equipment when received. The organization may choose to include all medical equipment in the management plan. Organizations may use any appropriate strategy including predictive maintenance processes: interval-based inspections, corrective maintenance, or metered maintenance to ensure reliable performance. Define intervals for inspecting, testing, and maintaining appropriate equipment. Minimize clinical and physical risks by using criteria such as the manufacturer's recommendations, risk levels, and current organization experience. Implement processes for monitoring equipment hazard notices and recalls. Develop procedures for monitoring and reporting equipment incidents that must be reported by the SMDA of 1990 (Table 11.2).

Maintenance, Testing, and Inspecting

- Maintain an up-to-date inventory of all equipment identified in the medical equipment management plan, regardless of ownership.
- Document performance and safety testing of all equipment before initial use.
- Document maintenance of equipment used for life support consistent with maintenance strategies to minimize any clinical and physical risks identified in the equipment plan.
- Document maintenance of non-life-support equipment on the inventory consistent with maintenance strategies to minimize clinical and physical risks.
- Document performance testing of all sterilizers used.
- Document chemical and biological testing of water used in renal dialysis based upon regulations, manufacturers' recommendations, and organization experience.

TABLE 11.2
Medical Equipment Risk Assessment Criteria

- Equipment function (diagnosis, care, treatment, or monitoring)
- Clinical use or application
- Maintenance requirements
- Equipment incident history

Medical Equipment Reporting

The FDA Modernization Act (FDAMA) of 1997 changed medical device adverse event reporting effective on February 19, 1998. On January 26, 2000, the FDA published in the FR changes to the implementing regulations, 21 CFR 803 and 804, to reflect these amendments and the removal Part 804. The user facility semiannual reporting requirement has been changed to annual reporting. The annual report is now due on January 1 of each year. Protect the identity of user facilities submitting reports except in connection with certain actions brought to enforce device requirements under the act or to communicate to a manufacturer a device report experienced a report to the FDA of death, serious illness or injury, or other significant adverse experience.

SMDA of 1990

This act requires healthcare facilities to report serious or potentially serious device-related injuries or illness of patients and/or employees to the manufacturer of the device. The FDA wants to obtain important information on device problems. The act applies to all inpatient facilities, ambulatory surgery care centers, perioperative facilities, diagnostic units, and outpatient treatment centers. It does not apply to physician offices. Failure to comply can result in civil penalties. Healthcare workers that provide care, review patient care, repair devices, or provide preventive maintenance must report device-related incidents. The incidents include device failure, malfunction, design problems, user errors, and inadequate labeling. Reporting responsibilities extend to physicians, nurses, allied health professionals, students, and other organizational personnel. Examples of a medical device include anesthesia machine, pacemaker, heart valve, suture, surgical sponge, wheelchair, hospital bed, catheter, infusion pump, dialysis machine, artificial joint, and implant devices.

SMDA Reportable Events

Facilities must report medical device events involving patient deaths to the FDA. Report serious injuries caused by devices or in which devices played a role to the manufacturer. The FDA requires that hospitals maintain documentation of all reportable events. Identify the person that completed the investigation and the information used to form an opinion about the causes of the event (Table 11.3). When reporting, use the following forms:

- FDA Form 3500, MedWatch Voluntary Reporting
- FDA Form 3500A, MedWatch Mandatory Reporting: Medication and Device Experience
- FDA Form 3419, Medical Device Reporting: Annual User Facility Report

TABLE 11.3
Responding to Device-Related Incidents

- Protect the device including packaging material and related parts.
- Document the equipment or device engineering and/or serial numbers.
- Remove the equipment from use and tag as defective.
- Notify the patient's physician as appropriate.
- Notify safety, risk management, and the appropriate response department.
- Complete an incident report as required by the policies but within 24 h.
- The facility must file the report with the manufacturer or the FDA within 10 days.

Other Reporting Requirements

The FDA mandates the reporting and tracking of designated devices. The designated devices include vascular grafts, ventricular bypass devices, pacemakers, and implant-type infusion pumps. The act requires that the receipt of tracked devices be reported to the manufacturer and that patient demographic and medical information be reported to the manufacturer upon implanting or use of the device within 5 working days. This enables the manufacturer to trace specified medical devices to patients and to facilitate patient notification and/or device recall.

Equipment Control and Asset Management

Every medical treatment facility should develop policies and processes on equipment control and asset management. Equipment control and asset management involve the management of medical devices within a facility and may be supported by automated information systems. Equipment control begins with the receipt of a newly acquired equipment item and continues through the item's entire life cycle. Newly acquired devices should be inspected by in-house or contracted biomedical equipment technicians (BMETs), who should establish an equipment control or asset number against which maintenance actions are recorded. This is similar to creating a new chart for a new patient that will be seen at the medical facility. Once an equipment control number is established, the device is safety inspected and readied for delivery to clinical and treatment areas in the facility. Facilities or healthcare delivery networks may rely on a combination of equipment service providers such as manufacturers, third-party services, in-house technicians, and remote support. Equipment managers must take responsibility for continuous oversight and responsibility for ensuring safe and effective equipment performance through full service maintenance. Medical equipment managers must exercise responsibility for technology assessment, planning, and management in all areas within a medical treatment facility.

Work Order Management

Work order management involves systematic, measurable, and traceable methods to all acceptance/initial inspections, preventive maintenance, and calibrations or repairs by generating scheduled and unscheduled work orders. Work order management may be paper-based or computer-based and includes the maintenance of active (open or uncompleted) and completed work orders that provide a comprehensive maintenance history of all medical equipment devices used in the diagnosis, treatment, and management of patients. Work order management includes all safety, preventive, calibration, test, and repair services performed on all such medical devices. A comprehensive work order management system can also be used as a resource and workload management tool by managers responsible for personnel time, total number of hours technicians spent working on equipment, maximum repair dollars for one-time repair, or total dollar allowed spending repairing equipment versus replacement. Post-work-order quality checks involve one of two methods: 100% audit of all work orders or statistical sampling of randomly selected work orders. Randomly selected work orders should place more stringent statistical controls based on the clinical criticality of the device involved. For example, 100% of items critical to patient treatment but only 50% of ancillary items may be selected for sampling. Track all work orders and immediately correct all discrepancies.

Data Quality Management

Data quality initiatives can help to ensure the accuracy of clinical/biomedical engineering data. The data needed to establish basic, accurate, maintainable automated records for medical equipment management include nomenclature, manufacturer, nameplate model, serial number,

acquisition cost, condition code, and maintenance assessment. Other useful data could include warranty, location, other contractor agencies, scheduled maintenance due dates, and intervals. These fields prove vital to ensure appropriate maintenance, equipment accountability, and are safe for use in patient care.

Patient Safety

The Joint Commission publishes annual lists detailing *National Patient Safety Goals* to be implemented by healthcare organizations. The commission publishes goals developed by experts in patient safety, nurses, physicians, pharmacists, risk managers, and other professionals with patient-safety experience in a variety of settings. Patient safety is among the most important goal of every healthcare provider, and participation in a variety of committees and processes concerned with patient safety provides a way for biomedical managers and clinical engineering departments to gain visibility and positively affect their workplace.

Risk Management

Risk management can help a medical treatment facility to avoid the likelihood of equipment-related risks, minimize liability of mishaps and incidents, and stay compliant with regulatory reporting requirements. The best practice is to use a rating system for every equipment type. For example, a risk-rating system might rate defibrillators as high risk, general-purpose infusion pumps as medium risk, electronic thermometers as low risk, and otoscopes as no significant risk. This system could be set up using Microsoft Excel or Access for a manager's or technician's quick reference. In addition, user error, equipment abuse, and no-problem/no-fault found occurrences must be tracked to assist risk management personnel in determining whether additional clinical staff training must be performed.

Medical Equipment Inventory Inclusion Criteria

The hospital uses the following risk criteria, at a minimum, for identifying, evaluating, and creating an inventory of equipment to be included in the medical equipment management plan before equipment is used: equipment function, physical risks, equipment history, maintenance requirements, and environment of use. Clinical engineering uses the AIMS database to inventory and assist in equipment evaluation and risk stratification.

Medical Equipment Maintenance

In order to achieve effective, safe, and reliable operation of all equipment in the inventory, the hospital uses interval-based inspections and preventive maintenance, corrective maintenance, or metered maintenance strategies. Model-specific strategies and preventive maintenance procedures developed for this equipment based on the risk stratification, the AHA Manual for Medical Equipment, manufacturer guidelines, and NFPA or ANSI standards.

Maintenance Intervals

Clinical engineering defines the time intervals based on manufacturer's recommendations, risk levels, and current hospital experience. Clinical engineering uses the AIMS database to define and maintain the preventive maintenance and inspection intervals on appropriate equipment in the inventory, automatically generating interval-based inspection and preventive maintenance work orders monthly.

Monitoring and Reporting Incidents as Required by the SMDA of 1990

Equipment malfunctions contributing to patient death or injury are reported to patient safety. Patient safety, with the aid of legal and risk management, should determine if it is appropriate to report the device-related adverse event to the FDA.

Emergency Procedures

Provide clinicians access to spare or substitute equipment that they can use in an emergency, either on their floor or a neighboring floor. Medical equipment considered critical to patient safety includes life-support, life-sustaining, or other critical equipment whose malfunction or failure may result in an adverse patient outcome or may require processes for emergency procedures in the event of failure. Train clinicians to know when and how to perform these emergency clinical interventions.

Medical Equipment Maintenance, Testing, and Inspection

Clinical engineering should use AIMS database to maintain a current, accurate, and separate inventory of all equipment identified in the medical equipment management plan, regardless of ownership. During scheduled inspections, verify the accuracy of the inventory.

Documentation of Acceptance Testing

Before any new equipment is initially put into use, it is tested for safety and performance according to established procedures. The inventory information and acceptance testing are documented in the AIMS database.

Documentation of Maintenance of Life-Support Equipment

Clinical engineering identifies life-support equipment in the AIMS database. The definition of life-support equipment adopted by clinical engineering is "medical devices intended to sustain life and whose failure to perform its primary function, when used according to manufacturer's instructions and clinical protocol, is expected to result in imminent death in the absence of immediate intervention." The maintenance of life-support equipment receives the highest priority in the medical equipment management efforts. The inspection schedule compliance goal is 100%.

Documentation of Maintenance of Non-Life-Support Equipment

Clinical engineering maintains non-life-support equipment according to a maintenance plan. This maintenance is documented. Maintain inspection and service records in the AIMS database. Use these records to determine inspection intervals, based on an analysis of the history of failures during scheduled inspections. Adjust the inspection schedule to meet any requirements for preventive maintenance.

Documentation of Performance Testing of Sterilizers

Test the performance of sterilizers and reprocessors according to the procedures outlined by the equipment manufacturers and individual departmental procedures. Testing results on equipment used in the sterilization of devices used for patient procedures are reported to the infection control department on a monthly basis. Testing results on equipment used in the autoclaving of waste prior to disposal.

Documentation of Testing Water Used in Renal Dialysis

Test water used for the dialysis unit according to AAMI standards. Document testing and ensure infection control monitors the testing. Report significant water quality issues to facility management.

Evaluation/Effectiveness

Reports can be run at any time to show the effectiveness of the medical equipment management plan. Using these reports, clinical engineering should report quarterly to the medical equipment management committee and to the safety committee on the effectiveness of the plan. Any changes to the plan should be made with the goal of minimizing the clinical and physical risks identified in the plan. The medical equipment management subcommittee evaluates the medical equipment management plan annually based on established criteria. Measure the scope, objectives, performance, and effectiveness of the plan against Joint Commission standards.

Clinical Engineers

The American College of Clinical Engineering (ACCE) maintains an established code of ethics. Clinical engineers, whether employed in hospitals or elsewhere, understand that the opportunity to practice in healthcare carries the responsibility to always give one's best, maintain appropriate discretion, and keep the well-being of the patient as the highest priority. Don't confuse clinical engineers with BMETs. BMET personnel provide direct support, service, and repair of the medical equipment in the hospital. BMET education and training focuses more directly on technical issues and requires specific schooling in service to the equipment. BMET personnel answer the call when medical equipment fails to function properly and must work closely with nurses, other hospital staff, and vendors to service and maintain the equipment. These men and women install, inspect, maintain, repair, calibrate, modify, and design biomedical equipment and support systems to adhere to medical standard guidelines. BMETs educate and advise staff and other agencies on the theory of operation, basic physiological principles, and safe clinical application of biomedical equipment maintaining the facility's patient care and medical staff equipment. Examples of different areas of biomedical equipment technology include the following: radiographic and fluoroscopic x-ray, diagnostic ultrasound, lasers, mammography, telemedicine, film image processing, nuclear medicine, gamma cameras, positron emission tomography (PET), medical imaging, computed tomography (CT), electron microscope, picture archiving and communication systems (PACS), magnetic resonance imaging instrument (MRI scanner), physiological monitoring, sterilization, dental, optometry, surgical, anesthesia, laboratory, dialysis, respiratory services (ventilators) computers, information technology, patient monitoring, and cardiac diagnostics. BMETs work closely with the nursing staff and medical material personnel to obtain parts, supplies, and equipment and even closer with facility management to coordinate equipment installations requiring certain facility requirements/modifications.

FDA Safety Communication: Cybersecurity for Medical Devices and Hospital Networks

In June 2013, the FDA recommended that medical device manufacturers and healthcare facilities take steps to assure that appropriate safeguards reduce the risk of failure due to cyber-attack, which could be initiated by the introduction of malware into the medical equipment or unauthorized access to configuration settings in medical devices and hospital networks. Many medical devices contain configurable embedded computer systems that can be vulnerable to cybersecurity breaches. In addition, as medical devices become increasingly interconnected, via the Internet, hospital networks, other medical device, and smartphones, there is an increased risk of cybersecurity breaches, which could affect how a medical device operates. Recently, the FDA has become aware

of cybersecurity vulnerabilities and incidents that could directly impact medical devices or hospital network operations, including

- Network-connected/configured medical devices infected or disabled by malware
- The presence of malware on hospital computers, smartphones, and tablets, targeting mobile devices using wireless technology to access patient data, monitoring systems, and implanted patient devices
- Uncontrolled distribution of passwords, disabled passwords, and hard-coded passwords for software intended for privileged device access
- Failure to provide timely security software updates and patches to medical devices and networks and to address related vulnerabilities in older medical device models
- Security vulnerabilities in off-the-shelf software designed to prevent unauthorized device or network access, such as plain-text or no authentication, hard-coded passwords; documented service accounts in service manuals; and poor coding/SQL injection

The FDA continues to work closely with other federal agencies and manufacturers to identify and mitigate vulnerabilities and incidents as they are identified. Many medical devices contain configurable embedded computer systems that can be vulnerable to cybersecurity breaches. Manufacturers must remain vigilant about identifying risks and hazards associated with their medical devices, including risks related to cybersecurity. The FDA expects medical device manufacturers to take appropriate steps to limit the opportunities for unauthorized access to medical devices. Specifically, recommend that manufacturers review cybersecurity practices and policies to assure that appropriate safeguards prevent unauthorized access or modification to their medical devices or compromise of the security of the network that may connect to the device. The extent of security controls depends on the medical device, environment of use, type and probability of the risks, and probable hazards to patients from a security breach. When evaluating devices, consider the following:

- Steps taken to limit unauthorized device access to trusted users only, particularly for those devices that function in life-sustaining or could directly connect to networks.
- Protect individual components from exploitation and develop strategies for active security protection appropriate for the device's use environment. Such strategies should include timely deployment of routine, validated security patches and methods to restrict software or firmware updates to authenticated code. *Note: The FDA typically does not need to review or approve medical device software changes made solely to strengthen cybersecurity.*
- Use design approaches that maintain a device's critical functionality, even during security compromises, known as *fail-safe modes*.
- Provide methods for retention and recovery after an incident with security compromises. Cybersecurity incidents can occur, and manufacturers should consider incident response plans that address the possibility of degraded operation and efficient restoration and recovery.

When evaluating network security, hospitals and healthcare facilities should consider the following:

- Restricting unauthorized access to the network and networked medical devices.
- Making certain appropriate antivirus software and firewalls are up-to-date.
- Monitoring network activity for unauthorized use.
- Protecting individual network components through routine and periodic evaluation, including updating security patches and disabling all unnecessary ports and services.
- Contacting the specific device manufacturer for a cybersecurity problem related to a medical device.

- When unable to determine or contact the manufacturer, the FDA and DHS ICS-CERT may assist in vulnerability reporting and resolution.
- Developing and evaluating strategies to maintain critical functionality during adverse conditions.

HEALTHCARE SECURITY

Healthcare facilities must establish a zero-tolerance philosophy regarding personnel and property security including physical violence. Any effective hospital-wide security function must place a strong emphasis on the employment of adequate human and physical resources to protect the facility and people from suspicious, dangerous, or illegal activities. The security coordinator should develop, implement, and monitor a comprehensive security management function. The security function must provide a variety of services focused on safeguarding and improving the physical security of patients, staff, and visitors while protecting the rights of individuals in accordance with all applicable laws. Security personnel must conduct regular patrolling of hospital campus and buildings. Security personnel should maintain a close liaison with local law enforcement officials and report/investigate any suspicious or criminal activity. The security function must also conduct traffic control during emergency operations plan implementation and during normal operations of the hospital. An important objective involves controlling patient and visitor access to the emergency department and other hospital areas. The security function must also serve as goodwill ambassadors by providing assistance to employees and visitors with problems such as dead batteries or *lost* children. Security must report and assess all potential security concerns and identify incidents and issues for investigation and follow-up.

NFPA 99-2012, Security Management (Chapter 13)

The newly revised Chapter 13 addresses security issues in emergency departments, pediatric locations, infant care units, medication storage locations, clinical labs, forensic patient treatments areas, and behavioral units. The chapter also addresses communications, data infrastructure, and security of medical/health records. Chapter 13 covers media relations, crowd control, employee practices, and security operations. Facilities must conduct a security vulnerability analysis and planning for the protection of people and resources beyond a disaster event. Security education should address customer relations, emergency procedures, use of force issues, importance of effective de-escalation of tense tactics, and restraint usage. The new code requires the development of policies, plans, and procedures to address hostage situations, bomb threats, workplace violence, disorderly conduct, and restraining order policies.

Resources

The hospital must allocate and dedicate adequate physical and human resources to provide a reasonable level of protection from illegal acts. These physical resources could include the following things such as two-way radio monitoring stations and security personnel. Silent *panic* alarms located in emergency department can provide for faster response. The issuance of identification (ID) cards for employees, volunteers, physicians, ministers, and others requiring access can greatly improve security. Human resources can improve security by ensuring sufficient staffing of security personnel during overnight shifts and at times when there are other security-related concerns.

Incident Reporting

Leaders must require that all hospital employees report all suspicious individuals and activities to the appropriate security function or office for dispatch of security response personnel. Maintain

accurate logs for all calls and dispatches. Ensure a management review of all security incident reports completed by response personnel. Submit these reports to the chief or coordinator of security management. Report any incident resulting in injury to an individual, any assault on a hospital patient (whether an injury results or not), and any incident involving the brandishing or use of a weapon immediately to security and hospital leadership or nurse supervisor. Recommend that all reports be analyzed and appropriate information provided to the safety and/or risk management committees. The appropriate committee would then present a summary report of security issues to the governing board at least on an annual basis. Provide an evaluation of the objectives, scope, performance, and effectiveness of the security plan to the EOC director and/or committee on an annual basis.

Property Protection

Part of the security function involves safeguarding hospital and individuals' property. Encourage patients to send valuables and other personal property home.

Patients receive written information about safeguarding their belongings upon admission. Require hospital employees to report any theft of which they become aware and any individual carrying objects or packages that appear to belong to the hospital. Searches of patients and visitors' persons or possessions may not be conducted by hospital security personnel. The hospital must investigate all thefts and other criminal acts reported. The organization should support the prosecution to the full extent of the law when a suspect is charged with a crime committed on hospital property.

Sensitive Area Access

The hospital must restrict and protect access to the facility including sensitive areas. All exterior doors with the exception of the emergency department lobby and ambulance entrance doors must be locked 24 h or locked during certain hours in accordance with specific policy. Security personnel must make rounds to verify locked doors. Report unlocked doors and investigate as required. Security personnel must conduct periodic walk-through tours of construction areas unless the contractor employs construction site security officers. Sensitive areas should install additional controls such as fire stairwell alarms. Control patient flow in the emergency department through access (door) controls and intercom communication. Keep pharmacy doors locked at all times and limit the number of personnel with access. Locate medication rooms throughout the hospital in very visible areas near nursing stations and keep doors locked at all times.

Identification of Patients, Visitors, and Staff

The hospital must provide ID badges to all employees and volunteers. Outside contractors/vendors whose employees visit the hospital must use hospital-issued ID cards. Other vendors should report to materials management/purchasing prior to visiting other departments. Visitors who seek to enter the hospital after regular visiting hours must be screened by security. Provide for only one public entrance after 9:00 p.m. Suggest issuing color-coded visitor passes with the intended destination noted on it. Encourage all personnel to report any suspicious individuals seen on a hospital campus. Dispatch security personnel to question such individuals and escort them off hospital grounds.

Traffic Control and Vehicle Access

The hospital must maintain designated traffic and parking controls. These controls include establishing fire lanes and crosswalks, posting speed limits, providing handicapped parking areas, and placing *no parking* signage in appropriate areas. The emergency department should provide a

separate ambulance entrance and loading area. Security personnel must regularly patrol this area and other loading zones and fire lanes. When necessary, locate drivers leaving vehicles unattended and require them to move the vehicles.

Weapons on Campus

Establish a firearms policy for the entire campus including a policy for all security personnel.

Security personnel authorized to carry a firearm must know the deadly force policy. The only occasion in which an officer should use a firearm is if he or she believes it is the only way that an individual can be stopped before using deadly force against another person. The hospital should define weapons as firearms (including air guns), knives (other than ordinary penknives and pocketknives), explosives, and any other deadly weapon as determined by the hospital. Publish policies and procedures for reporting and informing visitors, patients, and employees of this policy. (Noncompliant individuals will be asked by security to leave the hospital grounds.) Train security personnel to restrain violent individuals and do so upon request of nursing personnel/physicians or when, in their professional judgment, restraint is necessary to protect others.

Handling Civil Disturbances

Determine if security personnel can make arrests or must call local law enforcement authorities for assistance. Ban unwanted visitors and arrest violators for trespassing. Use additional security to seal off areas of the hospital such as the emergency department and screen anyone wishing to enter.

Handling Situations Involving *VIP*s or the Media

Plan to handle situations that might result in an influx of media representatives, a large patient *entourage* (e.g., secret service personnel accompanying a federal officer) and/or large numbers of curious onlookers. Additional security personnel should be called in as needed by the administrator on duty. Contact local law enforcement authorities and/or use private security firms as needed.

Access and Crowd Control

Access control will depend in part on what area of the hospital that is affected. Officers can be stationed at each unlocked hospital entrance to screen visitors and issue incident-specific visitor passes. Plant operation personnel can be utilized to help set up physical barriers/controls as needed. Facilities not operating an isolated *patient suite* can limit access to certain areas/floors by way of guards. Hospital personnel can help detect and deter unauthorized attempts to gain access.

Communications

Consider using the hospital's board room as a media work center. Facilities should provide a dedicated phone line cable in that area for such situations. An alternative site for media work space is the cafeteria or a dining area. The hospital telephone system allows for blocking calls to specific patient rooms.

Orientation and Education

Security personnel and other identified staff members should undergo appropriate education and training to ensure they possess and maintain the skills and knowledge necessary to safeguard the security of patients, visitors, and staff. All hospital employees must receive instruction of security issues as part of their general orientation. This includes instruction on how to report security

incidents involving patients, visitors, and employees and how to summon security assistance. In addition, employees in security-sensitive areas of the hospital receive additional education in their departments to identify specific mechanisms or procedures designed to minimize security risk.

Evaluation of Security

Security personnel must conduct ongoing assessments of security needs and issues. The safety and/or the care environment committees should establish performance standards and review effectiveness annually. The review should address the following areas:

- Staff security management knowledge and skill
- Level of staff participation in security management activities
- Security monitoring and inspection activities
- Detailed security and incident reporting procedures communicated
- Inspection, preventive maintenance, and testing of security equipment

Using Proven Practices to Improve Security

Hospital security professionals today better understand how to manage security risks than at any time in history. Increased and changing risks can compromise the effectiveness of security operations. OSHA workplace safety regulations, Joint Commission, or other accreditation standards provide guidance on minimum requirements. Other organizations such as ASIS, International Association of Healthcare Safety and Security (IAHSS), and NFPA also provide information on practices and guidelines that can help hospitals provide excellent security services. Learn from the successes—and mistakes—of other hospitals. Look for ways to improve security department capacity, reduce compensation expenses through better scheduling and management, and improve security officer recognition/performance.

Forensic Patients

Classify forensic patients into four categories: medical clearance, police hold, police custody, and emergency detention. The following four examples comprise the majority of forensic patients who interact with the general public every day in hospitals. Hospitals should run a risk assessment on police hold patients prior to intake. Hospitals must maintain responsibility for all patients and retain the right to ask how much of a danger a given patient presents to their facility. Healthcare security officers should continuously evaluate the status of forensic patients throughout their shift. All information on these patients should be passed on to relieving shifts. If possible, methods of tracking and flagging forensic prisoners should be integrated into the registration process. Nursing staff should report any concerns or suspicious activities involving their forensic patients.

Workplace Violence Prevention (NIOSH Publication No. 2002-101)

All hospitals should develop a comprehensive violence prevention plan. No universal strategy exists to prevent violence. The risk factors vary from hospital to hospital and from unit to unit. Hospitals should form multidisciplinary committees that include direct care staff as well as union representatives (if available) to identify risk factors in specific work scenarios and to develop strategies for reducing them. All hospital workers should be alert and cautious when interacting with patients and visitors. They should actively participate in safety training and be familiar with their employers' policies, procedures, and materials on violence prevention. The NIOSH defines workplace violence as "violent acts (including physical assaults and threats of assaults) directed toward persons at work or on duty." This includes terrorism as illustrated by the terrorist acts of September 11, 2001,

that resulted in the deaths of 2886 workers in New York, Virginia, and Pennsylvania. Although these guidelines do not address terrorism specifically, this type of violence remains a threat to US workplaces. Healthcare and social service workers continue to face significant risk of job-related violence. Assaults represent a serious safety and health hazard within these industries. OSHA's violence prevention guidelines provide recommendations for reducing workplace violence. OSHA suggests developing and following a careful review of workplace violence studies, public and private violence prevention plans with input from stakeholders. OSHA encourages employers to establish violence prevention plans and to track their progress in reducing work-related assaults. Although not every incident can be prevented, many can, and the severity of injuries sustained by employees can be reduced. Adopting practical measures such as those outlined here can significantly reduce this serious threat to worker safety.

Healthcare Worker Safety

Nurses and nursing assistants suffer the most nonfatal assaults resulting in injury. BLS rates measure the number of events per 10,000 full-time workers—in this case, assaults resulting in injury. In 2000, health service workers overall had an incidence rate of 9.3 for injuries resulting from assaults and violent acts. Healthcare workers face an increased risk of work-related assaults stemming from several factors (Tables 11.4 and 11.5). These include

- The prevalence of handguns and other weapons among patients, their families, or friends
- The increasing use of hospitals by police and the criminal justice system for criminal holds and the care of acutely disturbed, violent individuals
- The increasing number of acute and chronic mentally ill patients released from hospitals without follow-up care
- The availability of drugs or money at hospitals, clinics, and pharmacies, making them likely robbery targets
- Factors such as the unrestricted movement of the public in clinics and hospitals and long waits in emergency or clinic areas that lead to client frustration over an inability to obtain needed services promptly
- The increasing presence of gang members, drug or alcohol abusers, trauma patients, or distraught family members

TABLE 11.4
Workplace Violence Prevention

- Create and disseminate a clear policy of zero tolerance for workplace violence, verbal and nonverbal threats, and related actions. Ensure that managers, supervisors, coworkers, clients, patients, and visitors know about this policy.
- Ensure that no employee who reports or experiences workplace violence faces reprisals.
- Encourage employees to promptly report incidents and suggest ways to reduce or eliminate risks. Require records of incidents to assess risk and measure progress.
- Outline a comprehensive plan for maintaining security in the workplace. This includes establishing a liaison with law enforcement representatives and others who can help identify ways to prevent and mitigate workplace violence.
- Assign responsibility and authority for the prevention efforts to individuals or teams with appropriate training and skills. Make adequate resources available for this effort and that the team or responsible individuals develop expertise on workplace violence prevention in healthcare and social services.
- Affirm management commitment to a worker-supportive environment that places as much importance on employee safety and health as on serving the patient or client.
- Set up a company briefing as part of the initial effort to address issues such as preserving safety, supporting affected employees, and facilitating recovery.

TABLE 11.5
Elements of Violence Prevention

- Management commitment and employee involvement
- Worksite analysis
- Hazard prevention and control
- Safety and health training
- Recordkeeping and evaluation

- Low staffing levels during times of increased activity such as mealtimes, visiting times, and when staff must transport patients
- Isolated work with clients during examinations or treatment
- Solo work, often in remote locations with no backup or way to get assistance, such as communication devices or alarm systems
- Lack of staff training in recognizing and managing escalating hostile and assaultive behavior
- Poorly lighted parking areas

Management Commitment and Employee Involvement

Management commitment and employee involvement remain the essential elements of effective safety and health plans. Management and frontline employees must work together, perhaps through a team or committee approach. If employers opt for this strategy, they must be careful to comply with the applicable provisions of the National Labor Relations Act. Employee involvement and feedback enable workers to develop and express their own commitment to safety and health and provide useful information to design, implement, and evaluate the efforts. A worksite analysis involves a step-by-step, commonsense look at the workplace to find existing or potential hazards for workplace violence. This entails reviewing specific procedures or operations that contribute to hazards and specific areas where hazards may develop. A threat assessment team, patient assault team, similar task force, or coordinator may assess the vulnerability to workplace violence and determine the appropriate preventive actions to be taken. This group may also be responsible for implementing the workplace violence prevention plans. The team should include representatives from senior leadership, risk management, security, safety and health, and human resources. The team or coordinator should periodically inspect the workplace and evaluate employee tasks to identify hazards, conditions, operations, and situations that could lead to violence. After identifying hazards through the systematic worksite analysis, the next step is to design measures through engineering or administrative and work practices to prevent or control these hazards. If violence does occur, postincident response can be an important tool in preventing future incidents. Engineering controls remove the hazard from the workplace or create a barrier between the worker and the hazard. Base the selection of any control measure on the hazards identified in the workplace. Administrative and work practice controls affect the way staff perform jobs or tasks. Changes in work practices and administrative procedures can help prevent violent incidents.

Postincident response and evaluation can help prevent future violence. All workplace violence efforts should provide comprehensive treatment for employees victimized personally or traumatized by witnessing a workplace violence incident. Injured staff should receive prompt treatment and psychological evaluation whenever an assault takes place, regardless of its severity. Provide the injured transportation to medical care if not available onsite.

Every employee should understand the concept of *universal precautions for violence*—that is, that violence should be expected but can be avoided or mitigated through preparation. Frequent training also can reduce the likelihood of being assaulted. Employees who may face safety and

security hazards should receive formal instructions on the specific hazards associated with the unit or job and facility. This includes information on the types of injuries or problems identified in the facility and the methods to control the specific hazards. It also includes instructions to limit physical interventions in workplace altercations whenever possible. In addition, train all employees to behave compassionately toward coworkers when an incident occurs. Training and education should involve all employees, including supervisors and managers. New and reassigned employees should receive an initial orientation before being assigned their job duties. Visiting staff, such as physicians, should receive the same training as permanent staff. Qualified trainers should instruct at the comprehension level appropriate for the staff. Effective training should involve role playing, simulations, and drills. Employees should receive required training annually. In large institutions, refresher education may be needed more frequently, perhaps monthly or quarterly, to effectively reach and inform all employees.

Supervisors and managers need to learn to recognize high-risk situations to ensure not placing employees in assignments that compromise their safety. They also need training to ensure that they encourage employees to report incidents. Supervisors and managers should learn how to reduce security hazards and ensure that employees receive appropriate training. Following training, supervisors and managers should be able to recognize a potentially hazardous situation and to make any necessary changes. Security personnel need specific training from the hospital or clinic, including the psychological components of handling aggressive and abusive clients, types of disorders, and ways to handle aggression and defuse hostile situations. Training sessions should also provide an opportunity for an evaluation. At least annually, the team or coordinator responsible for the plan should review its content, methods, and the frequency of training. Plan evaluation may involve supervisor and employee interviews, testing, and observing and reviewing reports of behavior of individuals in threatening situations.

American Society of Industrial Security

Founded in 1955, American Society of Industrial Security (ASIS) promotes the professionalism of private security. ASIS develops educational sessions and materials that address a broad range of security topics. ASIS also conducts an annual professional development conference for its more than 30,000 members. Under the broad definition commonly used today, the term *private security* can represent a wide range of organizations, including corporate security, security guard companies, armored car businesses, investigative services, and many others. Personnel hired by these companies can serve in armed or unarmed positions. According to ASIS, proprietary security refers to any organization or department of that organization that provides full-time security officers solely for itself. Private security officer selection and training criteria vary from state to state ranging from comprehensive training requirements for every private security officer to little or no training for private security officers. Effective security today requires workers to understand all aspects of a facility's security system for assessing and containing potential threats. Security officers must understand emergency procedures, hazard control management principles, accident prevention concepts, and investigation techniques. They must also work closely and effectively with public safety personnel including first responders. The ability to protect the nation's critical infrastructure and contribute to homeland security efforts depends largely on the competence of private security officers (Table 11.6).

International Association of Healthcare Safety and Security (IAHSS) Standards

Develop a security plan consistent with the organizational environment. Consideration should be given but not limited to moral and legal responsibilities, vehicular and pedestrian traffic, neighborhood crime rate, frequencies of police patrol, and response capability. Organizations must also

TABLE 11.6
ASIS Defined *Core Elements* of Private Security Education

1. Physical security
2. Personnel security
3. Information systems security
4. Investigations
5. Loss prevention
6. Risk management
7. Legal aspects
8. Emergency and contingency planning
9. Fire protection
10. Crisis management
11. Disaster management
12. Counterterrorism
13. Competitive intelligence
14. Executive protection
15. Workplace violence
16. Crime prevention
17. Crime prevention through environmental design
18. Security architecture and engineering

consider the perceptions of patients, employees, visitors, and vendors. Each healthcare organization should designate a person to manage security functions. Preferably, the director or manager works in a full-time position. Issue easily read hospital ID badges to all hospital employees and approved medical staff. Badges should contain a photograph, job title, and department and employee ID number. Wearing of the ID badge must be required whenever an employee is on hospital property. Develop standardized key and locking policies for use throughout the facility. The key system should be designed to provide optimum retrieval and tracking of issued keys. Design the key system to accommodate anticipated facility expansion and upgrade or evaluate every 5 years. Maintain a security operations plan that contains a written statement addressing the scope, responsibilities, activities, and functions of protection efforts. The plan should also contain a written directive from the chief operating officer designating the specific administrative officers responsible for security. All hospitals employing either full-time or part-time security officers should maintain a record of training activities. This record should contain, as a minimum, the date of training, subject matter of the training, length of training, and the instructor's name and affiliation. This individual training record shall be maintained as long as the security officer is employed and for 5 years following termination of a security officer. The security officer should furnish a copy of the training record upon termination.

REVIEW EXERCISES

11.1 List five potential hazards found in central sterile operations.
11.2 What causes most ETO exposure events in central sterile operations?
11.3 What type of exposures to bloodborne pathogens would most likely occur in central sterile operations?
11.4 What two opportunistic infection risks can occur when medical instruments are stored wet after being cleaned?

11.5 List the vital aspects of medical supply management.
11.6 List at least nine issues or elements that should be addressed in a medical equipment management plan.
11.7 List the four basic elements of medical equipment risk assessment.
11.8 Describe the SMDA reportable event requirements.
11.9 What key security issues are addressed in NFPA 99-2012, Security Management, Chapter 13?
11.10 List five aspects that should be addressed in a healthcare security assessment.
11.11 Describe the five key elements of an effective violence prevention plan.

12 Nursing and Clinical Area Safety Topics

PATIENT CARE AREA HAZARDS

Many healthcare leaders overlook many of the safety and health concerns of healthcare personnel. Workplace stressors can contribute to disease and risk of injury in patient care environments. Stressors include factors related to tasks, organizational dynamics, and constant changes occurring in healthcare settings. Nursing personnel can experience significant physical and psychological demands during accomplishment of patient care duties. Nursing hazards can include stress and risk of infections. Leaders must understand the physical job demands such as patient lifting, working awkward postures, needlestick risks, chemical exposures, and potential workplace violence incidents. Healthcare organizations in the United States employ more than two million registered nurses. Organizations also employ more than three million practical nurses, vocational nurses, and nursing assistants. Long working hours can result in simple fatigue that can hinder patient safety efforts. Leaders should consult frontline nursing personnel when working to identify processes contributing to adverse patient events and medical errors. Senior leaders must also find ways to orient and educate nursing personnel about safety-related issues (Tables 12.1 and 12.2).

Bloodborne Pathogens

The OSHA Bloodborne Pathogens Standard requires workers to take precautions when dealing with blood and OPIMs. Implement engineering and work practice controls to eliminate or minimize exposure to bloodborne pathogens. Engineering controls can reduce employee exposure either by removing, eliminating, or isolating a hazard. Ensure employees wear appropriate PPE or clothing such as gloves, gowns, and face masks.

Ensure employees properly discard contaminated needles and other sharp instruments immediately or as soon as feasible. Consider all blood and other potentially infectious body fluids as infected. The Bloodborne Pathogens Standard does allow healthcare organizations to use acceptable alternatives to universal precautions. Consider using CDC Standard Precautions or body substance isolation techniques as appropriate for the setting. Safer needle devices must contain integrated safety features designed to prevent needlestick injuries. OSHA considers safer needle devices as passive or active. Passive needle devices offer the greatest protection because they contain safety features that automatically trigger during use. Consider a spring-loaded retractable syringe or self-blunting blood collection device as passive. Intervention studies show that the use of safer needles systems can reduce injuries.

Hazardous Material Safety

Hazardous chemical exposures can occur from aerosols, gases, and skin contaminants. Exposures can occur on an acute basis or result from chronic long-term exposures. Some substances, commonly used in the healthcare setting, can cause asthma or trigger attacks. Studies indicate scientific evidence linking cleaners and disinfectants, sterilants, latex, pesticides, volatile organic compounds, and pharmaceuticals to asthma. Many medications and compounds used in personal care products have known toxic effects. Although many medications pose hazards to workers,

TABLE 12.1
Caregiver Safety Tips

- Follow good hand hygiene practices.
- Use proper equipment and techniques to prevent sharps injuries.
- Use PPE.
- Wear appropriate footwear.
- Use safe patient moving techniques and lift assist devices.
- Avoid awkward positions.
- Take frequent breaks when doing repetitive tasks.
- Ensure the organization provides job stress assistance and counseling.
- Keep patient areas, hallways, and egress passages clutter-free.
- Adhere to all published safety practices.
- Wear appropriate monitoring devices when working near ionizing radiation.
- Understand fire and life safety rules, procedures, and policies.

TABLE 12.2
Nursing Safety Education and Training Topics

- Bloodborne pathogens and infection risks
- Standard precautions and hand washing requirements
- How to select, use, maintain, and store PPE
- Methods and engineering innovations to prevent needlestick injuries
- Patient and material handling or lifting techniques
- Protections against workplace violence
- How to work safely with compressed gases
- Fire, emergency response, and evacuation procedures
- Hazard, accident, and injury reporting procedures
- Hazardous substance safety including the location, availability, and use of SDSs
- Medical equipment procedures and adverse event reporting
- Patient safety issues relevant to the job assignment

those most commonly identified as hazardous to healthcare workers include antineoplastic drugs and anesthesia substances. Anesthetic gases can pose problematic challenges when escaping and creating occupational inhalation hazards.

Nursing Personnel and Workplace Violence

A recent survey of nurses and physicians revealed that about three-fourths of the respondents reported witnessing physicians engage in disruptive behaviors. Most of the incidents involved verbal abuse of another staff member. OSHA considers these types of issues as workplace violence. The same survey revealed that about two-thirds of respondents witnessed disruptive nurse behaviors. Most respondents believed that such unprofessional actions increase potential for medical error occurrence. Disrespectful behavior and in some cases physical violence by physicians can contribute to nursing dissatisfaction. Physicians practicing in high-stress specialties such as surgery, obstetrics, and cardiology appear more at risk to disruptive behaviors. The Joint Commission requires that organizations develop a code of conduct policy for all staff. The Joint Commission also recommends a *zero-tolerance* approach to all disruptive behaviors. The Joint Commission issued a Sentinel Event Alert to address the seriousness of these risks. Patient and family assaults on healthcare workers

can occur, especially during times of increased stress. Poor workplace security and unrestricted movement by the public in the facility can increase these types of risks. Emergency department personnel also face significant risks from assaults by patients or their families. Those carrying weapons in emergency departments create the opportunity for severe or fatal injuries. However, no location within a healthcare setting is immune from workplace violence. The OSHA publication *Guidelines for Preventing Workplace Violence for Health Care and Social Service Workers* provides an outline for developing a violence prevention plan. Develop performance-based violence prevention plans. Facilities must meet the challenge of developing a specific process that will yield results and protect healthcare personnel. The elements of any prevention plan must include management commitment, employee involvement, worksite analysis, hazard prevention and controls, and training and education.

Helicopter Safety

Many acute care and trauma facilities receive patients brought in by helicopters. Staff responsible for meeting these airborne ambulances must know proper safety procedures. Restrict the heliport to trained and authorized personnel. Personnel should never approach the landing zone until the craft lands. Wait for crew permission before approaching the craft. Require the wearing of hearing protection when aircraft engines run. Prohibit smoking in the heliport area. Personnel should never shine lights directly in front of the aircraft during landing. Approach the craft from the front or side as required but never approach from the rear. Stay in a crouched stance when approaching the aircraft. The wind created by the rotor blades can create hazardous situations due to flying dust, litter, and loose clothing. Place stethoscopes in pockets and secure hats or scarves. Tape sheets securely to the stretcher. Place the portable oxygen bottles so that it does not extend beyond the cart. The flight crew retains responsibility for opening and closing the aircraft doors. In most situations, the flight crew takes responsibility for off-loading the patient. The in-flight crew should direct hospital personnel on proper patient handling. The flight crew provides directions about the departure from the heliport. Not following instructions could result in an IV line being pulled or a change in the patient's skeletal alignment. Off-loading with the rotor blades turning requires caution at all times. Ensure the availability of sufficient fire extinguishers and that all personnel can operate the extinguishers.

Shift Work and Sleep Deprivation

Healthcare organizational leaders, supervisors, and safety personnel should realize that shift work and sleep deprivation affect not only task accomplishment but also personal safety. People function best during daylight hours. Performance is decreased during periods of rapid eye movement (REM). This REM sleep is known as the dream period and normally occurs in the early morning hours. During this period, the body temperature is at its lowest. Humans have what is called *circadian rhythms* or a 24 h body clock. This body clock can vary with individuals but can also receive undue influenced from environmental factors. Shift work and lack of sleep can contribute to health problems or the increase risk of health problems. Shift workers tend to experience high stress levels and family problems. Healthcare organizations should strive to make shift work safer and educate workers on adjustment strategies. Supervisors should know how to evaluate workers. Supervisor must look for the signs of sleep deprivation, stress, and fatigue. Evaluate the relationship between work shifts and personal health. Some factors to consider include the time and length of the work shifts, scheduled days off, demands of the job, personal characteristics, and work environments. Working extended hours increases exposure to environmental, chemical, biological, ergonomic, and psychosocial hazards. Research indicates bright lights in work settings can improve workers' alertness. Some studies indicate that power naps of no more than 35–40 min in length can increase alertness during the sleepiest times of a shift. Taking a short

TABLE 12.3
Sleep Deprivation Educational Topics

- Stress the importance of getting 6–7 h of uninterrupted sleep.
- Explain the importance of sleeping in a dark room free from distractions.
- Provide tips on how to deal with noise during sleep periods.
- Encourage the eating of a nutritious meal during the shift.
- Avoid caffeine late in a shift since it disrupts sleep patterns.
- Address the importance of exercising on a regular basis.

nap before a late night shift can help a person stay alert and awake. Sleepiness occurs most during night shifts. Poor daytime sleeping habits of many shift workers contribute to their on-the-job sleepiness. However, sleeping during the day can interfere with social and family activities. Personnel working long or extended shifts must consider ways to better cope with fatigue, lack of sleep, and family situations. The IOM recommends that nurses work no more than 60 h in a 7-day period and no more than 12 h on a single day. Most nurses working 12 h shifts tend to lose alertness during the last 2 h of their schedule (Table 12.3).

Job Stress

Healthcare workers experience stress complicated by understaffing, paperwork, tight schedules, equipment malfunctions, demanding families, dependent patients, and even death. Some workers feel that the depersonalized nature of healthcare leaves them feeling alone, isolated, angry, and frustrated. Stress contributes to worker's apathy, lack of confidence, and absenteeism. Studies have shown that healthcare workers have a high rate of hospital admission for mental disorders. Stress can cause loss of appetite, mental disorders, migraines, sleeping disorders, and emotional instability. It can also increase the use of tobacco, alcohol, or drugs. Stress can affect a person's attitude, motivation, and behavior, which can impact the quality of patient care. Healthcare organizations should educate employees and management about job stress by establishing employee assistance initiatives and organizational change education sessions. Employee assistance initiatives can improve the ability of workers to cope with difficult work situations. Stress management plans should focus on teaching workers about the nature and sources of stress, the effects of stress on their health, and learning personal skills that can help reduce stress (Tables 12.4 and 12.5).

TABLE 12.4
Common Healthcare Worker Stress Factors

- Understaffing and unbearable workload
- Inadequate resources to accomplish the task
- Working in an unfamiliar area, job, or role
- Rotating work shifts or shifts longer than 8 h
- Little or no input or participation in schedule planning
- No recognition by senior leadership for doing a good job
- Personal talents and expertise not utilized
- Exposure to biological, physical, and chemical hazards
- Increased potential for workplace violence
- Poor departmental or unit organization

TABLE 12.5
Ways to Cope with Stress

- Conduct staff meetings and allow open communication.
- Implement a formal stress management plan.
- Provide accessible counseling from a nonjudgmental source.
- Promote flexibility and creativity within the department.
- Ensure adequate staffing and sufficient resources.
- Organize work areas and departments to function efficiently.
- Work to provide reasonable and flexible work schedules.
- Emphasize the importance of worker safety and health.
- Provide regular in-service education and training sessions.
- Implement a complaint and suggestion system.

NONCOMPENSATED OR VOLUNTARY WORKER SAFETY

Volunteers work in a variety of capacities in most healthcare organizations. Each volunteer needs training and education on all potential exposure risks. Many organizations limit volunteers from patient contact tasks that could expose them to hazards including bloodborne pathogens. Healthcare organizations using volunteers should provide a comprehensive safety orientation session. Some key education topics should include fire safety, emergency evacuation procedures, infection control precautions, patient safety topics, radiation exposure controls, general safety orientation, hazard identification, and accident reporting procedures.

HOME HEALTH SAFETY

The home healthcare industry personnel encounter a number of hazards not found in traditional healthcare settings. Home healthcare providers spend a great deal of time traveling and enter environments where they have little or no control. Many patients live in unsafe neighborhoods that could expose providers to violence. However, home healthcare providers are exposed to bloodborne pathogen and patient moving hazards much like their hospital counterparts. Nursing aides, nurses, and therapists often work alone with no one to support them in a time of crisis. Home-based healthcare remains unpredictable and the agency must take responsibility for worker safety. Home health personnel must ensure that care plans identify hazards and care requirements. Use well-lighted and common walkways when visiting patients. Instruct patients and family members on the importance of infection control. Always knock or ring doorbell before entering a patient's home. Know injury and emergency reporting procedures and learn to document unsafe behaviors, threats, and menacing pets. If possible, schedule *joint* visits in unsafe neighborhoods or homes. Always request security escorts for night visits in potentially unsafe areas. If threatened, home health personnel should scream, kick, and use chemical spray or a whistle. Lock automobiles and keep in top mechanical condition. Park vehicles as near to the patient's home as possible. Suggested training topics for home health personnel include

- Ways to understand a patient's cultural, economic, and social background
- Ways to understand a patient's mental, emotional, and spiritual needs
- Personal security precautions including travel safety
- How to conduct a hazard assessment during a consultation visit
- Protection guidelines for bloodborne pathogens exposure
- Sharps and needle safety precautions
- Medical waste disposal procedures

- Back injury prevention techniques
- Safe lifting and transfer techniques
- Care plan development to identify risks

MUSCULOSKELETAL INJURIES AND DISORDERS

Changes in healthcare during recent years resulted in increasingly heavy demands on nurses and other healthcare workers. Extended schedules along with increased physical and psychological demands can increase the risk of experiencing musculoskeletal injuries and disorders. Healthcare workers experience more upper extremity worker compensation claims than workers in other industries. Nursing staff levels can impact physical and postural risk factors related to impaired sleep, pain medication use, and absenteeism. Encourage nurses to participate in ergonomics interventions. Traditional methods used to prevent work-related musculoskeletal injuries associated with patient moving include use of proper body mechanics, training personnel about safe lifting techniques, and the use of lumbar support belts. Evidence suggests that these three interventions, by themselves, prevent worker injuries. Many healthcare organizations now follow evidence-based practices such as providing patient handling equipment, implementing no-lift policies, and creating patient lift teams.

Organizations should identify existing and potential ergonomics hazards. Assessment of work tasks must include an examination of duration, frequency, repetition, awkward postures, and magnitude of exposure to force in all lift tasks. Conduct environmental walk-through tours to ask workers about lifting or stressful tasks. OSHA logs and workers' compensation injury reports can provide data related to ergonomics-related hazards. Use administrative controls to ensure adequate staffing. Emphasize the importance of patient or resident assessment to help determine level of risk for lifting, moving, or transferring tasks. Implement engineering controls to help to isolate or remove the hazards by providing proper selection, training, and use of assist devices or equipment. Stress the early identification and treatment of injured employees. Develop a modified or transitional duty plan for workers recovering from an injury. Healthcare personnel experience a great variety of activities involving manual lifting, laterally transferring between two horizontal surfaces, ambulating, repositioning in bed or chair, or manipulating extremities. Healthcare workers can also experience risks when transporting patients or equipment, performing activities related to daily living, stopping falls or transfers from the floor, and assisting in surgery.

Administrative Issues

Conduct a review that evaluates if the equipment is appropriate for the specific lifting or moving activity. The review should involve on-site testing of a variety of equipment by the end users. Provide for the convenient storage of assist and institutional equipment. This can ensure that equipment is easy to find and, in turn, help encourage healthcare workers to use it. Use flexible purchasing procedures that allow for the evaluation and purchase of up-to-date equipment with the most appropriate features. Administrative issues affect the equipment available to employees, the types of work tasks they perform, and the methods of accomplishment.

Equipment Maintenance

A regular maintenance plan can help ensure sufficient quantities of equipment in all units or floors and avoid shortages and breakdowns. Some maintenance-related problems include jammed or worn wheels, which make it harder to move and steer or which cause chairs or other equipment to shift during transfers. Hard-to-reach controls or manual cranks on beds, chairs, or equipment can create risks and cause them to assume awkward postures or make forceful exertions. Handles on beds, carts, or other equipment of the wrong size or placed at an inappropriate height can also contribute to injuries. Missing attachable IV/Med poles can lead to workers awkwardly pushing gurneys or

wheelchairs with one hand and holding free-standing poles with the other hand. Older mechanical lift devices can become hard to operate, uncomfortable, unstable, or even dangerous. High or heavy medical, food, or linen carts can result in unnecessary bending, reaching, or twisting when loading or unloading.

Use systematic preventative maintenance techniques to keep all assist and moving equipment in proper working condition.

Facility Design Issues

Healthcare workers may need to assume awkward postures because rooms, bathrooms, hallways, and other spaces are small or crowded or contain obstructions. These factors may also prevent getting help from other employees or using assist equipment. Poorly maintained floors can cause slipping, tripping, and abrupt movements when lifting or moving patients, residents, or equipment. Well-designed and well-maintained institutional equipment and facilities remain the important factors in reducing or preventing back injuries. Institutional equipment should allow the user to maintain neutral body postures and reduce forceful motions. Beds, wheelchairs, cardiac chairs, and other equipment must be easy to adjust and move. Facilities should provide easy-to-operate equipment.

Mechanical Lift and Assist Devices

Train personnel on lifting equipment and proper procedures before permitting use of mechanical lifting devices. Always explain the lift to the resident or patient before beginning the procedure. Ensure the resident or patient is positioned correctly in the sling before continuing the lift procedure. One person must ensure that the patient remains stable during the entire lifting procedure. Never allow the sling to swing and never leave a patient or resident suspended in the sling. Mechanical assist devices or lifts can help reduce injury by avoiding unnecessary manual transfers, awkward postures, forceful exertions, and repetitive motions.

Understanding the Body

The first seven vertebrae called cervical vertebrae form the neck. Areas of the spine such as the neck where flexible can experience strains and sprains. The shoulder consists of a ball-and-socket joint where the ball of one bone fits into a hollow crevice of another. The shoulder joint allows movement and rotation of the arms inward, outward, forward, or backward. There are several different tendons attached to bones in the shoulder. Bursar reduces friction and cushions the tendons as they slide back and forth. The spine is a column of approximately 30 bones called vertebrae, which run from the neck to the tailbone. These vertebrae stacked on top of one another in a shaped column form spinal joints that move independently. Health spines contain three natural curves: forward curve in the neck, a backward curve in the chest area, and another forward curve in the lower back. The back's three natural curves should align correctly when ears, shoulders, and hips form a straight line. At the end of the spine, the vertebrae fuse together to form the sacrum and the tailbone. The lower back or lumbar area provides the workhorse capacity of the back. It carries most of the weight and load of the body. Aligning and supporting the lumbar curve properly helps prevent injury to vertebrae, discs, and other parts of the spine. The spine contains various types of associated soft tissues like the spinal cord, nerves, discs, ligaments, muscles, and blood vessels. Discs, the soft shock-absorbing cushions located between vertebrae, move smoothly and absorb shock as you move. Each disc contains a spongy center and tough outer rings. The vertebrae are connected by a complex system of ligaments that *knit* them together. Strong flexible muscles maintain the three natural spinal curves and help in movement. The most important muscles that affect the spine include the stomach, hip flexors, hamstrings, buttocks, and back muscles.

Injuries and Disorders

A sprain refers to damage to ligament fibers caused by moving or twisting a joint beyond its normal range. A strain occurs when a muscle or a muscle tendon unit is overused. Bursitis is an irritation of bursae in the shoulders areas caused by rubbing on adjacent tendons. Tendinitis occurs when a tendon is overused and becomes inflamed. When the tendon sheath is involved, the condition is called tenosynovitis. Neck tension syndrome occurs where the last neck vertebra meets the first mudpack vertebra and is a major site of acute back pain, muscle tension, and other injuries. Common symptoms can include muscle tightness, soreness, restricted movement, headaches, and numbness/tingling in the hands, wrists, arms, or upper back. Over time, discs wear out or degenerate from natural aging. The discs dry out and become stiffer and less elastic. The outer fibrous rings can crack and the disc narrows. They become less able to handle the loads put on them.

If the inner jellylike center bulges into the outer rings, it may compress nearby nerves or blood vessels. If the inner jellylike center breaks through the outer rings, the condition is called a ruptured or herniated disc.

Other Back Problems

The lower discs can experience more damage than other discs because they bear most of the load in lifting, bending, and twisting. Sciatica occurs when bulging or ruptured discs constrict the sciatic nerve or nearby blood vessels causing pain to down the hips, buttocks, or legs. Degenerative or osteoarthritis simply means the wearing out of joints, vertebrae, discs, facets, or other structures over time. Osteoarthritis is associated with loads put on the spine over long time periods. As the discs dry out and narrow, they lose their shock-absorbing ability. The vertebrae become closer together and irritated and may produce bony outgrowths. Facet joint syndrome occurs when the facets interlock with the vertebrae above and below to form joints in the spine. The facets can become misaligned from bending, lifting, and twisting while working. Slipped vertebrae occur when the vertebrae in the lower back pushes forward so they don't line up with other vertebrae. This condition disrupts the proper natural curves of the spine and causes joints, ligaments, and muscles to become overburdened. Spinal canal narrowing can occur in the canal that the spinal cord runs through or in the gap at the sides of vertebrae where nerves exit.

Back Injury Prevention

Management and prevention efforts should focus on eliminating lifts wherever possible. Use patient handling, transfer, and lifting equipment. Establish patient lift guidelines to help workers safely assess patient handling situations. Redesign the workplace to increase efficiency and decrease the potential for injuries. Educate workers about back anatomy and personal back care responsibilities. Provide recurring education and training on proper body mechanics and patient transfer techniques. Require employees to participate in exercise and/or stretching routines before lifting. Establish and train two person lift and transfer teams. Use physical or occupational therapy professionals to instruct workers in patient handling techniques. Assess the patient or resident before lifting or moving them. Eliminate or reduce manual lifting and moving of patients or residents whenever possible. Get patients or residents to help as much as possible by giving them clear, simple instructions with adequate time for response. Know your own limits and do not exceed them and get help whenever possible. Never transfer patients when off-balance. Lift loads close to the body. Never permit workers to lift alone. Preferably require team lifting for fallen patients and when using assist devices. Limit the number of allowed lifts per worker per day.

Investigate all accidents and make changes to prevent recurrence. Assign a case management worker to oversee medical treatment and return-to-work efforts. Never move or lift from side to side. Keep items close to the body when reaching, carrying, or lifting. Plan the lift and size up the load to better reduce spine movement. Keep the patient load as close to the body as possible. Ten pounds

at waist height equates to 100 lb force on the back with arms extended away from the body. Bend at the knees when lifting loads from floor level. Ten pounds at floor height with bent knees is equal to 100 lb of force when bending at the waist with legs straight. Avoid any twisting motion and pivot the feet to turn. Always push rather than pull loads. Pushing reduces the force necessary to move an object by 50%. Use lifting equipment and devices such as chair lifts, mechanical lifts, transfer boards, and gait belts. Keep beds at proper heights. Keep the back straight and maintain correct posture with head up and stomach tucked in. Focus on the following items to help reduce injuries:

- Education on the back and proper body mechanics
- Recurring training on patient transfer techniques
- Exercise routines for those involved in lifting
- Formation and required use of lifting teams
- Ergonomic evaluations to detect problem areas
- Effective housekeeping procedures
- Lift and patient assist equipment

Lateral Transfers

Use lateral transfers or sliding techniques to move patients and residents between two horizontal surfaces such as bed to gurney. Helpful equipment and devices include slide boards, transfer mats, slippery sheets, draw sheets, and incontinence pads.

Ambulating, Repositioning, and Manipulating

For help with these types of activities, use equipment and gait belts, transfer belts with handles, slippery sheets, plastic bags, draw sheets, incontinence pads, pivot discs, range of motion machines, fixtures, etc.

Performing Activities of Daily Living

These activities include showering, bathing, toileting, dressing or undressing, and performing personal hygiene and related activities. Equipment devices include shower toilet combination chairs, extension hand tools, shower carts, gurneys, and pelvic lift devices.

Useful Tips

Encourage healthcare workers to use assist equipment and devices. Some suggestions about assist devices and equipment are as follows:

- Purchase the proper devices in sufficient quantities.
- Store devices in areas visible and readily available.
- Involve end users in evaluating and selecting devices.
- Ensure the organization accomplishes effective training on device usage.
- Equip devices with sufficient replacement accessories such as slings.
- Implement a comprehensive maintenance plan for all devices.

Lift Teams

Some organizations choose to create a special *lift team* dedicated to performing the majority of the lifting or moving of patients or residents. The lift team should coordinate with the nurses and other medical personnel responsible for the patient or resident. Some organizations train teams to

- Eliminate uncoordinated lifts
- Prevent unprotected personnel from performing lifts
- Reduce weight and height differences between partners
- Prevent untrained personnel from lifting
- Encourage the use of lifting equipment when possible

Guiding and Slowing Falls

Review patient or resident assessments and watch for signs of weakness. If falls do occur, attempt to guide, slow, and lower the patient or resident to the floor. Try to maintain a neutral body posture when assisting patients. Regulatory reporting requirements may cause employees to try stopping a fall. Reporting of falls should not lead to faultfinding or negative consequences.

Transfer Task Safety

Communicate the plan of action to the patient and other workers to ensure that the transfer takes place using smooth and unexpected moves. Remove any obstacles and focus on maintaining sure footing. Patients should wear slippers that provide good traction. Maintain eye contact, communicate with the patient, and stay alert for trouble signs. Record any problems on the patient's chart so that other shifts will know how to cope with difficult transfers. Also note the need for any special equipment. Implement measures to reduce or prevent back injuries such as

- Developing a return-to-work or modified duty procedures
- Writing job descriptions that establish the appropriate physical requirements
- Requiring immediate reporting and treatment of injuries

Personal Factors

Home and recreational activities involving forceful exertions or awkward postures can also lead to or aggravate back injuries. Some examples include sports and home repair work. Physical fitness, weight, diet, exercise, personal habits, and lifestyle may also affect the development of back injuries. Individuals not in good physical condition tend to have more injuries. Excessive body weight can place added stress on the spine and is often associated with a higher rate of back injuries.

Previous trauma or certain medical conditions involving bones, joints, muscles, tendons, nerves, and blood vessels can also contribute to back-related disorders. Psychological factors, such as stress, may influence the reporting of injuries, pain thresholds, and even the speed or degree of healing. Physically fit individuals tend to have fewer and less severe injuries. Remember to consult with a physician or physical therapist about which aerobic, strength, and flexibility exercises to do. This is especially important for those individuals who have preexisting injuries or medical conditions.

Work Evaluation Tools

Involve the employees performing the work in evaluating problems and coming up with potential solutions. Following the simple three-step hazard control process can help reduce lifting-related injuries and complaints. The first step in the process is to identify lifting tasks by observing and evaluating patient/resident needs on the unit. The second step involves analyzing both data and observations. Conduct observations for a period of time to validate the actual tasks. The analysis step should help managers identify causal factors related to lifting or moving tasks. Once the analysis step is completed, the identification and assessment team can consider appropriate control to reduce worker's risk of injury. Never select and implement controls if accomplishing the identification and analysis steps incorrectly.

Training and Education

Provide training at the level of understanding appropriate for those being trained. Give workers an opportunity to ask questions. Provide an overview of the potential risks, causes, and symptoms of back injury and other injuries. Teach workers how to identify existing ergonomic stressors and methods of control. Explain the use of engineering, administrative, and work practice controls needed to conduct patient or resident handling tasks. Encourage workers and staff to stay physically fit. Provide education and hands-on practice that allows feedback. Review the work task analysis and evaluation information. Implementing improvement options or controls should guide the type of education provided. Training and education must focus on the nature and causal factors of worker injuries. Require that employees demonstrate the skills learned in a competency evaluation. Provide a systematic approach reinforced by retraining. Training is usually most effective when it includes case studies or demonstrations. Answer any questions that may arise during the training. Ensure that charge nurses and supervisors participate in the education and training. They should reinforce safety policies and oversee incident reporting requirements. Supervisors should ensure the implementation of task-specific procedures and adherence by workers to published policies.

PATIENT TRANSPORT FUNCTIONS

Some hospitals transport patients using members of a trained team. These transporters move patients to various locations in the hospital complex. Patient transportation may involve high-risk patients such as patients using an oxygen tank. Some transport team members also collect and deliver laboratory specimens. Transporters may transport equipment such as stretchers and wheelchairs. Transporting patients from one location to another includes vehicle to bed, room to procedure area, or building to building. Patient transporters serve as the frontline custodians of patient experience. The patient transportation staff must receive thorough training in all aspects of safe patient handling procedures including lifting protocols and infection control. Transportation functions must stress prompt and efficient services. Patient transport services require strong leadership. Effective transportation services permit nurses and staff members to focus on patient care requirements.

Transporting Patients

Establish practices to ensure safe care during the transport of patients. Transporters must learn to recognize hazards during the transport journey. Consider the following issues when planning for a transport: (1) need for IV poles, (2) need for transport oxygen tank, (3) conscious state of patient, and (4) the age and size of patient. Determine physical abilities and the condition of the patient. Consider the following when selecting the type of transportation to use:

- Wheel locking capability and need for safety straps.
- Side rail height sufficiency to prevent falls.
- Need to transfer IV poles.
- Ability to accommodate patient positioning.
- Mattress on gurney is held in place.
- Ability to use patient transfer device.
- Maneuverability of transportation device.
- Transportation device deemed safe.

Patient Care

The individual who is transporting the patient should introduce and identify herself or himself to lessen patient anxiety. Correctly identify the patient to prevent wrong-patient surgery. If the

patient is conscious, explain the transfer procedure prior to implementation to reduce the anxiety of the patient and promote safety. Instruct the patient to move slowly to avoid severe physiological alterations. Maintain the patient's dignity during the transfer. This will aid in decreasing the patient's anxiety and ensure personal and moral rights. Adhere to all safety procedures including the following:

- Elevate the side rails and apply safety strap.
- Confirm IV lines, indwelling catheters, monitoring lines, and drains.
- Protect the head and arms and make the patient as comfortable as possible.
- Transport patient's feet first and avoid quick movements.
- Verbalize to patient to keep hands and arms inside the safety rails.
- Explain all actions to conscious patient.
- Maintain dignity by keeping the patient covered at all times.

Transport Team Development

Interdisciplinary transport teams can help reduce patient risk during transport by using standardized protocols and policies. Transport team policies should include the use of sound communication techniques and teamwork with specific roles and responsibilities. The facility must obtain the appropriate equipment to ensure safety. Ensure the curriculum for transport team members focuses on ensuring competency. Education should include lesson on IV lines, catheters, and oxygen use. It should also include CPR certification, knowledge of patient safety goals, and handoff communication procedures. Organizations must develop standardized handoff communication checklists to ensure patient safety. Transport teams can help patient safety efforts and reduce the potential for adverse events. Develop a transport team model of care with a clear outline of the specific responsibilities for each team member. Coordinate pretransport communication between the transporter, the nurse, and the destination location. Ensure that patient equipment is functional, fully charged, filled, and in good repair (Tables 12.6 through 12.8).

TABLE 12.6
Questions That Assess Transport Activities

- Which patients are being transported?
- Focus initial efforts on the most frequent source units and patient types.
- To which locations are most patients transported?
- Are these destinations in the main hospital, adjacent buildings, across the street?
- Are there special safety hazards in any of the units?
- Pretransport patient assessments.
- What criteria determine patient stability, patient risk, and level of monitoring during transport?
- Who is responsible for this assessment?
- What is the recommended timing for this assessment?
- Do the assessment criteria include risk factor assessment based on the type of procedure/diagnostic, patient positioning during transport, and duration of transport time?
- Does the assessment take into account the possibility of decline in clinical condition and the need for escalating support increase in oxygen flow rate and change to oxygen mask with same oxygen saturations?
- How the assessment is communicated to the care team, the transport personnel, and the destination personnel.

TABLE 12.7
Questions Related to Transport Personnel

- Do unlicensed and licensed personnel transport patients?
- What are their specific responsibilities before and during transport?
- What are the competency assessments necessary to ensure patient safety during transport?
- What should minimum basic life support training entail for transport personnel?
- Does training cover how to receive and provide handoff communications?

TABLE 12.8
Questions Related to Handoff Communication

- How are the patient's condition, potential safety risks, and needs communicated?
- Is a checklist used? Is patient identification included?
- What is the responsibility of the sending and receiving providers and/or transporters?
- What are necessary supplies and equipment needed for transport?
- What equipment is required to accompany the acute care patient during transport?
- What person ensures that therapies are maintained during transport?

Wheelchair Safety

Wheelchair safety requires making plans to address emergencies such as brake failure on a power chair or a manual chair tipping backward. Do not rush when assisting an individual in a wheelchair. Lifting appropriately protects the patient and can reduce worker's back and arm stress. Always lock the brakes before the patient moves in or out of the chair or when leaving a client unattended. Engage both wheel locks. Never use the wheel locks as a brake when moving. Lift the footplates up before the patient gets in or out of the chair. When adjusting the elevating leg rest, support the frame while lowering or raising to prevent a sudden release of the leg rest.

Take care in wet or icy weather, particularly on sloping pavements, as wheelchairs tend to slide to the lowest point. Lack of maintenance or poor maintenance can lead to the wear or failure of components that may cause the wheelchair or the user to change position unexpectedly. This could lead to the user falling from the wheelchair or tipping over with the wheelchair. Adhere to manufacturer's maintenance instructions. Always use a qualified technician to service or repair the wheelchair. If the wheelchair is approved by the manufacturer for transportation of a seated person in a vehicle, make sure that you use the wheelchair tie-down and occupant restraint system specified by the manufacturer. If using large public buses or trains, use the dedicated wheelchair space and any restraint systems provided.

SURGICAL DEPARTMENT SAFETY

All personnel should know the location of all emergency equipment. This includes drugs, cardiac arrest equipment, and resuscitators. Ensure the use of explosion-proof electrical equipment and plugs.

Develop written schedules of inspections and maintenance of all electrical equipment. Operating room personnel should receive annual training on bloodborne pathogens and other safety issues. Implement policies and procedures for sharps injury reporting. OSHA requires an appropriate sharps safety plan that includes the evaluation and selection of safer sharps and needles. Operating

rooms must document the evaluation of commercially available safety products such as safe suturing devices, safety needles, safety scalpels, sharps, and passing containers. Offer hepatitis B vaccination series at no cost to employees with exposure to blood or OPIMs. The surgical staff must maintain a sharps injury log that includes the type and brand of the device involved in an exposure, the work area where the exposure occurred, and an explanation of how it happened. Minimize the hazards of exposures in surgery suites by promoting the use of

- Safer needles and other sharps devices
- Blunt suture needles
- Needleless IV connectors
- Proper containerization of sharps
- Establishing a no-pass zone for surgical instruments

Surgical Room Relative Humidity Requirements

The CMS recently decided to change the minimum hospital operating room relative humidity from 35% to 20%. CMS currently requires hospitals to comply with the 2000 edition of NFPA 101: *Life Safety Code*®. That edition references the 1999 edition of NFPA 99: *Health Care Facilities Code*, which requires operating room humidity to be at least 35%. This *Life Safety Code* waiver CMS permits hospitals to keep operating room relative humidity level at a minimum of 20%. The most recent edition of NFPA 99 shifted to a minimum requirement of 20% humidity. The wavier does not apply if more state or local laws/regulations have more stringent requirements. Facilities must monitor relative humidity levels in anesthetizing locations and must take action to ensure levels remain at or above 20%. Facilities that elect to use this categorical waiver do not have to apply in advance. However, they must document their decision to use the waiver.

Hazardous Chemicals

Exposure to possible hazardous chemicals could include peracetic acid used in cold sterilizing machines and methyl methacrylate used to secure prostheses to bone during orthopedic surgery. Recommend mixing methyl methacrylate only in a closed system. Employees should carefully read and follow instructions and warnings on labels. Employees should follow all SDS instructions regarding safe handling, storage, and disposal of hazardous chemicals. According to the HCS, employers must inform employees of chemical hazards and have on-hand SDS for all hazardous chemicals used in their facilities.

Environment and Equipment Hazards

Staff can experience risk of trip and fall hazards such as falling over portable equipment that easily blends into the floor or slipping on debris. Electrical cords crossing floors can create trip hazards. OSHA requires work areas kept clean, orderly, and in a sanitary condition. Keep aisles and passageways clear and in good repairs, with no obstruction across or in aisles that could create a hazard. Provide ceiling or floor plugs for equipment, so power cords need not run across pathways. Static postures from continuously standing in one position during lengthy surgical procedures may cause muscle fatigue and pooling of blood in the lower extremities. Standing on hard work surfaces such as concrete can create trauma and pain to feet. Avoid awkward postures such as tilting the head forward for long periods of time. Provide stools where their use is possible. Use shoes with well-cushioned insteps and soles. Provide a footrest bar or a low stool. Use height-adjustable work surfaces. Ensure that all electrical service near sources of water is properly grounded. Use appropriate PPE and safe work practices for assessed hazards. Develop procedures to routinely monitor the condition of equipment and address work practices of employees.

Instrument Passing and Sharps Disposal

Recommend a hands-free technique for passing instruments. NIOSH published *The Effectiveness of the Hands Free Technique in Reducing Operating Room Injuries* in November 2001. The use of blunt needles when appropriate and suturing devices with needlestick protection offers the highest protection against suture needlesticks. Avoid placing hands unnecessarily near sharps. Surgical personnel should avoid unnecessary handling of sharps. Never hold any sharp simultaneously with another instrument. Contain sharps in designated zones at all times. Never cross the room with a sharps instrument in hand. Some operating rooms use trays or basins where the instrument is placed before being picked up by the second person. Sometimes they use a designated area on a cart or table. Verbally announce the transfer of sharps into the neutral zone. Keep eyes on sharps until placed in designated zones. Use safety transfer trays and magnetic drapes to transfer sharps between nurse and surgeon during surgical procedures. Recent studies indicate that more than 60% of scalpel blade injuries were inflicted by the user on assistants, typically during equipment transfer. The thumb and index finger of the nondominant hand commonly experience injury with scalpels and suture needles because they reposition or hold tissue. Develop alternatives to include the use of retractors instead of hands, rounded scissors instead of pointed tips, staples for skin closure, and electrocautery instead of standard scissors. Dispose of sharps immediately after use. Make puncture-resistant containers available nearby to hold contaminated sharps. The OSHA Bloodborne Pathogens Standard also requires the discarding of contaminated needles and other sharp instruments immediately or as soon as feasible after use into appropriate containers.

Never bend, recap, or remove contaminated needles and other contaminated sharps except as noted in 29 CFR 1910.1030. Employers must provide readily accessible hand washing facilities and ensure that employees wash their hands immediately or as soon as feasible after removal of gloves.

Personal Protective Equipment

Surgical staff should wear appropriate protective clothing and equipment, which can protect from unwanted fluid splash or sharps injuries. PPE includes gloves, face masks, soak-proof gowns, impervious boots or shoe covers, face shields, and other eye protection devices. Make safety scalpels with movable shields or retracting blades available to surgeons and other operating room personnel.

LASERS AND ELECTROSURGERY

Light amplification by stimulated emissions of radiation or laser can pose a risk to healthcare workers and patients. Eye safety is the number one concern for anyone working with or near a laser. Though rare, laser eye injuries become permanent. A laser emits electromagnetic radiation in the visible spectrum. Laser use is increasing at a very fast pace in the healthcare environment. Lasers used in radiology departments help align patients for treatment. The main hazard of lasers is the potential for eye damage. The nature of eye damage depends on the type, power, and duration of the laser exposure. The most common type of injury results when a light beam heats the retina and causes loss of vision in a point of a person's field of vision. A beam from a pulse laser can cause an explosion in the retina and result in severe damage. A laser with enough energy can cause retina cell death. Any damage is permanent but not as severe as thermal or acoustic damage. Lasers striking the skin can result in erythematic, blistering, and charring. The extent of the damage depends on wavelength, power, and length of exposure. Lasers also use high voltage and pose electrical risks. The FDA Bureau of Radiological Health under 21 CFR 1040 regulates laser performance. Lasers receive calibration by the manufacturer, but always check the laser system before each procedure and during extended procedures. Classifications of lasers should coincide with actual measurement of output. Only personnel trained in laser technology should make measurements. Engineering controls, such as protective housings, remote controls, or enclosed laser beam paths,

ensure protection for laser operators except when the operator needs to set up, adjust, or maintain the beam. These technicians experience the highest risk for serious injury. The laser safety officer (LSO) must take actions to ensure monitoring and enforcing the control of laser hazards. These controls apply to the operation, maintenance, and service. Lasers and laser systems are classified on the basis of the level of the laser radiation accessible during intended use.

Laser Safety

The primary responsibility of a perioperative nurse during a laser procedure is keeping the patient safe. Safety hazards come inherent with laser usage, but adherence to proper procedures lowers injury risks. When perioperative nurses receive education in laser science and safety, they can recognize potential hazards and help ensure adherence to safety parameters. Class 3b and 4 laser exposures usually occur from unintentional operation or users fail to follow proper controls. The high electrical energy used to generate the beam is a potential shock hazard. Direct beam exposure can cause burns to skin and eyes possibly resulting in blindness. Electric shock and fire also pose potential hazards when using lasers. Primary worker protection measures include using effective eye protection and properly shielding high-energy beams. Attach laser to an individual transformer and an emergency power source. Ensure availability of an approved fire extinguisher. Identify laser use areas and post warning signs. Personnel should prevent laser beams from coming into contact with combustible, flammable, and reflective materials. Ensure personnel using or exposed to lasers become part of the eye health medical surveillance system.

Laser Safety Officer

Appoint an LSO when personnel use class 3 or 4 lasers. Ensure the LSO possesses the authority to monitor and enforce the laser safety requirements. The LSO administers the overall laser safety plan including confirming the classification of lasers and assuring the use of proper control measures. The LSO also approves substitute controls and SOPs. The LSO recommends and/or approves eye wear and other protective equipment, specifies appropriate signs and labels, provides proper laser safety training, and conducts medical surveillance. The LSO should receive detailed training including laser fundamentals, laser bioeffects, exposure limits, and classifications and control measures including area controls, eye wear, barriers, and medical surveillance requirements.

Laser Standards

No federal requirements exist for safety during laser procedures. Hospital operating rooms, surgery centers, and physician practice–based surgery suites should comply with the recommended consensus safety standards. The General Duty Clause permits OSHA to cite employers for not providing a place of employment free from recognized hazards. NIOSH believes that potential hazards exist from smoke generated by lasers. Studies indicate formaldehyde, hydrogen cyanide, and benzene can occur in surgical smoke emitted from lasers. NIOSH issued suggestions for the use of smoke evacuation units, preferably vented to the outside and protective equipment to be worn by personnel servicing or changing filters on smoke evacuation devices. The FDA's Center for Devices and Radiological Health (CDRH) regulates lasers approved for the market. These agencies also regulate which procedures lasers can perform and the ancillary supplies, including fibers, and hand pieces, authorized for sale. Laser injury incidents fall under the SMDA reporting requirements. The key safety standards for laser use are ANSI Z136.1-1993: *American National Standard for the Safe Use of Lasers* and ANSI Z136.3-1996: *American National Standard for the Safe Use of Lasers in the Health Care Environment*. OSHA regulates work exposures by using the General Duty Clause and CFR 1910.132 that addresses face and eye protection. ACGIH publishes recommendations about

how to reduce occupational exposures. NIOSH recommends that organization appoints an LSO in facilities where laser use warrants extra precautions. The Laser Institute of America also publishes information on safely using lasers and is the source organization for the ANSI standards. The Association of periOperating Room Nurses (AORN) addresses laser safety in its *Recommended Practices for Laser Safety in Practice Settings.* ANSI Standard Z136.3 remains the recognized national standard for laser safety in healthcare organizations. However, AORN standards function as the optimal standards of perioperative nursing practice. For the most part, both sets of standards communicate the same information regarding laser safety and strongly promote laser safety education and training for all individuals present during a laser procedure. Individuals must complete this training before assigned to work with lasers. Yearly reinforcement of the information and recredentialing should also take place.

Laser Classifications

The new classes—1m, 2m, and 3r—will further delineate the danger potential of medical and industrial lasers. Laser energy is light energy. Consider all class 3 and class 4 lasers as nonionizing, which indicates that laser energy does not cause molecular changes to tissue of the operator or others in close proximity. A pregnant staff member or physician need not fear that laser energy will cause harm to her fetus. Beam-related safety hazards include eye injuries, fire and thermal injuries, and smoke plume. Consider any electrical hazards as nonbeam related. Refer to IEC 60825-1 standard for requirements of the classification system. Classes 2 and higher must contain the triangular warning label. Lasers may require other labels in specific cases indicating laser emission, laser apertures, skin hazards, and invisible wavelengths.

Class 1 Laser

A class 1 laser is safe under all conditions of normal use. Never exceed the maximum permissible exposure (MPE) limit. This class includes high-power lasers within an enclosure that prevents exposure to the radiation and that cannot be opened without shutting down the laser. For example, a continuous laser at 600 nm can emit up to 0.39 mW, but for shorter wavelengths, the maximum emission is lower because of the potential of those wavelengths to generate photochemical damage. The maximum emission is also related to the pulse duration in the case of pulsed lasers and the degree of spatial coherence.

Class 1M Laser

A class 1M laser is safe for all conditions of use except when passed through magnifying optics such as microscopes and telescopes. Class 1M lasers produce large-diameter beams, or beams possess divergent capabilities. Never exceed the MPE for a class 1M laser unless using focusing or imaging optics to narrow the beam. Classify a laser as class 1M if the total output power remains below class 3B if the power that can pass through the pupil of the eye stays within class 1.

Class 2 Laser

A class 2 laser is safe because the blink reflex will limit the exposure to no more than 0.25 s. It only applies to visible-light lasers (400–700 nm). Limit class 2 lasers to 1 mW continuous wave or more if the emission time remains less than 0.25 s or if the light does not perform as spatially coherent. Intentional suppression of the blink reflex could lead to eye injury.

Class 2M Laser

A class 2M laser is safe because of the blink reflex if not viewed through optical instruments. As with class 1M, this applies to laser beams with a large diameter or large divergence, for which the amount of light passing through the pupil cannot exceed the limits for class 2.

Class 3R Laser

A class 3R laser is considered safe if handled carefully, with restricted beam viewing. With a class 3R laser, the MPE can be exceeded but with a low risk of injury. Visible continuous lasers in class 3R must limit to 5 mW. For other wavelengths and for pulsed lasers, other limits apply.

Class 3B Laser

A class 3B laser poses hazards when eyes receive direct exposures. Diffuse reflections such as from paper or other matte surfaces are not harmful. Continuous lasers in the wavelength range from 315 nm to far infrared must limit to 0.5 W. For pulsed lasers between 400 and 700 nm, the limit is 30 mJ. Other limits apply to other wavelengths and to ultrashort pulsed lasers. Protective eyewear is typically required where direct viewing of a class 3B laser beam may occur. Class 3B lasers must be equipped with a key switch and a safety interlock.

Class 4 Laser

Class 4 lasers include all lasers with beam power greater than class 3B. By definition, a class 4 laser can burn the skin, in addition to potentially devastating and permanent eye damage as a result of direct or diffuse beam viewing. These lasers may ignite combustible materials and thus may represent a fire risk. Class 4 lasers must be equipped with a key switch and a safety interlock. Most entertainment, industrial, scientific, military, and medical lasers are in this category.

Plumes

During surgical procedures that use a laser or electrosurgical unit, the thermal destruction of tissue creates a smoke by-product. Thousands of healthcare personnel experience exposure to laser or electrosurgical smoke each year including surgeons, nurses, anesthesiologists, and surgical technologists. According to NIOSH, research studies have confirmed that this smoke plume can contain toxic gases and vapors such as benzene, hydrogen cyanide, formaldehyde, bioaerosols, cellular material including blood fragments, and viruses. At high concentrations, the smoke causes ocular and upper respiratory tract irritation in healthcare personnel and creates visual problems for the surgeon. The smoke produces an unpleasant odor and may possess mutagenic potential. Surgical smoke may possess potential for generating infectious viral fragments. Use portable smoke evacuation devices and room suction systems. Keep the smoke evacuation devices or room suction hose nozzle inlet within 2 in. of the surgical site to effectively capture airborne contaminants. Keep smoke evacuation devices activated at all times when airborne particles are produced during all surgical or other procedures. Consider all tubing, filter, and absorbers as infectious waste and dispose of them appropriately. Install new filters and tubing before each procedure. Inspect smoke evacuation systems regularly to prevent possible leaks. Use universal precautions as required by the OSHA Bloodborne Pathogens Standard. For additional information, refer to *Control of Smoke from Laser/Electric surgical Procedures*: DHHS (NIOSH) Publication No. 96-128.

Laser Skin Protection

If a potential exists for skin exposure to UV lasers (200–400 nm), use skin covers and/or sunscreen. Most gloves will provide some protection against laser radiation. Tightly woven fabrics and opaque gloves provide the best protection. A laboratory jacket or coat can provide protection for the arms. For class 4 lasers, give consideration for using flame-resistant materials. Use protective clothing when exposed to levels of radiation that exceed exposure limits for the skin.

Fire Prevention Tip during Laser Surgery

Place the laser in standby mode whenever it is not in active use. Activate the laser only when the tip is under the surgeon's direct vision. Allow only the person using the laser to activate it. Deactivate

the laser and place it in standby mode before removing it from the site. When performing laser surgery through an endoscope, pass the laser fiber through the endoscope before introducing the scope into the patient. This will minimize the risk of damaging the fiber. Before inserting the scope in the patient, verify the fiber's functionality. During lower airway surgery, keep the laser fiber tip in view and make sure it is clear at the end of the bronchoscope or tracheal tube before laser emission. Use appropriate laser-resistant tracheal tubes during upper airway surgery. Follow the directions in the product literature and on the labels, which typically include information regarding the tube's laser resistance, use of dyes in the cuff to indicate a puncture, use of a saline fill to prevent cuff ignition, and immediate replacement of the tube if the cuff becomes punctured.

INTENSIVE CARE UNITS

Intensive care unit (ICU) workers experience the risk of exposure to blood, OPIMs, and bloodborne pathogens because of the immediate, life-threatening nature of treatment. The Bloodborne Pathogens Standard requires precautions when dealing with blood and OPIMs. Engineering and work practice controls must serve as primary means to eliminate or minimize exposure to bloodborne pathogens. Employers should wear appropriate PPE when anticipating blood or OPIM exposure. Ensure employees discard contaminated needles and other sharp instruments immediately or as soon as feasible after use into appropriate containers. Maintain exposure control plan documentation of consideration and implementation of appropriate commercially available and effective engineering controls designed to eliminate or minimize exposure to blood and OPIMs. Treat all blood and other potentially infectious body fluids as infected and take appropriate precautions to avoid contact with these materials. The Bloodborne Pathogens Standard does allow hospitals to practice acceptable alternatives to universal precautions such as standard precautions or body substance isolation.

ICUs, particularly neonatal units, may be designed without walls between patient spaces. This may allow employees to unknowingly experience exposure to aerosolized chemicals and x-ray radiation that escape from neighboring areas. Ensure that all rooms can remove contaminants through normal ventilation means. When using recirculated air, ensure installation of adequate filtering mechanisms. Because of the ICU atmosphere, there exists potential slip and fall hazards if water or other fluid remains on floors. Never permit electrical cords run across pathways or place emergency equipment or supplies in passageways. Provide safe cleanup of spills and keep walkways free of obstruction.

Injury may occur to employees from improper training or use of medical equipment. Implement procedures that routinely monitor status of equipment and proper training of employees to use equipment safely. Workplace violence is an issue in ICUs because of the crowded, emotional situations that can occur with critical patients. Good work practice recommends a security management plan that addresses workplace violence issues. Train staff to recognize and diffuse violent situations and patients. Require reporting of suspicious behaviors. Provide intervention measures including verbal, social, physical, and pharmacological interventions. Warning signs of anger and violence include (1) pacing and/or restlessness, (2) clenched fist, (3) increasingly loud speech, (4) excessive insistence, (5) threats, and (6) cursing.

Studies suggest work stress may increase a person's risk for cardiovascular disease, psychological disorders, workplace injury, and other health problems. Early warning signs may include headaches, sleep disturbances, difficulty concentrating, job dissatisfaction, and low morale. Ensure workloads remain in line with workers' capabilities and resources. Design jobs to provide meaning, stimulation, and opportunities for workers to use their skills.

PHYSICAL THERAPY

OPIMs include human body fluids such as semen, vaginal secretions, cerebrospinal fluid, synovial fluid, pleural fluid, pericardial fluid, peritoneal fluid, amniotic fluid, saliva in dental procedures, and any body fluid that is visibly contaminated with blood. Universal precautions must

prevent contact with blood or OPIMs. Staff must wear PPE such as gloves when providing treatment for patients if exposure to blood or OPIMs is anticipated. Use masks, eye protection, and face shields whenever spray, spatter, or droplets of blood could result in potential eye, nose, or mouth contamination.

Physical therapy personnel face exposure to potential work-related strain and sprain injuries to back and shoulder areas from constant lifting and reaching for patients during treatment procedures and transfers. Good work practice recommends employers address ergonomic stressors in the physical therapy department and provide engineering controls and work practice techniques to help minimize stressors. Emphasize and teach the use of proper lifting techniques using good body mechanics. Staff should bend knees and use arm and leg muscles when lifting. Instruct them to keep the back straight and use smooth, steady lifting motions. Avoid lifting/reaching or working above shoulder height. Lift items close to the body. Avoid sitting or standing for long periods of time and take short breaks. Use mechanical aids to reduce the need to lift patients. Use mechanical lifting equipment when lifting patients who cannot support their own weight into/out of whirlpools or tubs. Sliding boards used under patients to help reduce friction during transfers to and from wheelchairs, and treatment tables can also help reduce injury. Use adjustable equipment such as tubs and therapy tables. Therapists can then adjust the equipment to fit their individual height and comfort levels.

Physical therapists use different modalities for treating patients. Some of these treatments include ice bags, moist hot packs, whirlpools, and various exercise equipment. There is a potential slip and fall hazard if water is spilled on the floor or if electrical or other cords run across pathways. OSHA requires safe cleanup of spills and walkways free of obstructions. Floors must be kept clean and dry. Nonslip mats and other dry standing places should provide traction. Use nonslip floor mats in whirlpool areas. Keep aisles and passageways clear and in good repair, with no obstruction across or in aisles that may create a hazard. Provide floor plugs for equipment, so power cords do not run across pathways. Place a table to the side of the *hydrocollator* machine that stores the moist heat packs.

Exposure to hazardous chemicals can occur in physical therapy areas. Cleaning chemicals such as glutaraldehyde can pose exposure risks. Other chemicals used in physical therapy areas include ultrasound gels, prescription medications, creams, and ointments. Refer to the National Antimicrobial Information Network for lists of other approved cold sterilization products. Properly ventilate rooms containing glutaraldehyde. Use increased dilution ventilation in whirlpool rooms, along with the careful application of the glutaraldehyde with a long-handled brush rather than a spray applicator. Follow procedures for safe administration of medications and creams. Therapists should wear gloves while applying certain medications to patients. Implement a written plan that meets the requirements of the HCS to provide for worker training, warning labels, and access to SDS for all hazardous chemicals/medications used by physical therapists. Physical therapists use different types of electrical treatment equipment, such as the hydrocollator and ultrasound devices, that could pose hazards. If water and electrical energies mix, it may result in a possible shock hazard. If equipment is used improperly, excessive occupational exposure to ultrasound may occur. Develop a plan to monitor the condition of equipment and address work practices of therapists. Conduct visual inspection of cords and equipment for hazards. Do not use if frayed or damaged. Ensure that all electrical service near sources of water is properly grounded. Use proper techniques when administering ultrasound and electrical stimulation treatments to avoid excessive exposure of therapist's hand. Improper technique could result in hand weakness. Physical therapist should use the handle rather than the head of the ultrasound device when administering treatments. Exposure to Legionnaires' disease can occur by breathing aerosolized water that contains the Legionella bacteria. This could occur in shower or whirlpool area or any areas with spray nozzles. Cooling towers, evaporative condensers, fluid coolers, and domestic hot-water systems can provide water sources that could provide optimal conditions for growth of the Legionella bacteria.

EMERGENCY DEPARTMENT

Emergency department personnel experience continuing risks of exposure to blood, OPIMs, and bloodborne pathogens because of the immediate, life-threatening nature of treatment. Employees can be exposed to hazardous chemicals or hazardous drugs. Emergency departments should implement approved decontamination procedures. Because of the emergency department's busy atmosphere, slips, trips, and falls pose a major risk. Provide safe cleanup of spills and keep walkways free of obstruction. Keep access to exits clear and unobstructed at all times. Injury may occur to employees from improper training or use of equipment such as defibrillators. Electric shock may also occur as a result of lack of maintenance or misuse of equipment. Workplace violence is an issue in emergency departments because of the crowded and emotional situations that can occur with emergencies. Good work practice recommends a security management plan that addresses workplace violence. Train staff members to recognize and diffuse violent situations and patients. Stay alert for potential violence and suspicious behavior and report it. Provide intervention measures including verbal, social, physical, and pharmacological interventions. Install concealed panic buttons in the department and at triage areas. Install proper lighting and video surveillance equipment. Limit access to the area by implementing a waiting room area with controlled access points. Patients must enter through a secure door. Consider the use of metal detectors to determine if individuals possess weapons of some type. Provide a *secure* room for patients identified as violent. This room could include controls such as video camera surveillance. Exposure to TB and other infectious agents can occur from patients in waiting rooms and treatment areas. Provide and practice early patient screening for TB during admission to identify potentially infectious patients. Provide isolation to prevent employee and other patient exposure. Provide engineering, work practice, and administrative procedures to reduce the risk of exposure. Ask patients with a productive cough to wear a mask to prevent the spread of infection. Post waiting rooms signs that state, "If you are coughing, you may be asked to wear a mask." Isolate patient until verification testing is negative. Some departments provide an isolation room to safely isolate potentially infectious patients. Others can designate an isolation area for infectious patients. Maintain isolation rooms under negative pressure. AFB isolation refers to a negative-pressure room or an area that exhausts room air directly outside or through HEPA filters if recirculation is unavoidable. Protect employees from exposure to the exhaled air of an individual with suspected or confirmed TB. Isolate patients with suspected or confirmed TB.

Exposure of department personnel can occur from patients exposed to biological agents, chemical agents, and mass causalities as a result of terrorist attacks or events. Provide and plan for emergency response for healthcare employers and emergency responders. The DHHS, the CDC, the AHA, the Department of Defense, and OSHA publish resources for how hospitals to use when planning for terrorist events.

DIALYSIS UNIT SAFETY

Hazards present in this unit include exposure to sterilizing solutions and bloodborne pathogens including hepatitis B. In recent years, a number of reports indicate blood contamination incidents related to the internal components of dialysis equipment. The possibility of cross-contamination could permit the transfer of bloodborne pathogens from patient to patient. Under certain conditions, cross-contamination is possible despite the use of new blood tubing sets and external transducer protectors. Please also note that routine maintenance is not adequate to detect internal machine contamination. Qualified personnel should inspect all machines, including the internal pressure tubing set and pressure sensing port, for possible blood contamination. Always use an external transducer protector and utilize pressure alarm capabilities as indicated in the manufacturer's instructions. If contamination occurs, take the machine out of service. Frequent blood line pressure alarms or frequent adjusting of blood drip chamber levels may indicate an occurring problem.

Ensure employees working in dialysis units know the adverse health effects of glutaraldehyde. Staff should wear proper protective equipment whenever handling sterilizing solutions. Protective equipment should include rubber gloves, protective aprons, and eye and face protection. Appoint a dialysis staff member as the safety coordinator with authority to enforce biological safety policies within the dialysis unit. Require all personnel follow the requirements of the OSHA Bloodborne Pathogens Standard 29 CFR 1910.1030. Hospital-based dialysis units should coordinate infection control exposure plans with the hospital infection control function. Refer to the appropriate CDC guidelines for additional information. Appoint a dialysis staff member as the safety coordinator with authority to enforce biological safety policies within the dialysis unit. Isolate patients who are hepatitis B surface antigen (HBsAg)-positive in a separate room or unit designated for HBsAg-positive patients if possible. Otherwise, segregate these patients from hepatitis B seronegative patients in a separate area. Assign staff members with the most dialysis experience or best technique to care for the HBsAg-positive patients.

Equipment

Never use dialysis equipment for both HBsAg-positive and seronegative patients. If this is impossible, make the staff aware that the chances for cross-contamination increases significantly. All patients should receive specific assignments for dialysis chairs or beds and machines. Change linen used on chairs and beds for each patient. Clean chairs and beds after each use. All patients should receive an assigned supply tray including tourniquet, marking pencils, and antiseptics. Never use clamps, scissors, and other nondisposable items for more than one patient unless autoclaved or appropriately disinfected.

Personal Protective Equipment

Staff must wear disposable gloves handling patients or dialysis equipment and accessories. Staff should wear gloves at all times including taking blood pressure, injecting saline or heparin, or touching dialysis machine knobs to adjust flow rates. The staff should never touch surfaces with gloved hands that will subsequently be touched with bare hands. The staff should wear gloves whenever handling blood specimens and whenever working in the laboratory area. Recommend wearing protective eye glasses and surgical-type masks during any procedure with potential for spurting or splattering of blood. Staff should wear gowns or scrub suits at all times and properly dispose of clothing at the end of each day. Follow the housekeeping practices required by the OSHA Bloodborne Pathogens Standard.

REVIEW EXERCISES

12.1 List at least nine safety education and training topics for nursing personnel.
12.2 What two alternative practices can organizations use in lieu of *universal precautions*?
12.3 List five factors related to work schedules that can have an impact on a person's safety and health.
12.4 List five key educational topics that address the issue of sleep deprivation for shift workers.
12.5 List at least seven common healthcare worker stress factors.
12.6 List seven key education and training topics for home health personnel.
12.7 Why would proper patient or nursing home resident assessment be important in reducing back-related worker injuries?
12.8 List five actions that would help reduce healthcare worker back-related injuries.
12.9 What role could home and recreational activities play in aggravating back injuries?
12.10 What five things can organizations do to minimize the biohazard exposures in the surgery area?

12.11 List the three halogenated anesthetic gases used in surgical departments that have published NIOSH RELs.
12.12 List and describe the seven classes of lasers.
12.13 What federal organization requires laser users to report all incidents resulting in death or injury?
12.14 Describe two key occupational hazards found in dialysis units.

13 Patient Safety

PATIENT SAFETY: AN ORGANIZATIONAL FUNCTION

All healthcare safety personnel should understand the importance of patient safety and how it fits into the organization's total safety system. We need to view patient safety as a discipline within healthcare professions and organizations. Healthcare leaders should consider both the science and practice of safety when addressing patient care issues. Healthcare risk and quality management personnel should learn to view patient safety as a function associated within their disciplines. Patient safety could be defined as preventing patient adverse events and errors while minimizing the harm of those events that do occur. We should approach patient safety effectiveness from two key directions. First of all, consider organizational issues such as leadership, organizational dynamics, operating cultures, and patient care effectiveness. The coexistence of the organizational operating culture and the overall safety culture may be in conflict in many hospitals. They may attempt to operate in parallel dimensions. Second, make patient safety a function of the organization. Educate organizational members that patient safety is not just another program but a subsystem of the total safety system.

Many healthcare leaders consider patient safety as a clinical concern; others view it as a function of risk management or quality improvement processes. However, many other professionals may define patient safety using varying definitions or reference points. Medical specialization, organizational fragmentation, and compartmentalization can hinder safety efforts. Improving patient safety performance at all organizational levels must become a strategic goal of all healthcare organizations. Healthcare organizations should learn to *connect the dots* of the many well-intentioned efforts to improve patient safety efforts. Many organizations spend too much time touting the mere existence of their transactional patient safety endeavors. Connecting the dots in a children's book, if done correctly, produces a recognizable picture. The picture of patient safety *progress* over the past 10 years is not a clear one. Patient safety should focus more than just on methods, tools, surveys, policies, buzzwords, and trendy thematic books. Leaders must learn to consider the patient safety function of every medical or healthcare organization as recognizable *subsystem* of the total safety system. Effective patient safety requires more than a policy statement signed by senior leaders. Patient safety is much more than an office location, a phone number, an e-mail address, or a slogan strategically placed on an organizational website.

When seeking patient safety information on the web, one quickly learns that too much information can create a challenge to sort through and result in a disappointing endeavor. Some recent patient safety innovations yielded good results such as preventing central-line and surgical wound infections. Many hospitals took actions to reduce medication and surgical adverse events with some positive results. Healthcare organizations should learn to connect the dots, build the bridges, and understand that many hidden cultures exist in all organizations. These *covert* or *hidden* cultures operate within the *overt* or *formal* cultures on a daily basis. The informal cultures can and in many instances operate independently of the recognized organizational culture.

Another hindrance to patient safety success at the local level relates to failure of leaders to understand open and closed systems. High-reliability methods, no matter how appropriate they may seem, will never be effective in all hospital areas, departments, or functions. Healthcare can be best described as an *open system* with some *closed microsystems.* High-reliability methods can work well in highly closed and controlled settings. However, *open systems* should anticipate many uncontrolled elements that impact effective operations. The words *patient* and *their families* should

send the message, loud and clear, that healthcare organizations operate as open systems. Healthcare organizations should implement policies and hazard controls to ensure visitor safety while in the facility. Organizations should implement measures to educate visitors on how they can help protect the safety of patients.

We can base patient safety efforts on three key concepts. First of all, view patient safety as an organizational function and not a program or department. Never consider patient safety efforts as a function of risk management or quality improvement. Second, view patient safety as an operational *subsystem* of the organization safety system. Implementing a comprehensive safety system requires an organizational culture change. I was speaking to a *patient safety coordinator* a few years ago, and she quickly pointed out that the patient safety function was separate from the hospital's *environmental safety* function. I calmly mentioned to her that patient safety occurs or does not occur in the *environment of care*. Patient safety does not compete with the components or subsystems of its own system. Patient safety complements the other safety system components of worker safety, visitor safety, contractor and vendor safety, and community safety. The function of healthcare safety within the organization should derive its value from people. The third aspect relates to the fact that many senior leaders incorrectly believe that patient safety requires a *clinical* professional to lead the efforts. Patient safety can only improve if the organization undergoes transformational changes.

LEADING PATIENT SAFETY EFFORTS

Leading people can prove more difficult than managing other organizational assets. Leaders should assess how well staff and other healthcare providers support the patient safety function. Education, communication, and feedback must become a top priority. Promote the use of *action plans* to guide patient safety processes and needed innovations. Leaders place the focus on improving processes and not blaming people. Do not *talk the talk* unless you *walk the walk*. Frequent walking tours promote safety, improve communication, and provide valuable information to the leadership team. Finally, leading safety requires allocation of adequate resources to support the ongoing function of patient safety. Leaders can help improve organizational safety functions by focusing on patient-centered strategies. Implement system-centered approaches and look for evidence-based solutions. Create teams with the knowledge and resources to act when appropriate. Develop effective monitoring and measurement tools.

Peer review of physicians historically has been viewed as a punitive process and not an opportunity to learn. To engage physicians in safety, target the 20% of physicians who spend the most time in the hospital and not the 80% that rarely enter the hospital. By making physicians partners not consumers permits the patients to become the customers. This will require physicians to become responsible not just to their patients but also to the system providing care. Organizational leaders committed to improving patient safety should also create an environment that attracts and retains the best nurses. Create ways to acknowledge the value of nurses and support continuous learning activities. The nursing profession needs leaders that value and support frontline nurses. Leaders should learn to encourage and promote more collegial nurse and physician relationships.

Developing a true safety culture will include demanding that nurses be treated with respect. Organizational excellence in patient safety can never occur without implementing policies that address nursing safety, well-being, and job satisfaction.

Healthcare organization oversight and governing boards should lead the patient safety journey. Board members spending less than 25% of their time addressing patient safety and quality issues do a disservice to their organization. Oversight boards should develop and publish policies addressing formal quality improvement measures. Boards can promote patient safety only by continuously interacting with the medical stuff Governing boards should ensure that organizational leader compensation and job descriptions related to patient safety performance. The board should require that the CEO lead the way by being the person most identified with patient safety and quality

improvement. The Institute of Healthcare Improvement recommends that governing boards establish organizational patient safety goals, listen to *sharp end* stories, implement system-level measures, and monitor important issues such as organizational culture change.

Organization accountability should focus on full disclosure to patients and their families. Conduct a sequence of event analysis after medical errors and adverse events. Gather facts including the timeline of an event. Use the information collected to assist with a focused analysis. Hold individuals accountable by clearly defining roles and relationships. A just culture dictates a balance between nonpunitive actions and situations requiring accountability and discipline. Humans will and can make mistakes. Hold people accountable when they overestimate their abilities and underestimate their limitations. Humans often fail to recognize fatigue, stress, and work environmental issues such as noise or poor lighting. Illness, boredom, frustration, home situations, and substance abuse can also impair job performance. Create policies that enforce and support accountability. Make an effort to educate frontline staff on the accountability system. Educate all managers, supervisors, and team leaders on expectations. Senior leaders should take actions to publicly embrace the need for more accountability and the development of a culture that learns from errors.

SUMMARY OF KEY IOM REPORTS

The 1999 IOM report, *To Err Is Human*, challenged the public and healthcare to create a *climate* to support change. Controversy created since the release of the 1999 IOM report related to mandatory versus voluntary error reporting. The 2001 IOM report, *Crossing the Quality Chasm*, focused on the theme of providing a common purpose for changing healthcare. The 2001 IOM report listed the following six aims for improving healthcare: (1) safe, (2) effective, (3) outcome focused, (4) timely, (5) efficient, and (6) equitable care. The 2003 IOM report, *Patient Safety: Achieving a New Standard of Care,* emphasized the importance of an electronic health record (EHR) with regard to patient safety. It also recommended the development of better definitions for patient safety including terms near misses and adverse events. The 2004 IOM report titled, *Transforming the Work Environment of Nurses*, recommended that healthcare organizations evaluate and improve areas such as nurse management practices, workforce capability, work place design, and organizational culture. The 2004 IOM report, *Quality through Collaboration: The Future of Rural Health Care,* proposed a strategy for meeting the health challenges facing rural communities including providing quality care.

ERRORS AND ADVERSE EVENTS

An adverse event is an injury caused by medical management rather than by some underlying disease or patient condition. Medical errors result from a complex series of system-related issues and not from a single individual. Errors may or may not result in an adverse outcome. IOM defines errors in two ways: (1) error of execution refers to correct action that did not proceed as intended and (2) error of planning is when an intended action was accomplished incorrectly. The National Patient Safety Foundation (NPSF) defines patient safety as the prevention of and elimination or mitigation of patient injury by errors. NPSF defines a healthcare error as an unintended outcome caused by a defect in the delivery of care to a patient. The AHRQ defines a medical error as an act of commission (doing the wrong thing), omission (not doing the right thing), or execution (doing the right thing incorrectly). Consider the following examples of error:

- A physician failed to use an indicated diagnostic test or misinterpreted test.
- Emergency room personnel could not use a defibrillator with dead batteries.
- Patient developed a postsurgical wound infection resulting in a longer stay.
- A patient received the wrong blood type during a transfusion.

Active and Latent Errors

Reason's model stresses the fact that humans and systems can cause errors. Characteristics of high-reliability organizations: (1) acknowledging and planning for human variability and fallibility, (2) members anticipating the worst and planning for failure, and (3) planning for failure helps avoid harm when failures occur. Leaders understand technical, organizational, environmental, and human factors that impact error. Trust pervades the organization so people report safety concerns and errors because they understand what constitutes unsafe practice. Reporting can prove valuable to staff and leaders aware of the importance of accurate data and reward reporting of errors and near misses. Flexibility gives frontline personnel responsibility for immediate situations.

Factors Impairing Human Performance

Research and anecdotal evidence indicate that a number of factors can impair human performance. While working in complex surroundings, humans can easily experience a limited short-term memory. Running late or being in a hurry can impact task performance. Some individuals find it very difficult to multitask.

Others lose their concentration due to job or task interruption. Healthcare workers and professionals should deal with stress, lack of sleep, and fatigue on the job. Workplace environmental factors, personal or home distractions, and substance abuse can also impair performance. James Reason in his studies developed some questions to address errors committed on the job. Consider the following questions when investigating an error or other adverse event:

- Did the incident involve malicious intent?
- Did someone knowingly work impaired?
- Did someone knowingly do something wrong or unsafe?
- Would a person with identical training make the same mistake?
- Did someone demonstrate a history of adverse event involvement?

Error Reporting

Collect data in a proactive but in a nonpunitive manner. Learn from errors to identify trends that may reveal problems with care. Two incentives for reporting include immunity and confidentiality. Effective reporting procedures help determine educational and training needs. Accurate reporting of errors can help identify policies needing revision. Reporting systems should collect information on healthcare providers. Consider voluntary reporting as a passive form of surveillance for near misses, close calls, and unsafe conditions. Active surveillance involves direct observation of providers or chart review using trigger tools. An effective incident reporting and evaluation system should support privacy and receive information from a broad range of individuals. Reporting systems should also provide timely feedback and contain mechanisms that ensure evaluation and corrective action plan creation. The reporting process should promote a continuous flow of information into the system. Use reported information to assess and develop appropriate educational or training sessions.

Reporting Using Technology

Web-based systems can now receive information from electronic medical records (EMRs). The advantages of voluntary event reporting systems include relative acceptability and involvement of frontline personnel. Ensure voluntary event reporting systems remain confidential. Compared with medical record reviews or direct observations, event reports capture only a fraction of events. Physicians generally do not utilize voluntary reporting systems. Failure to receive feedback after reporting an event can create organizational problems. Incident reports should combine direct observations, use of

TABLE 13.1
Methods Used to Identify Adverse Events

- Anonymous reporting systems
- Information from licensing and accreditation surveys
- Infection control surveillance
- Medication data mining
- Legal complaints and lawsuits
- Performance improvement data
- Retrospective clinical record review
- Information from patients and their families
- Satisfaction surveys

trigger tools, and any chart audits. The Patient Safety and Quality Improvement Act legislation provides for the confidentiality and privilege protections for patient safety information when healthcare providers work with approved Patient Safety Organizations (PSOs). Healthcare providers may choose to work with a PSO and specify the scope and volume of patient safety information to share with a PSO. Hospitals should maintain confidential incident reporting systems (Table 13.1).

Analyzing Events and Errors

Individuals responsible for analyzing adverse events should recognize the human component of error.

They should also strive to identify system and latent components of error. Proper event analysis helps the organization plan for change and improve processes. Tracking changes confirms that suggested solutions work and help to determine the impact on risk reduction efforts. Use an independent process or function to analyze adverse events. Place the emphasis on using multidisciplinary approaches to avoid the hindsight bias. Conduct an analysis to determine which systems or redesign processes contribute to adverse events. The analysis of *near miss* events can help identify trends or causal patterns that could contribute to actual events. Focus on the following areas when analyzing an event: (1) defining objectives for supporting families, (2) understanding what happened, (3) identifying opportunities for improvement, and (4) incorporating learning into daily operations. Publish rules to address the issues of blame, transparency, confidentiality, and innovation. Create processes to document the sequence of events while uncovering opportunity for improvement.

Common Error Causal Factors

Research and analysis reveal that several common causal factors contribute to medical errors and adverse events. Some studies reveal that poor communication among providers, caregivers, and other staff members contributes to patient-related incidents. Another important causal factor, often overlooked, relates to the unavailability of critical information during times of decision making. The simple failure of personnel to follow established policies, guidelines, protocols, and processes also contributes to such events. Other common causal factors documented in reports and investigations include the improper patient identification, incomplete patient assessment, failure to obtain informed consent, and lack of proper patient education. Healthcare organizations should place a priority and focus on improving systems to reduce medical errors. Leaders must realize that healthcare professionals can and do make mistakes. Undertaking proactive measures that seeks to identify and intervene in potential system failures can reduce errors and adverse events. Implement proven surveillance methods or processes to identify challenges and problems that hinder patient safety. Identify and evaluate best practices for possible use at the facility. A spontaneous reporting system

permits anyone in the hospital—clinician, employee, volunteer, patient, or family member—to report an issue, concern, or problem. Assess all information contained in risk management reports, quality improvement assessments, malpractice reports, and patient complaints.

Implementing Structured Handoff and Sign-Out Procedures

Refer to the process of transferring responsibility for care by using the term *handoff* and use the term *sign-out* when referring to an act of transmitting information about a patient. Studies reveal a link between sign-outs and adverse event occurrence. Communication failures among providers can contribute to preventable errors according to studies of closed malpractice claims affecting emergency physicians and trainees. The simple task of communicating an accurate medication list can help prevent errors. Hospitals must reconcile medications across the continuum of care. Ensure the accuracy of the following:

- Administrative data such as patient's name, medical record number, and location.
- Update new clinical information.
- Clearly explain any tasks performed by the covering provider.
- Communicate illness severity accurately.
- Outline contingency plans for changes in status to assist cross-coverage of a patient overnight.

The 2006 Joint Commission National Patient Safety Goal 2E requires all healthcare providers to implement a standardized approach to handoff communications including an opportunity to ask and respond to question. The Joint Commission National Patient Safety Goal also contains specific guidelines for the handoff process:

- Use interactive communications.
- Provide up-to-date and accurate information.
- Limit the number of interruptions.
- Establish a process for verification.
- Provide the opportunity to review any relevant historical data.

Note: The Accreditation Council for Graduate Medical Education (ACGME) also requires that residency programs maintain formal educational sessions to address handoffs and care transitions.

Medical Education and Error Acknowledgment

Most institutions teach medical education in an authoritarian manner. Some healthcare professionals inadvertently and incorrectly promote the infallibility of medicine. Many other educators stress perfection to their medical students. Healthcare personnel sometimes perceive senior clinicians as right because of their experience or reputation. Some clinicians believe that there is one right answer to every medical situation. Some others view professional overconfidence as being equal to competence. Errors do not truly happen but can equate to incompetence, negligence, or laziness. Errors can mark medical professionals and can result in shame among peers and other professionals. Medical decision making always carries some degree of uncertainty. Good clinicians should act decisively but remain flexible to needed changes. Each decision should seek to achieve the goal while minimizing risk. It requires vigilance and alertness to prevent harm. Organizations must learn to report, investigate, and analyze errors and their causes. Stress the integration of patient safety education into daily practice and encourage behavioral change. Patient safety education should begin in medical and professional schools. Educational sessions should present topics on human factors, cultures, system methods, and proactive risk reduction.

SAFETY CULTURES

Healthcare management and advances in technology can unknowingly encourage a fragmentation of care. Traditional healthcare methods create hierarchy and confusion that can result in gaps in communication, knowledge, and processes. Sometimes a single individual cannot overcome the various forces that exist in organizations. Recurring medical errors make up a large number of the reported adverse events. Healthcare should learn from recurrent errors by creating a genuine safety culture that thrives on transparency. Culture change can happen only when senior leaders communicate the important objective of harm-free care.

The concept of safety culture originated outside of healthcare. Studies of high-reliability organizations attempt to minimize adverse events by maintaining a commitment to safety at all organizational functions and levels. Such a commitment provides a foundation for establishing a safety culture. Healthcare organization must start acknowledging the high-risk nature of an organization's activities. Achieving consistently safe operations requires a blame-free environment where individuals report errors or near misses without any fear of reprimand or punishment. Established safety cultures promote collaboration across all levels, functions, and disciplines, which help find solutions to patient safety challenges, risks, and problems. Safety culture development requires senior leaders to commit the necessary resources to address organizations' concerns. Studies reveal a wide variation in perceptions of safety culture across organizations and job descriptions. Many issues can undermine healthcare safety culture development. Poor teamwork and lack of communication create a culture of low expectations.

AHRQ offers Patient Safety Culture Surveys and a Safety Attitudes Questionnaire to assist organizations with evaluating individual units and even the entire organization. Improving safety cultures pose a challenge to most organizations. However, teamwork training, executive walk rounds, and establishing unit-based safety teams help improve safety culture measurements. Some organizations take actions such as implementing structured communication methods to help address cultural issues, but the effect of error rate reduction remains unproven.

The culture of individual blame impairs the advancement of a safety culture. A just culture focuses on identifying and fixing system issues that contribute to unsafe behaviors. A just culture distinguishes between human error and at-risk or reckless behavior. To improve any safety culture, organizations must find solutions for specific problems. Significant variations in safety culture may exist within an organization. Perceptions can vary from high to low depending on the unit. Many variables can impact safety culture including professional relationships and local situations. This can create a changing safety culture microsystem levels. Finally, some key reasons for a lack of true safety culture relate to poor leadership, lack of teamwork, ineffective communication, low expectations, and lack of authority (Table 13.2).

Healthcare Bureaucratic Structure

Most hospitals function as a bureaucracy with rules and lines of authority. Leaders should learn to decentralize and promote a trusting culture. Culture comes from the sum of individual or group

TABLE 13.2
Key Features of True Safety Cultures

- Acknowledgment of the high-risk nature of an organization's activities
- Determination to achieve consistently safe operations
- Creation of a blame-free environment where individuals report errors without fear
- Encouragement of collaboration to seek solutions to patient safety problems
- Organizational commitment of resources to address safety concerns

values, attitudes, perceptions, competencies, and patterns of behavior. Leaders should encourage input (voice) and participation (choice) of all organizational members. Elements necessary to build safety cultures include addressing the perceptions associated with teamwork and identifying safety norms and expected behaviors. Organizations should assess job satisfaction, evaluate senior management effectiveness, and recognize the reality of stress. Healthcare organizations should continually determine the adequacy of supervision, education, and training. Focus on evaluating reporting systems, communication effectiveness, and feedback that could help change wrong assumptions about causes of adverse events.

Proactive Organizations

Healthcare organizations undergoing change and transitioning to a proactive safety culture should consider a number of issues as vital to the success of the transition. True safety cultures should focus on establishing nonpunitive incident and close call reporting systems. Healthcare team members should receive education in problem-solving and decision-making techniques. Top leaders promote patient harm as untenable and encourage team members to voice any and all concerns. The organization places a strong focus on improving systems and processes. Never tolerate the blaming of individuals for system failures. Finally, all team members should acknowledge that no best safety model exists to address every issue that could arise in complex healthcare systems. Do not just promote vigilance—expect it.

Understanding Change

Many healthcare organizations incorrectly believe that change happens because someone in leadership deems it so. Organizational transition can take place only by implementing transformational processes and not with transactional instruments. Transactional change instruments come in the form of memos, policies, letters, and directives. First-order change refers to transactional change and second-order change refers to transforming change. Those leading changes should place people correctly in the organizational structure to execute a strategy of change. Many times, senior leadership should use a *burning platform* to create a desire for change. Use a real event or incident to make the *burning platform* relevant to the need for change. Never forget to articulate how change will impact the staff, patients, families, visitors, and vendors. Ensure that educational sessions for everyone focus on *real-world* situations. Require good documentation practices but place more emphasis on continuous learning. Define and describe data collection, analysis, and dissemination processes in detail. Plan, evaluate, and implement innovative processes using system methodologies. Change cannot take place unless leaders integrate individual needs with organizational goals. Finally, leaders should learn to implement the culture change before attempting to promote other needed process or system interventions.

Organizational Change

Healthcare organizational leaders should expect hindrances to change processes. They must stay ready to deal with them immediately. The science of medicine sometimes values *individual thought* processes of physicians over systematic change. Many physicians feel strongly about expressing their own style. Standardization of medical practices and treatment protocols offends many practicing healthcare professionals. Some professionals even reject basic teamwork principles. Some healthcare personnel express open unwillingness to accept imperfection. Educational processes that do not address decision making in the context of uncertainty can hinder any change process. Leaders should encourage some rationale risk avoidance to minimize patient harm. Finally, the lack of creativity when encouraging change is often undervalued and frequently overlooked. Creativity

refers simply to an organized way of *thinking outside of the box*. Organizational leaders must take action to help with the journey of change. Create teams that understand the importance of continuous improvement processes. Solicit suggestions from teams and other frontline or sharp-end personnel. Teamwork and change processes need effective communication and feedback. Ensure that all organizational members can participate in the change processes. Value their voice (opinions) and let them make some choices (decisions). Educate organizational members about the basic elements of system thinking and methods.

Educate and involve patients and their families in the change processes under way. Healthcare facilities undergoing change and transition to a true safety culture should consider the three overlapping organizational levels impacted by change: (1) environmental, (2) organizational, and (3) the clinical interface between clinicians and patients.

Before embarking on the organizational change journey, the organization should assess the current climate. Do this through the use of interviews, focus groups, personal observations, and perception surveys. Surveys help establish a baseline measure of perceptions. In large organizations, perceptions can easily become truths. Define in an honest manner the strengths and weaknesses of the organization. Find and use available tools to help with the assessment process. Search for the best tools to use by considering any available reliability or validity evidence. During the assessment of the organizational climate, track innovations and interventions using the timeline approach. Determine adherence with policies, procedures, and directives during the journey.

Teamwork

Teamwork in medical systems requires coordination of efforts to achieve the desired outcome. The most successful teams cooperate and communicate effectively. The AHRQ and the Department of Defense Military Health System have developed TeamSTEPPS to provide evidence-based tools to promote teamwork. Teamwork tools should be designed for high-stress settings such as critical care units, emergency department's operating rooms, and obstetrical suites. Tailor teamwork curriculums to specific settings or units. Patient safety depends on individuals with disparate roles and responsibilities acting together as team. Communication barriers across hierarchies, failure to understand human fallibility, and poor situational awareness can result in poor teamwork. Teamwork training should focus on developing effective communication skills and creating an open team member atmosphere. Educate team members to cross-check actions of others, offer assistance as needed, and address errors in a nonjudgmental fashion. Debriefing and feedback remain key components of teamwork training.

MORE ABOUT UNDERSTANDING SYSTEMS

IOM defines a system as many subsystems connected by culture/mission. Healthcare should learn to respond to safety issues from a system's view. A good example is that patient safety begins before the patient arrives at the facility. Do not fail to search within the organization for people and resources to solve complex patient safety concerns. Leaders should not tolerate, excuse, or cover up poor decisions in a system. Hospitals function as open systems with some closed subsystems or microsystems. Closed systems exist in high-reliability organizations that can control most outside threats to system operation. Leaders should never forget that modern healthcare delivery systems can experience stress and overload. Team, communication, feedback, and coordination breed success in any organization. Acknowledging the risk of failure remains an inherent element of complex systems with risk serving as the emerging concern. People cannot always see or know system-related risks. Humans can fail when putting forth their best efforts, and systems can also fail regardless of their design. Trained team members can recognize and compensate for system risks (Table 13.3).

TABLE 13.3
Common Elements of System Failures and Medical Errors

- A complex system can *break or fail* and contribute to harm.
- A system or process may contain a latent defect before harm results.
- Humans develop behaviors to compensate for the chronic system flaws.
- System errors can occur far from the sharp end.
- Current medical culture promotes individual accountability.
- People attempting to *fix* system errors may not see how it impacts patients.
- Seek to identify all contributing factors that could cause to harm.
- Recognize that any part of the system can impact care.
- System problems can eventually cause harm.
- Leaders should understand that system problems and failures can impact care.

Systems Approach

The systems approach seeks to identify situations or factors that likely contribute to human error. James Reason's analysis of industrial organizations revealed that catastrophic safety failures almost never result from isolated errors committed by individuals. Most incidents result from smaller and multiple errors in components and environments with underlying system flaws. Reason's *Swiss Cheese Model* describes this phenomenon. Errors made by individuals can result in disastrous consequences due to flawed systems that are represented by the holes in the cheese. Reason believed that human error would happen in complex systems. Striving for perfection or punishing individuals who make error does not appreciably improve safety. A systems approach stresses efforts to catch or anticipate human errors before they occur. Reason used terms *active errors* and *latent errors* to distinguish individual errors from system errors. Active errors almost always involve frontline personnel. They occur at the point of contact between a human and some element of a larger system. Latent errors occur due to failures of the organization or designs that allow inevitable active errors to cause harm. The terms *sharp end* and *blunt end* correspond to active error and latent error. The systems approach provides a framework for the analysis of errors and efforts to improve safety.

Key System Safety Elements

Systems need a focus on standardization, simplification, and automation. Minimize fatigue, stress, and boredom of workers. Reduce reliance on human memory but promote vigilance. Encourage teamwork and improve reporting accuracy and timeliness. Complex systems need an enhanced information transfer process within the organization. Design equipment to reduce failures but always consider technology and the human interface during the design processes. Study history to ensure that patient safety continues to improve over time. Statistics can help measure the impact of interventions or innovations. Promote the fact that real continuous improvement processes shift the focus from an individual to the team.

System Reliability

Reliability refers to the probability that a system or process will consistently perform as designed. We should view this as the opposite of its rate or error or failure. Many reliable systems will not work effectively unless accepted in a just culture that values teamwork, communication, accountability, and learning from mistakes. Consider the following reasons that many organizations struggle with reliability issues: (1) current improvement trends focus on trying harder or paying more attention, (2) focusing on individual outcomes tends to exaggerate reliability, (3) clinical autonomy allows for

wide performance margins, (4) failure to respond to errors in ways that do not prevent recurrence, and (5) processes rarely designed to meet specific goals or objectives.

Failure Mode and Effect Analysis

FMEA is a process that attempts to prospectively identify error-prone situations or failure modes, within a specific process or system. FMEA begins with identifying all the steps that should take place for a given process to occur. Once completing mapping, use FMEA to identify the ways in which each step can go wrong, the probability of detecting an error, and the consequences or impact of an error going undetected. The estimates of the likelihood of a particular process failure, the chance of detecting such failure, and its impact can combine to produce a criticality index. This criticality index provides a rough quantitative estimate of the magnitude of hazard posed by each step in a high-risk process. Assigning a criticality index to each step allows prioritization of those elements targeted for correction/improvement. An FMEA of the medication-dispensing process in a hospital would break down all steps from the receipt of orders in the central pharmacy to filling automated dispensing machines by pharmacy technicians. Each step in this process would use an assigned probability of failure and a score or rating value.

Technology and Safety

Technology has four common pitfalls: (1) poor design, (2) lack of technology interface with the patient or environment, (3) inadequate implementation plans, and (4) inadequate maintenance. Nursing intuition now relies on technology to detect physical changes in patient conditions. While technology has the potential to improve care, it can also create risks. Healthcare technology can help alleviate many patient safety risks but technological advances can also create new patient related risks. Nurses and other care providers can focus on data from monitors that they fail to detect subtle patient changes. Patient care technologies of interest to nurses range from relatively simple devices, such as catheters and syringes, to highly complex devices, such as barcode medication administration systems and EHRs.

PATIENT-CENTERED HEALTHCARE

Elements of patient-centered care include patient preferences, patient needs, and patient values. Integrated performance consists of clinical performance, operational performance, and financial performance. Restore patient and caregiver trust through organizational transparency (Tables 13.4 and 13.5).

Error Disclosure

Surveys can help to define the components of disclosure that matter most to patients and their families: (1) disclosure of all harmful errors, (2) an explanation as to why the error occurred, (3) how

TABLE 13.4
Informed Consent Issues

- Execute the informed consent procedure and place in chart.
- Document name and signature of the person who explained the procedure.
- Provide informed consent forms written at a fourth-grade reading level.
- Provide consent in primary language of patient (use interpreter if needed).
- Ensure the patient/legal surrogate recounts the information presented.

TABLE 13.5
Documenting Informed Consent

- Patient name, hospital, and medical procedure
- Practitioners' names
- Risks including alternative procedures and treatments
- Signatures of patient or legal guardian and date/time of consent
- Statements that procedure was explained to patient or guardian
- Signature and designation of person witnessing the consent

TABLE 13.6
Key Error Disclosure Issues

- Acknowledge what happened, how it happened, and seek why.
- Determine what actions would reduce recurrence.
- Make a statement that an immediate analysis of the errors will take place.
- Express sympathy and compassion.
- Inform the patient, representative, or family about social services.
- Basic elements of medical disclosure include moral, ethical, and legal.
- Reluctance to admit mistakes provides the greatest barrier to physician disclosure.

to minimize the error's effects, and (4) steps the physician and organization will take to prevent recurrences. *Full disclosure* of an error incorporates these components as well as acknowledgment of responsibility and an apology by the physician. Many physicians *choose their words carefully* by failing to clearly explain the error or its effects on the patient's health. Circumstances surrounding an error can become complex. Physicians may not know how much information to disclose and how to explain the error to the patient. Recently developed guidelines should assist physicians with this process. Since 2001, the Joint Commission has required disclosure of unanticipated outcomes of care. In 2006, the National Quality Forum (NQF) endorsed full disclosure of *serious unanticipated outcomes* as one of its 30 *safe practices* for healthcare (Table 13.6).

Medical Error Disclosure Guidance

The American College of Physicians and American Society of Internal Medicine suggests disclosing if it is *material* to the patient's well-being. The AMA advises error disclosure whenever major medical complications occur. The Joint Commission criterion is for any unanticipated outcome. The NPSF bases the disclosure threshold on any injury occurrence. Use a predetermined error threshold.

Disclosure enhances learning for the clinician and institution. Disclosure enables the patient to obtain appropriate treatment/understanding. Disclosing errors and harm does not result in increased litigation.

The risk of litigation increases when patients or families sense deception. Some clinicians believe that medical errors or unanticipated outcomes can appear as a negligent disclosure of error or the error it could create liability risks (Table 13.7).

Evidence-Based Medicine

Evidence-based medicine (EBM) avoids reliance on instincts and experiences. Specialties many times interpret evidence-based practices in a manner most appropriate to their areas and create inconsistency of systems (Tables 13.8 through 13.11).

TABLE 13.7
Advance Patient Directives

- Self-determination honors a patient's wish regarding end-of-life issues.
- Helps avoidance of discomfort with the preservation of individual dignity.
- Provides for effective pain relief and appropriate emotional support.
- Prevents inappropriate intrusive medical assessments or interventions.
- Permits family and significant personal support including spiritual care.
- Details procedures for palliative medicine or hospice consultation.
- Informs staff about decisions regarding the donation of organs and tissues.

TABLE 13.8
Examples of High-Risk Medical Procedures

- Medication management
- Blood and blood product use
- Restraint and seclusion use
- Behavior management and treatment
- Operative and other invasive procedures
- Resuscitation and its outcomes

TABLE 13.9
Key Sentinel Event Causal Factors

- Communication
- Orientation and training
- Patient assessment
- Availability of information

TABLE 13.10
Practice Guidelines

- Widely used to modify physician behavior.
- Systematically developed to assist with decisions for specific clinical issues.
- Guidelines may affect both the process and the outcome of care.
- Guidelines traditionally focused on ensuring a perceived standard of care.
- Guidelines now emphasize good patient outcomes and safety.

TABLE 13.11
Critical and Clinical Pathways

- Targets the specific processes or sequences of care
- Pathways can help improve multi-disciplinary methods of patient care
- Integrated with local or national clinical practices
- Incorporates responsibilities of care providers with those of ancillary services

General Patient Safety Practices

General patient safety practices include any processes or structures that can reduce the probability of an event occurring as a result of an exposure to something in the healthcare system. A patient safety practice can address either clinical or nonclinical issues.

Using Patient Safety Checklists

An *algorithmic* checklist in many clinical settings can prevent the overlooking of vital steps of a process. Schematic behavior relates to tasks performed reflexively while attentive behaviors deal with tasks requiring active planning and problem solving. Refer to errors associated with failures of schematic behavior as slips. This type of error occurs due to lapses in concentration, distractions, or fatigue. Attentive behavior errors refer to mistakes and frequently result from lack of experience or insufficient training. Checklists can help reduce risks associated with the risk of central-line bloodstream infections. Using demand response checklists for inducing anesthesia, taking surgical timeouts, and transferring a patient out of surgery has helped to reduce adverse patient events. View checklists as useful tools that can improve patient safety but work to understand their limitations. Checklist usage may require certain co-interventions by the medical staff and caregivers to maximize their impact. Checklist can help prevent in clinical tasks that involve primarily attentive behaviors.

HUMAN FACTORS

Human factors science and engineering functions as a broad discipline that considers human strengths and limitations when designing interactive processes and systems. Human factors science addresses issues that involve people, tools, technology, and work environments. A human factors professional examines an activity in terms of its component tasks. Important considerations include the following: (1) physical demands, (2) skill requirements, (3) mental workload, (4) team dynamics, (5) elements in the work environment, and (6) device design required to complete the task optimally and safely. Human factor assessments focus on how systems operate with fallible humans at the controls. Human factors engineers test new systems and/or equipment under real-world conditions when possible. This real-world testing helps identify unintended consequences of new technologies.

Some key human factor issues remain overlooked or ignored by healthcare leaders. Continuous improvement processes always shift the focus from individuals to teams, processes, or systems. The concept known as *migrating decision making* permits a person with greatest expertise (regardless of rank) to make an important decision. Finally, managing complexity of patient care can and often does exceed the capabilities of individuals.

Three key elements of human factors science include (1) forcing functions, (2) standardization, and (3) resiliency efforts. Forcing functions of a system prevents an unintended or undesirable action from being performed or allows its performance only if another specific action is performed first. Standardization increases system reliability, improves information flow, and minimizes cross-training needs. The use of checklists to ensure safety step performance in the correct order can trace its roots to human factors and system methodologies. Resiliency efforts focus design to preclude error. Resiliency approaches tap into the dynamic aspects of risk management and explores how organizations anticipate, adapt, or recover from system anomalies.

PATIENT SAFETY OFFICERS AND COMMITTEES

The IOM recommends that healthcare should establish a comprehensive patient safety function overseen/operated by trained personnel in a culture of safety. Organizations should designate a dedicated patient safety officer. An effective patient safety officer promotes action through the training

of staff and the implementation of proven error reduction methods. Write a job description that assigns the primary role of promoting a culture of safety. A patient safety officer should contribute to the strategic planning through assessing, organizing, and managing organizational patient safety efforts. The appointed person should inspire others and possess effective communication skills. Finally, a patient safety officer should possess healthcare experience and skills to collect and analyze data. Healthcare organizations could establish a committee or other process structure to help ensure patient safety success. Use an approach and structure for your facility that will be effective. Organizations can establish a patient safety committee or use existing committees depending upon the size and resources of the organization. Suggest that larger institutions create a multidisciplinary to implement a patient safety function and assist the patient safety officer. The primary mission should focus on improving communication and care outcomes while promoting better coordination among other functions or departments.

QUALITY IMPROVEMENT TOOLS AND STRATEGIES

As addressed previously, IOM identified six aims of healthcare: (1) effective, (2) safe, (3) patient-centered, (4) timely, (5) efficient, and (6) equitable. The aims of effectiveness and safety target process-of-care measures. Since errors result from system or process failures, adopting various process-improvement techniques can help identify inefficiencies, ineffective care, and preventable errors. Make the identified changes to the associated processes or systems. The complexity of healthcare delivery, the unpredictable nature of healthcare, and the occupational differentiation and interdependence among clinicians and systems make measuring quality difficult. One of the challenges in using measures in healthcare relates to attribution variability associated with high-level cognitive reasoning, discretionary decision making, problem solving, and experiential knowledge. Another measurement challenge relates to reporting and tracking near miss incidents. These types of events, under the right circumstances, could produce harm.

Benchmarking

Define benchmarking in healthcare as the continual and collaborative discipline of measuring and comparing the results of key work processes with those of the best performers in evaluating organizational performance. We can use two types of benchmarking to evaluate patient safety and quality performance. Use internal benchmarking to identify best practices within an organization, to compare best practices within the organization, and to compare current practice over time. Use competitive or external benchmarking to judge performance and identify improvements proven successful in other organizations.

Other Measurements

Structure measures assess the accessibility, availability, and quality of resources, such as health insurance, bed capacity of a hospital, and the number of nurses with advanced training. Process measures assess the delivery of healthcare services by clinicians and providers. Outcome measures indicate the final result of care. Many useful measures can apply to different settings. Without commitment and support of senior-level leadership, even the best intended projects can fail. Champions of quality initiatives and improvement process need to be visible throughout the organization, but especially in leadership positions and on the team.

Stakeholders

When addressing quality improvement efforts, we need to recognize the needs of patients, insurers, regulators, patients, and staff. There exists a need to identify priorities for improvement and meet

the competing needs of stakeholders. Determine the threshold of variation needed to attain to produce desired results. Using a bottom-up approach to changing clinical practice can prove successful if senior leadership supports the efforts and the organizational culture supports change. Whatever the term or acronym of the method/tool used, the important component of quality improvement is a dynamics of the process that often employs multiple tools.

Plan-Do-Study-Act

The majority of quality improvement efforts using plan-do-study-act (PDSA) found greater success by using a series of small and rapid cycles to achieve the goals for the intervention. This helped to implement the initiative gradually and allowed the team to make changes early in the process. The ability of the team to successfully use the PDSA process was improved by providing instruction and training on the use of PDSA cycles, using feedback on the results of the baseline measurements, meeting regularly, and increasing the team's effectiveness by collaborating with others, including patients and families, to achieve a common goal. Some teams experience difficulty in using rapid-cycle change processes, collecting data, and constructing run charts. However, one team reported that applying simple rules of the PDSA cycle generate success when used in complex systems.

Root Cause Analysis

RCA should attempt to discover and analyze causal factors that feed surface problems. Once the problem or issue has been defined, the RCA team attempts to identify, group, and analyze both surface and below-the-surface causal factors. The interface between humans and complex systems that contain hidden factors results in adverse events. The following categories of causal factors commonly arise during healthcare root cause sessions: (1) organizational cultures, (2) management deficiencies, (3) work environments, (4) team effectiveness, (5) staffing, (6) task-related issues, and (7) patient issues. Many investigations miss root causes and focus on finding fault. Placing blame has no place in the investigations or analysis processes. RCA teams need the knowledge and tools to help them systematically organize and analyze collected data. Teams should understand what happened before they attack the why of an event. Sentinel events and other major patient incidents can relate to multiple causes that require systematic analysis. Many healthcare organizations fail to use creative synergistic techniques to identify and correct system root causes. A simple tool that can aid RCA is the *What, Why, Why, Why* process. Another important tool is asking probing or open-ended questions. Never ask questions that require an yes-or-no response. Use the following basic causal factor grouping scheme when categorizing early in the RCA process: (1) organizational factors, (2) operational factors, and (3) motivation factors.

PATIENT ROLES IN PATIENT SAFETY

Efforts to engage should focus on encouraging patients and their families to become actively involved in the care process. Hospital studies reveal that patients often report errors that were not detected through traditional mechanisms such as chart reviews. The AHRQ Fact Sheet *20 Tips to Help Prevent Medical Errors* and the Joint Commission *Speak Up* promotion help educate patients about safety hazards and provide specific questions that patients can ask regarding their safety. The level of patient and family participation remains very difficult to predict. Patients and caregivers already shoulder a significant emotional burden for ensuring safety while hospitalized. Engaging patients in error prevention simply shifts responsibility for safety from providers and institutions to the patients themselves. Patients may also contribute or cause errors. Patient errors occur due to the difficulties inherent in an individual's interaction with a complex medical system. Patient engagement in safety efforts is a strong priority of influential regulatory and governmental organizations.

IMPROVING PATIENT SAFETY

Wrong Surgeries

Few medical errors provide more terror for patients than those experiencing surgery on the wrong body part, undergone the incorrect procedure, or received a procedure intended for another patient. These *wrong-site, wrong-procedure, wrong-patient errors* (WSPEs)—rightly termed never events—should never occur. Wrong-site surgery may involve operating on the wrong level of the spine, a common mistake for neurosurgeons. A classic case of wrong-patient surgery involved a patient who underwent a cardiac procedure for another patient with a similar last name. According to AHRQ, a seminal study estimated that these errors occur in approximately 1 of 112,000 surgical procedures. A study using Veterans Affairs data found that fully half of WSPEs occurred during procedures outside of the operating room. Early efforts to prevent WSPEs focused on developing redundant mechanisms for identifying the *correct* site, procedure, and patient. These procedures included *sign your site* initiatives. It soon became clear that even this simple intervention posed problems. Site-marking protocols did increase the use of preoperative marking, but implementation and adherence differed significantly across surgical specialties and hospitals. In some instances, confusion occurred about whether the marked site indicated the area needing surgery or the area to avoid. However, site marking remains a core component of the Joint Commission's Universal Protocol. RCAs of WSPEs reveal that communication-related factors continue to surface as key causal factors in adverse events. The use of a surgical timeout or a planned pause to review important aspects of a procedure with all involved personnel improves communication in the operating room and helps prevent WSPEs. The Universal Protocol also specifies the use of a timeout prior to all procedures. Although initially designed for operating room procedures, organization should use timeouts before any invasive procedure. The use of checklists can improve surgical and postoperative safety. The incidence rate makes it difficult to establish any single intervention that can reduce or eliminate WSPEs. Preventing WSPEs depends on the use of system solutions such as strong teamwork, establishing a safety culture, and through individual vigilance. The NQF considers WSPEs as never events. The Joint Commission treats such errors as sentinel events. In February 2009, the CMS announced that hospitals lose reimbursement for any costs associated with WSPEs.

Diagnostic Errors

Cognitive psychology has classified several types of errors that clinicians make due to anchoring errors or premature closure that relied on initial diagnostic information. Framing errors occur when providers make biased diagnostic decisions based on subtle cues and collateral information. Blind obedience errors result when placing undue reliance on clinical test results or *expert* opinions that can delay proper diagnosis. Biases on the part of individual clinicians do play roles in many diagnostic errors. Underlying healthcare system problems also contribute to many missed or delayed diagnoses. Many diagnostic errors occur in primary care, pediatrics, emergency medicine, and surgery. Poor teamwork and communication among clinicians can contribute to diagnostic errors. Preventing some diagnostic errors would mitigate the effect of these biases and provide physicians with more objective information for their decision making. Many clinicians remain unaware of diagnostic errors they committed. Computerized diagnostic decision support has not yet been proven to improve overall diagnostic accuracy. Information technology has improved clinicians' ability to follow up on diagnostic tests in a timely fashion. Structured protocols for telephone triage, teamwork training, communication improvement, and increased supervision of trainees could help improve diagnostic performance. A key goal should encourage clinicians to reflect about their personal thinking processes. A recent commentary termed diagnostic error *the next frontier for patient safety* and called for more research into solutions for individual and system causes of diagnostic error.

Never Events

The term *never event* was initially introduced in 2001 by a former CEO of the NQF. The term refers to particularly shocking medical errors, such as a wrong-site surgery, that should never occur. The list includes identifiable and measurable events. Listed *never events* can result in death or significant disability. The NQF initially defined 27 such events in 2002 and revised and expanded the list in 2006. The list is grouped into six categorical events: surgical, product or device, patient protection, care management, environmental, and criminal. Refer to the current list of never events on the NQF website. A recent study estimated that a typical hospital might experience a case of wrong-site surgery once every 5–10 years. The Joint Commission mandates an RCA after each sentinel event. The Leapfrog Group recommends that in addition to an RCA, organizations should disclose the error and apologize to the patient, report the event, and waive all costs associated with the event. CMS announced in 2007 that Medicare would no longer pay for additional costs associated with many preventable errors, including those considered never events. Since then, some states and private insurers adopted similar policies. Since early 2009, CMS has not paid for any costs associated with wrong-site surgeries.

Handoffs

Handoffs happen frequently, and studies link them to adverse events occurring in settings ranging from emergency departments to intensive care units. Guidelines for safe handoffs focus on standardizing policies. The components of a safe and effective sign-out include the following: (1) accurate administrative data such as patient name, medical record information/number, and location; (2) update of any new clinical information; (3) covering provider should clearly explain needed tasks; (4) communicate illness severity; and (5) outline of contingency plans for changes in clinical status to assist cross-coverage management of the patient overnight. The Joint Commission requires all healthcare providers to "implement a standardized approach to handoff communications including an opportunity to ask and respond to questions."

Discharged Patient Events

Studies suggest that one in five patients experience adverse events within 3 weeks of discharge from the hospital. Most were drug-related incidents. Minimizing postdischarge adverse events should become a patient safety priority. Actually, patient safety begins before a patient arrives and continues after discharge. The transition of care process contributes to most of the events. Lack of continuity and poor communication among inpatient and outpatient providers occur too frequently. Inadequate medication reconciliation results in an increased risk of adverse drug events (ADEs). Low health literacy contributes to the problem. Hospitals should conduct a thorough assessment of discharged patients and their ability to care for themselves after release. The segmentation or fragmentation of care also hinders a hospital's incentive to improve discharge processes. Healthcare organizations should develop systematic discharge processes that focus on medication reconciliation, discharge communication, and education of patients and their families on diagnoses and follow-up requirements. Use trained staff to meet with patients before and sometimes after discharge to address medication reconciliation, self-care instructions, and how to facilitate communication with outpatient physicians.

HEALTHCARE-ASSOCIATED INFECTIONS

According to the CDC, almost 1.7 million hospital-acquired infections occur yearly, contributing to approximately 99,000 deaths. Such infections were long accepted by clinicians as an inevitable hazard. Recent efforts demonstrate that simple measures can prevent the majority of common infections.

Hospitals and providers must work to reduce the burden of these infections. Four specific infections account for more than 80% of all hospital-related infections. Their list includes surgical site infections (SSIs), catheter-associated urinary tract infection (CAUTIs), central venous catheter (CVC)–related bloodstream infections (CRBSIs), and ventilator-associated pneumonia (VAP). Preventing the transmission of antibiotic-resistant bacteria such as MRSA has become increasingly important. Effective measures exist to prevent the most common healthcare-associated infections (HAIs).

Central Venous Catheter–Related Bloodstream Infections

Employ maximal sterile barrier precautions. Use aseptic technique including the use of a cap, mask, sterile gown, sterile gloves, and a large sterile sheet for the insertion of all CVCs. Use 2% chlorhexidine gluconate solution for skin sterilization at the CVC insertion site. Avoid femoral site for nonemergency CVC insertion and ensure prompt removal of unnecessary catheters.

Surgical Site Infection

Ensure administration of appropriate prophylactic antibiotic, generally begun within 1 h before skin incision and discontinued within 24 h. Avoid shaving of the operative site and use clippers or other methods for hair removal in the area of skin incision(s). Ensure maintenance of blood glucose less than 150 mg/dL during postoperative period. Use tighter controls needed in specific patient populations.

Ventilator-Associated Pneumonia

Ensure elevation of the head of the bed to more than 30° for all mechanically ventilated patients. Minimize the duration of mechanical ventilation by minimizing sedative administration (including daily *sedation holidays*) and/or using protocol-based weaning.

Catheter-Associated Urinary Tract Infection

Ensure the use of skin antisepsis at insertion and proper aseptic technique for the maintenance of catheter and drainage bag, and the use of closed urinary drainage system. Ensure removal of urinary catheter when no longer essential for care.

MEDICATION SAFETY

Medications include prescriptions, samples, herbal remedies, vitamins, over-the-counter drugs, vaccines, diagnostic drugs, and contrast agents used on/administered to persons to diagnose, treat, or prevent disease. The list includes radioactive medications, respiratory therapy treatments, blood derivatives, intravenous solutions, and any product designated by the FDA as a drug. The definition of medication does not include enteral nutrition solutions, oxygen, and other medical gases. Consider medication management as an important component in the palliative, symptomatic, and curative treatment of many diseases or conditions.

Medication Errors

Clinicians must deal with more than 10,000 prescription medications. One-third of adults in the United States take five or more medications. Patients admitted to a hospital commonly receive new medications or incur changes to their existing medications. Hospital-based clinicians also may not access a patient's complete medication list or remain unaware of recent medication changes. As a result, the new medication regimen prescribed at the time of discharge may inadvertently omit needed

medications, unnecessarily duplicate existing therapies, or contain incorrect dosages. Such unintended inconsistencies in medication regimens may occur at any point of transition in care such as transfer from an intensive care unit to a general nursing unit. Studies show that unintended medication discrepancies occur in nearly one-third of patients at admission, a similar proportion at the time of transfer from one site of care within a hospital, and in 14% of patients at hospital discharge. Medication reconciliation refers to the process of avoiding such inadvertent inconsistencies across transitions in care by reviewing the patient's complete medication regimen at the time of admission, transfer, and discharge and comparing it with the regimen being considered for the new setting of care. Though most often discussed in the hospital context, medication reconciliation can prove equally important in ambulatory care, as many patients receive prescriptions from more than one outpatient provider.

Advances in clinical therapeutics can result in major improvements in the health of patients. These benefits can become overshadowed by increased risks. An ADE is defined as harm experienced by a patient as a result of exposure to a medication, and ADEs account for nearly 700,000 emergency department visits and 100,000 hospitalizations each year. ADEs affect nearly 5% of hospitalized patients, making them one of the most common types of inpatient errors; ambulatory patients may experience ADEs at even higher rates.

As with the more general term *adverse event*, the occurrence of an ADE does not necessarily indicate an error or poor quality care. A *medication error* refers to an error (of commission or omission) at any step along the pathway that begins when a clinician prescribes a medication and ends when the patient actually receives the medication. Preventable ADEs result from a medication error that reaches the patient and causes any degree of harm. We can characterize medication errors that do not cause any harm because of interception before reaching the patient or by simple luck as potential ADEs. A certain percentage of patients can still experience ADEs from medications correctly prescribed and administered appropriately. Consider these events as adverse drug reactions or nonpreventable events. For example, the safe use of heparin requires weight-based dosing and frequent monitoring of tests of the blood's clotting ability. Taking these actions can help avoid either bleeding complications for high doses and or clotting risks for low doses. Prescribing an incorrect dose of a medication would result in an error even if a pharmacist detected the mistake before the patient received the dose. If the incorrect dose gets dispensed and administered, but no clinical consequences occurred, that would still classify as a potential ADE.

Risk Factors for Adverse Drug Events

There exist patient-specific and drug-specific risk factors for adverse events. Older patients take more medications and can prove more vulnerable to specific medication adverse effects. Pediatric patients experience a more elevated risk, particularly when hospitalized due to poor weight dosing. Other well-documented patient-specific risk factors include limited health literacy and math ability. Ambulatory patient factors remain overlooked as an important source of ADEs. Studies show that both caregivers and patient can commit medication administration errors at surprisingly high rates. The Institute for Safe Medication Practices (ISMP) maintains a list of high-alert medications—medications that can cause significant patient harm if used in error. These include not only medications with dangerous adverse effects, but also look-alike, soundalike medications, with similar names and physical appearance but containing completely different pharmaceutical properties.

Prevention of Adverse Drug Events

The pathway between a clinician's decision to prescribe a medication and the patient actually receiving the medication consists of several steps:

- Ordering: The clinician should select the appropriate medication and determine the dose and frequency of administration.

- Transcribing: In a paper-based system, an intermediary (a clerk in the hospital setting, or a pharmacist or pharmacy technician in the outpatient setting) should read and interpret the prescription correctly.
- Dispensing: The pharmacist should check for drug–drug interactions and allergies, then release the appropriate quantity of the medication in the correct form.
- Administration: Supply the correct medication for administration to the correct patient at the correct time.

While the majority of errors likely occur at the prescribing and transcribing stages, medication administration errors do occur frequently in both inpatient and outpatient settings. Analysis of serious medication errors invariably reveals other underlying system flaws, such as human factors engineering issues and impaired safety culture, that allowed individual prescribing or administration errors to reach the patient and cause serious harm. Integration of information technology solutions, computerized provider order entry (CPOE), and barcode medication administration into *closed-loop* medication systems holds great promise for improving medication safety in hospitals. Preventing ADEs remains a key priority for accrediting and regulatory agencies. The Partnership for Patients now includes ADE prevention as a patient safety improvement goal. The Partnership for Patients set a goal of reducing preventable ADEs in hospitalized patients by 50%.

Accomplishing Medication Reconciliation

A 2012 systematic review of inpatient medication reconciliation studies did find some evidence supporting pharmacist-led medication reconciliation processes. However, the study did not reach any firm conclusions regarding the most effective strategies.

The Joint Commission suspended scoring of medication reconciliation during on-site accreditation surveys between 2009 and 2011. As of July 2011, medication reconciliation became incorporated into National Patient Safety Goal 3, *Improving the safety of using medications*. This National Patient Safety Goal requires that organizations "maintain and communicate accurate medication information" and "compare the medication information the patient brought to the hospital with the medications ordered for the patient by the hospital in order to identify and resolve discrepancies."

Medication reconciliation processes can help avoid inadvertent inconsistencies across transitions in care. Accomplish this by reviewing the patient's complete medication regimen at the time of admission, at transfer, and upon discharge to compare it with the regimen being considered for any new setting of care. Researchers continue to study a variety of methods to include (1) pharmacists performing the entire process, (2) linking medication reconciliation to existing CPOE systems, and (3) integrating medication reconciliation within the EMR system. In 2009, the Joint Commission announced that they would no longer formally score medication reconciliation during on-site accreditation surveys. This policy change was made in recognition of the lack of proven strategies for accomplishing medication reconciliation (Table 13.12).

TABLE 13.12
Key Medication Reconciliation Suggestions

- Facility personnel should identify all medications of patients being admitted.
- Require the patient or a family member validate the list if possible.
- Compare admission orders with the preadmission medication list.
- Make the list readily available to prescribing professionals.
- Provide reconciliation info to the next unit or patient care setting.
- Give the complete list of medications to the patient at discharge.

Medication Administration

Develop guidelines for staff members administering medications with or without supervision, consistent with law and regulation and organization policy. Address an individual's qualification to administer by medication, medication class, or route of administration. Provide guidelines for prescribing professional notification in the event of an adverse drug reaction or medication error. Identify the patient by using at least two individual identifiers excluding patient location. Verify the correct medication by reviewing the medication order and product label. Verify stability by conducting a visual examination for particulate matter or discoloration and check the medication expiration date.

Verify that no contraindication exists before administering the medication. Validate the medication administration time, prescribed dose, and correct administration route. Advise the patient or the patient's family about any potential adverse reactions. Discuss any significant concerns about the medication with the patient's physician or prescriber. Provide guidance and training to patients doing self-administration of drugs. Training topics should include how to administer, frequency, route of administration, and dosage. Educate caregivers about any possible side effects of the medications administered (Tables 13.13 and 13.14).

Reducing Medication Errors

Many medication errors occur while communicating or transcribing medication orders. Take steps to reduce the potential for error or misinterpretation of written or verbal orders. The written policy should address the required elements of a complete medication order. Develop and publish as a list of unacceptable abbreviations, symbols, acronyms, and dose information. Provide guidance on the use and acceptability of generic versus brand name drugs. Implement detailed policies for ordering drugs with look-alike or soundalike names. Post procedures for dealing with incomplete, illegible, or unclear orders.

TABLE 13.13
Medication Administration Safety Suggestions

- Ensure guidelines consistency with laws, regulations, and policies.
- Address qualifications to administer by medication, class, or route.
- Develop guidance for professional notification for an adverse drug event.
- Identify patients using at least two individual identifiers excluding room.
- Review orders and product labels and conduct a visual exam of medications.
- Check the medication expiration date.
- Ensure that no contraindication exists before administering.
- Verify medication administration time, dose, and route.
- Advise patient or the patient's family about any potential adverse reactions.

TABLE 13.14
High-Alert Medications Safety Suggestions

- Identify all high-alert drugs available at the facility.
- Implement processes to identify new medications for placement on the list.
- Develop guidelines, dosing scales, and checklists for all high-alert drugs.
- Implement a process to audit compliance with the protocols and guidelines.

TABLE 13.15
Medication Error Categories

- Failure to administer medication when required or as prescribed
- Administration of the medication at the wrong time or using an incorrect route
- Administration of the wrong dosage or concentration of a drug
- Administration of the wrong medication
- Misunderstanding verbal/written medication orders including transcription
- Administering medication to the wrong patient
- Failure to read container labels and using improper injection techniques

Discourage the use of verbal and telephone orders. Implement a verification process for verbal or telephone orders. Create policies for implementing weight-based dosing (Table 13.15).

Reporting Medication Errors

Each organization should comply with internal and external reporting requirements. This may include notifying US Pharmacopeia (USP), FDA, or ISMP. Error and adverse events may relate to professional practice, healthcare products, procedures, and systems. This can include prescribing, order communication, product labeling, packaging, nomenclature, compounding, dispensing, distribution, administration, education, monitoring, and usage. The FDA receives medication error reports on marketed human drugs including prescription drugs, generic drugs, and over-the-counter drugs, and nonvaccine biological products/devices. In 1992, the FDA began monitoring medication error reports forwarded to FDA from the USP and ISMP. The Agency also reviews MedWatch reports for possible medication errors.

Investigating Medication Errors

The organization should designate a qualified person or department to conduct a thorough investigation to document all the facts. Investigations should seek to determine or document all facts surrounding the incident. Document all facts such as unit, time, date, and shift. Evaluate and determine staffing levels at the time of occurrence. Determine what other factors contributed to the event. Assess the legibility and accuracy of physician orders. Gather information on failure to follow safety precautions or other procedures. Ensure evaluation of facts by senior leaders, nurses, and pharmacy personnel. Document trends or patterns and implement corrective actions.

Computerized Provider Order Entry

The basic steps of a CPOE system include (1) ordering appropriate medication, dose, and frequency of administration; (2) transcribing the order correctly and communicating accurately to the pharmacist; (3) dispensing, which requires the pharmacist to check for drug–drug interactions and allergies before releasing the appropriate quantity of the medication in the correct form; and (4) administration, which requires that the nurse should receive the medication and check for accuracy before giving it to the correct patient. CPOE refers to any system in which clinicians directly enter medication orders into a computer system. The system transmits the order directly to the pharmacy. A CPOE system does ensure standardized, legible, and complete orders that can reduce errors at the ordering and transcribing stages. Other advantages include averting problems with similar drug names, drug interactions, and specification errors. Some unanticipated consequences of using CPOE systems includes (1) workflow issues, (2) system demands, (3) changes in communication patterns and practices, (4) negative feelings toward the new technology, (5) unexpected changes to

organizational power structure or culture, and (6) an overdependence on the technology. AHRQ and the NQF both recommend CPOE system usage as 1 of the 30 *Safe Practices for Better Healthcare*. The Leapfrog Group also recommends CPOE implementation as one of its first three recommended *leaps* for improving patient safety. A 2009 study found that only 17% of US hospitals used a CPOE system.

EMERGENCY DEPARTMENT PATIENT SAFETY

Emergency department errors can easily become less visible due to lack of feedback. Clinicians may never know if their decisions or actions were right or wrong. Errors can occur since responsibility can be diffused across shifts and teams. Patients can present symptoms or problems of varying acuity. Healthcare personnel may not possess all of the information about patients. Emergency department personnel can experience a high degree of uncertainty despite urgency to provide medical intervention. Emergency departments face many distractions including the need to multitask. The nature of the job including shift work and informal communication networks can hinder patient care.

Diagnostic errors or flawed decisions continue to commonly occur in emergency departments. Mistakes can occur at any of the following steps: (1) knowledge gap or inexperience, (2) failure to recognize a disease pattern, and (3) misinterpretation or misapplication of diagnostic testing. High-risk times such as shift transitions, staffing issues, and patient transfers can also contribute to errors (Table 13.16).

AMBULATORY CARE PATIENT SAFETY

The nature of interactions between patients and outpatient providers can also contribute to adverse events. Circumstances can limit face-to-face interaction between a provider and a patient. Patients then should assume a much greater role in and responsibility for managing their own health. This elevates the importance of patient education to ensure that patients understand their illnesses and treatments. Medication errors can occur due to a patient's understanding of the indication, dosing schedule, proper administration, and potential side effects of a drug. Low health literacy and poor patient education contribute to increased error risks. Patients should understand how and when to contact their caregivers outside of routine appointments.

PHYSICIAN WORK HOURS AND PATIENT SAFETY

In 2003, the ACGME implemented new rules limiting work hours for all residents. Residents should work no more than 80 h/week or 24 consecutive hours at a time. Schedule residents for on-call duty for more than every third night. Organizations should provide them 1 day off per week. A 2008 study of pediatric residents found no change in medication errors after implementation

TABLE 13.16
Common Malpractice Situations in Emergency Departments

- Delay in treatment
- Missed fractures
- Wound care complications
- Abdominal or stomach pain
- Missed meningitis
- Spinal cord injury
- Subarachnoid hemorrhage
- Ectopic pregnancy

of the ACGME regulations. The impact of the duty-hour regulations on educational variables has also been surprisingly mixed.

Accreditation Council for Graduate Medical Education

The ACGME issued new standards for duty hours in the fall of 2010, which went into effect in July 2011. The new regulations concurred with the 2008 IOM report entitled, *Resident Duty Hours: Enhancing Sleep, Supervision, and Safety*, by recommending the elimination of extended duration shifts. Early experiences with simulation successfully improved a resident's technical, cognitive, and teamwork skills. The new ACGME regulations do not recommend a significant reduction in overall weekly work hours from the present limit of 80.

RAPID RESPONSE SYSTEMS

Many hospitals now use rapid response teams as a patient safety intervention. Patients whose condition deteriorates acutely while hospitalized often exhibit warning signs in the hours before experiencing adverse clinical outcomes. A 2006 consensus conference advocated use of the term *rapid response system* (RRS) as a unifying term. Many physician hospitalists now assume RRS duties, either as the primary responder or to assist nurse-led teams. Many hospitals permit any staff member to call the team if one of the following criteria is met: (1) high or low heart rate, (2) high or low respiratory rate, (3) systolic blood pressure greater than 180 or less than 90, (4) low oxygen saturation, (5) acute change in mental status, (6) low urine output, and (7) a staff member has significant concern about the patient's condition.

CALL SYSTEM OPERATION

Consider call systems as patient safety tools. To promote legitimate use of call systems, patients and nurses need additional education. Nurses should know that call systems encourage patients not to do things for which they need help. Recent reports indicate that some nursing personnel may ignore calls during overnight shifts. Even though a call for help may seem to be a nuisance, nurses should be encouraged to consider what might happen if a patient attempted a potentially dangerous activity without assistance. Nursing personnel should explain to each patient the proper use of the call system and specify what the patient can do and should not attempt to do without assistance. Responding promptly and courteously to patient calls will encourage patients to use the system rather than attempt a dangerous activity. Locate call buttons within easy reach of the patient's bed. This action can help prevent major patient incidents.

ELECTRONIC MEDICAL AND HEALTH RECORDS

Many individuals view EMRs and EHRs as identical. However, The EMR is the legal record of source data created in healthcare environments. EMRs create data used by EHRs. The EHR represents the capability to provide medical information among various stakeholders. EHRs rely upon information contained in EMRs. However, EMRs will also rely upon EHRs compiling the historical patient treatment information. NIH defines an EHR as a longitudinal electronic record of patient health information generated as a result of receiving medical treatment in various settings. EHRs provide information about a patient's demographics, progress notes, problems, medications, vital signs, medical history, immunizations, laboratory data, and even radiology reports. The EHR helps automate and streamline a healthcare professional's workflow. The EHR has the ability to generate a complete record of a clinical patient encounter. An EHR, normally generated and maintained within a hospital, delivery network, clinic, or physician office, improves the quality and timeliness of decision making by providing nurses, physicians, and other clinicians. EHRs can provide

comprehensive and up-to-date information, and it provides a source of data for error reporting and analysis. Organizations should employ information technology that uses standards to support data interchange, medical terminologies, and knowledge transfers.

Key Components of Electronic Health Records

Most commercial EHRs combine data from the large ancillary services, such as pharmacy, laboratory, and radiology, with various clinical care components such as nursing plans, medication administration records, and physician orders. The number of integrated components and features involved in any given situation would depend on data structures and systems used. The EHR may import data from the ancillary systems via a custom interface or may provide interfaces that allow clinicians to access the silo systems through a portal. The EHR may incorporate only a few ancillaries.

Electronic Charting

Point-of-care clinical documentation solutions enable nurses to focus more on the important patient care tasks at hand and less on documentation. Access to electronic documentation at the bedside also streamlines the care process and assists all clinicians in making better patient care decisions. Critical patient data such as lab results and vital signs stay at the clinician's fingertips. Record vital signs and other clinical data electronically through interfaces to patient monitors, further streamlining the documentation process. Communication among caregivers is enhanced since patient data are now available in real time to any caregiver with access to the system. Bedside charting means the change in patient charting tasks from the old-fashioned paper-based system of medical records management that was done by a file clerk in an office to using cutting-edge technology for nurses and physicians to do real-time electronic patient chart management right at the bedside. Some clinical studies did find that the use of electronic bedside patient charting could dramatically decrease medical error occurrence while improving outcomes and decreasing administrative costs. Due to high start-up costs for implementing EMR systems, a significant number of hospitals, physicians' offices, and care clinics still use paper-based patient charting. Some hospitals with EMR systems still generally do not use mobile bedside charting technologies. Many hospitals now use workstations on wheels. These electronic devices provide instant access to patient information. Caregivers can easily access, monitor, and chart patient care. Some hospitals use coordinated systems that address patient care, medication verification, and CPOE.

INFANT ABDUCTION PREVENTION

As part of contingency planning, every facility should develop a written protocol plan for infant abduction. Communicate this protocol to all staff members within the maternal child care unit. All departments including plant operations, communications, switchboard operations, plant engineering, accounting, and public relations should know the protocol. When formulating a protocol, facilities need to consider several items. For instance, the layout or schematics and traffic patterns differ among facilities. Ask law enforcement to use crime code numbers to help prevent the general population from becoming aware of the situation during the initial response. Follow the media response plan to control the release of information. Clear any releases with law enforcement or hospital authorities. Officials making statements should do so in forthright manner without invading the privacy of the family. The family should know about the media plan and their cooperation sought in working through the official spokespersons. Notify newborn nurseries, pediatric units, emergency rooms, and outpatient clinics for postpartum/pediatric care at other healthcare facilities about the incident. Provide a full description of the baby and the suspected or alleged abductor. Designate a separate area where friends and family of the parents can gather to receive regular updates on the

abduction in order to keep them informed about the case and shielded from the press. Provide operators with a written response for use of those inquiring about the situation.

Preventive Measures

Implement a policy that requires the mandatory wearing of identification badges by all hospital workers, medical staff, and other designated provider groups. A photo ID is preferable. Consider using further security measures for those working in nurseries, pediatrics, and obstetrics. Issue specific badges to employees assigned to the area on a temporary basis such as housekeeping and volunteer personnel.

Develop a system to identify the infant, mother, father, or a designated other before the baby leaves the birthing area. Develop procedures to address discharge of the mother prior to the infant leaving the hospital. Ensure adherence to documentation procedures to follow when a mother will not receive the baby on discharge (Tables 13.17 and 13.18).

PATIENT RESTRAINTS

We can define restraints as any manual method, physical device, or mechanical device used to restrict the freedom of movement or normal access to one's body. Due to an increasing number of reports of injury and death associated with the incorrect use of patient restraints, the FDA warns health professionals to ensure the safe use of these devices. Restraints can include safety vests, lap belts, wheelchair belts, and body holders. Incorrect use of these devices has involved using the

TABLE 13.17
Infant Abduction Offender Profile

- Female, 12–50 years of age and often overweight.
- Most likely compulsive; most often relies on manipulation, lying, and deception.
- Frequently indicates that she has lost a baby or incapable of having one.
- Often married or involved in cohabitation arrangement.
- Companion's desire for a child may/can provide motivation for the abduction.
- Usually lives in the community where the abduction takes place.
- Frequently visits nursery and maternity units prior to the abduction.
- Asks detailed questions about hospital procedures and the maternity floor layout.
- Frequently uses a fire exit stairwell for escape.
- Usually plans the abduction and does not target a specific infant.
- Frequently impersonates a nurse or other allied health professional.
- Often becomes familiar with hospital personnel and even with the victim's parents.
- Abductors provide good care to the baby.

TABLE 13.18
Root Causes of Infant Abductions

- Lack of appropriate security equipment
- Poor line-of-sight entrances and unmonitored elevators or stairwells
- Staff-related factors such as insufficient education, lack of competency, and insufficient manpower
- Delay in notifying security when an abduction is suspected, improper communication of relevant information among caregivers, and improper communication between hospital units
- Organization cultural factors such as reluctance to confront unidentified visitors or providers

wrong size for a patient's weight, errors in securing restraints, and inadequate patient monitoring. Such mistakes can result in fractures, burns, and strangulations. We can simply define a restraint as any manual method, physical device, mechanical device, material, or equipment attached or adjacent to a patient or resident's body that restricts freedom of movement or normal access to one's body. Under this functional definition, other devices or facility practices also may meet the definition of a restraint, such as tucking in a bedsheet so tightly that a patient's movement in or out of bed is restricted or use of a specialty bed that limits a patient from voluntarily exiting from bed. This definition considers side rails, regardless of size, as restraints. The CMS issued regulations in 2006 clarifying under Medicare's Conditions of Participation for Hospitals who may order patient restraint or seclusion as a delegated responsibility.

The use of restraint should comply with the order of a physician or other licensed independent practitioner permitted by the state to order a restraint. Any professional is permitted by state law and hospital policy to order restraints and seclusion for patients independently, within the scope of the individual's license and consistent with the individually granted clinical privileges. Physicians must take individually accountability for the care of their patients. The physician has the discretion to delegate, or to withhold the delegation of, tasks or responsibilities, as he or she deems appropriate. CMS requires consultation with the attending physician as soon as possible if the attending physician did not order the restraint or seclusion. The final regulations clarify that physicians, PAs, and RNs can perform face-to-face assessment within 1 h. When using restraint or seclusion for the management of violent or self-destructive behaviors jeopardizing the physical safety of a patient, staff member, or others, see the patient within 1 h after the initiation of the intervention. The regulations also require that if an RN or PA performs the assessment, they contact the attending physician with the results as soon as possible.

Most Medical/Surgical Restraints Exempt

Define a restraint as any manual method, physical or mechanical device, material, or equipment that immobilizes or reduces the ability of a patient to move his or her arms, legs, body, or head freely. Drugs also qualify when used as a restriction to manage the patient's behavior or restrict the patient's freedom of movement. Restraints used in medical or surgical care do not fall under the CMS rule. A restraint does not include devices, such as orthopedically prescribed devices, surgical dressings or bandages, protective helmets, or other methods that involve the physical holding of a patient for the purpose of conducting routine physical examinations or tests, or to protect the patient from falling out of bed, or to permit the patient to participate in activities without the risk of physical harm (Table 13.19).

Patient Evaluation

Use data collection practices to measure and evaluate restraint-related injuries as well as the overall use of restraints. Use continuous quality improvement processes to monitor no injury-related falls.

TABLE 13.19
Types of Patient Restraints

- Safety bars—Used on wheelchairs to prevent falls.
- Soft belts—Similar to seat belts to prevent falls from beds and wheelchairs.
- Safety vest—Provides more support in preventing falls from a chair or bed.
- Wrist restraint—A limb-holding restraint that prevents the patient from removing tubes or bandages. Note: Physically check every 15 min to ensure circulation.
- Mitt restraint—This type of restraint restricts finger movement but permits movement of the arm and wrist.

RCA can help catalog factors contributing to serious falls. Provide staff with continuing education on fall risk assessment, interventions to prevent falls, proper application of restraint, monitoring of the restrained veteran, methods to reduce restraint use, and documentation of these care practices. The use of physical restraints may occur only if documentation reflects the presence of a specific medical symptom warranting their use. Document the use of such restraint to treat the symptom and how the restraint assists the patient in attaining or maintaining his or her highest level of physical, mental, and psychosocial well-being.

PATIENT FALL PREVENTION

Slips, trips, and falls represent the most common patient-related occurrences in healthcare facilities. Many healthcare workers also become slip, trip, and fall victims each year. Determine trends and problem areas by analyzing appropriate safety and risk data. Falls happen because people and conditions do not remain static. Nursing personnel should become actively involved in the fall prevention efforts. Leaders must strive to increase the awareness of fall hazards located in the unit or department. Care plans should contain information on each patient or long-term care resident to help minimize the risk of a fall. An effective process should identify, evaluate, and correct all hazards contributing to fall events. Educate caregivers about the physical hazards and behavioral aspects of fall prevention. Establish procedures for analyzing the trends and problems within the facility. Implement hazard surveillance strategies to identify and correct physical fall hazards. Place an emphasis on high-risk areas as determined by a statistical analysis of data. Conduct a quarterly assessment of effectiveness and an annual audit of all plan elements.

Environmental Hazards

The healthcare organization should maintain a safe environment for patients, visitors, and staff. Switches should be accessible to the patient upon entering the room and from the bed. Lights should shine bright enough to compensate for limited vision and for the activities performed in the room. Night-lights should be available in patient rooms, bathrooms, and hallways. Lighting should be adequate on stairs and hallways. Floor-level lighting should reduce glare. Secure handrails should be provided on both sides of the staircase. Steps can be painted or outlined for increased visibility and covered with nonslip material. Keep stairs clutter free and well maintained. Floors should never produce glare. Recommend the use of nonskid wax surfaces and throw rugs with nonslip backing. Tape or tack down carpet edges. Some carpet patterns impair perception and may contribute to falls. Use visual warnings to alert patients about flooring changes and hallway turns. Design unobstructed pathways from bed to bathroom. Ensure the proper location and security of chairs, tables, nightstands, and over-the-bed tables. Make call buttons or bells easily accessible from the bed. Ensure that bathroom doors permit easy wheelchair or walker passage. Ensure that all tubs and showers contain nonskid strips or mats. Install grab bars securely to the walls and at a height to allow easy access. Place grab bars near tubs, showers, and toilets. Make sure that the toilet seats are not elevated.

HEALTH INSURANCE PORTABILITY AND ACCOUNTABILITY ACT

This act covers all healthcare organizations. This includes all healthcare providers, even single physician offices, health plans, employers, public health authorities, life insurers, clearinghouses, billing agencies, information systems vendors, service organizations, and universities. The goal of the act is to promote administrative simplification of healthcare transactions and to ensure the privacy and security of patient information. The act's transaction standards call for the use of common electronic claims standards, common code sets, and unique identifiers for all healthcare payers and providers. The security regulations of the act prescribe the administrative procedures and

physical safeguards for ensuring the confidentiality and integrity of protected health information. The security regulations will provide a uniform level of protection of all health information housed or transmitted electronically. Patients retain the right to understand and control the use of their health information. Healthcare providers should provide patients with a clear written explanation of how they use, keep, and disclose patient information. Provide patients access to their medical records. The standard restricts the release of certain information without patient consent. The act prohibits coercion of patient consent. Patients retain recourse options when an organization violates their confidentiality. Protected patient information includes the following:

- Name and specific dates of birth, admission, discharge, or death
- Telephone numbers, Social Security number, and medical record number
- Photographs, city, zip code, and other geographic identifiers

BED SAFETY

Today there are about 2.5 million hospital and nursing home beds in use in the United States. Between 1985 and January 1, 2009, 803 incidents of patients caught, trapped, entangled, or strangled in beds with rails were reported to the US Food and Drug Administration. Of these reports, 480 people died, 138 had a nonfatal injury, and 185 were not injured because staff intervened. Most patients were frail, elderly, or confused. Carefully assess all patients experiencing problems with memory, sleeping, incontinence, pain, uncontrolled body movement, or who get out of bed. Assessment by the patient's healthcare team will help to determine how best to keep the patient safe. Never use or permit bed rails to become restraints. Regulatory agencies, healthcare organizations, product manufacturers, and advocacy groups encourage hospitals, nursing homes, and home care providers to assess patients' needs and to provide safe care without restraints.

Bed Safety Inspections

Inspect all bed frames, side rails, and mattresses as part of the preventive maintenance procedures. Ensure proper alignment and that no gap exists wide enough to entrap a patient. Never replace mattresses and side rails with dimensions different from the original equipment supplied by the manufacturer. Check bed side rails for proper installation using manufacturer's instructions. Establish safety rules and procedures for patients considered at high risk for entrapment. Use bed side rail protectors to close off open spaces which could lead to entrapment. Never use bed side rails as a patient-protective restraint. Use of restraints requires frequent monitoring and compliance with local, state, and federal regulations. The Safe Medical Device Act requires healthcare organizations to report bed-related incidents resulting in death or injury. Using a bed rail or other device to restrain the patient could place the patient's safety at risk.

Individualized Patient Assessment

Any decision regarding bed rail use or removal from use should be made within the framework of an individual patient assessment. If a bed rail has been determined necessary, take steps to reduce the known risks associated with its use. Consider medical diagnosis, conditions, symptoms, and/or behavioral symptoms.

REVIEW EXERCISES

13.1 Why should organizations consider patient safety as an organizational function and not just another program?

13.2 List three aspects of patient safety, other than clinical issues.

13.3 In your own words, explain the importance of effective leadership in patient safety improvement efforts.
13.4 What was the focus of the IOM report, *Crossing the Quality Chasm*?
13.5 How does IOM define errors?
13.6 Define an adverse event.
13.7 How does AHRQ define a medical error?
13.8 List at least six methods used to identify adverse events.
13.9 List the five key features of a true safety culture.
13.10 In your own words, describe the concept of *system reliability.*
13.11 List at least seven common elements related to system failure and medical errors.
13.12 When should organizations use FMEA?
13.13 List four common pitfalls of technology.
13.14 List the three basic elements of medical disclosure.
13.15 List five high-risk medical procedures.
13.16 Describe the three key elements of human factors science.
13.17 Define the concept known as healthcare benchmarking.
13.18 What is the purpose of conducting RCA?
13.19 Why is medication reconciliation an important aspect of patient safety efforts?
13.20 List at least six safety issues related to medication administration.
13.21 List at least five medication error categories.
13.22 Describe the basic steps inherent in using a CPOE system.
13.23 List five unanticipated consequences of using a CPOE system.
13.24 List four common malpractice situations that can occur in emergency departments.
13.25 List five key root causes found in infant abduction events.

14 Radiation, Laboratory, and Pharmacy Safety

IMAGING AND RADIATION AREA SAFETY

Ionizing radiation occurs naturally from decay of radioactive materials or by the operation of x-ray emitting devices. A radioactive element spontaneously changes to a lower energy state and emits particles and gamma rays from its nucleus. X-rays result when highly energized electrons strike the nuclei of a targeted material. The electrons deflected from their path release energy as electromagnetic radiation or x-rays. Ionizing radiation occurs anytime an electron dislodges from its parent atom or molecule. Ionizing radiation's ability to penetrate the body depends on wavelength, frequency, and energy of the material. Alpha particles do not penetrate the skin. An alpha particle cannot penetrate a thin layer of paper or clothing. Highly energized beta particles require shielding of some type of low-density material such as plastic, wood, water, or acrylic glass. Beta particles can travel a few centimeters into living tissue. Beta contaminants that remain on the skin for a prolonged period can cause injury. Beta emitting contaminants can also cause harm if deposited internally. Gamma and x-rays can penetrate human tissue. Radioactive materials that emit gamma radiation constitute both an external and internal hazard to humans. Gamma radiation frequently accompanies the emission of alpha and beta radiation. X-rays also possess longer wavelengths, lower frequencies, and lower energies than alpha or beta particles. The international community measures radiation using the System International (SI). The United States uses a conventional system of measurement depending on what aspect of radiation requires measurement (Table 14.1).

OSHA Ionizing Radiation Standard (29 CFR 1910.1096)

The OSHA standard covers x-ray equipment, accelerators, accelerator-produced materials, electron microscopes, and naturally occurring radioactive materials such as radium. OSHA exposure standards for whole-body radiation should never exceed 3 rem/quarter (year). Lifetime or cumulative exposure should not exceed 5 (N-18) rem. OSHA regulates exposure to all ionizing radiation for sources not under NRC jurisdiction. OSHA and NRC signed a memorandum of agreement in 1989 that outlined compliance authority of both agencies. This coordinated interagency effort helps prevent gaps in protecting workers and avoids duplication of effort.

The degree of human exposure depends on the amount of radiation, duration of exposure, distance from the source, and the type of shielding used. OSHA recommends workers wear a badge or device to support long-term exposure monitoring efforts. OSHA recommends a passive dosimeter for personal working with x-ray equipment, radioactive patients, or radioactive materials. Depending on the work situation, body badges may be worn at the collar, chest, or waist level. Personnel working in high-dose fluoroscopy settings need to wear two badges for monitoring purposes. Personnel exposed to beta and gamma doses should wear ring devices on the hand nearest the radiation source. Lead aprons and gloves offer some protection for employees and patients exposed in a direct x-ray field. Assign a specific person to ensure proper maintenance of all portable x-ray machines. For preventive and corrective maintenance information for x-ray machines, refer to 21 CFR 1000, Radiological Health. For information about exposure limits, refer to the OSHA Ionizing

TABLE 14.1
Radiation Measurement Terms

- Absorbed dose is the amount of radiation that is absorbed by the body.
- Ci is a unit of measurement of radioactivity at 1 Ci = 3.7×10^{10} decays/s.
- Exposure is the amount of radiation to which the body is exposed.
- RAD is a measure of the absorbed dose of ionizing radiation.
- RAD = 100 erg/g = 0.01 gray (Gy).
- Radioactive half-life is the time required for isotope radioactivity to decrease by 50%.
- REM is the dosage of any ionizing radiation that will cause biological injury to human tissue equal to the injury caused by one roentgen of x-ray or gamma ray dosage with 1 rem is equivalent to 0.01 Sievert (Sv).
- Roentgen is the unit of measure for the quantity of radiation produced by gamma or x-rays.

Radiation standard found in 29 CFR 1910.1096. Employers must supply appropriate personnel monitoring equipment such as film badges, pocket chambers, pocket dosimeters, or film rings.

Restricted Areas

OSHA requires the designation of restricted areas to protect individuals from radiation exposure. The term unrestricted area refers to any area access not controlled by the employer for purposes of protection of individuals from exposure to radiation. No employer can possess, use, or transport radioactive material within a restricted area that causes individuals to experience airborne radioactive material exposure in excess of limits specified in Table 1, Appendix B to 10 CFR 20. When monitoring exposure, make no allowance for the use of protective clothing or equipment, or particle size.

Surveys and Monitoring

Survey means an evaluation of the radiation hazards incident to the production, use, release, disposal, or presence of radioactive materials or other sources of radiation under a specific set of conditions. When appropriate, such evaluation includes a physical survey of the location of materials and equipment and measurements of levels of radiation or concentrations of radioactive material present. Every employer shall supply appropriate personnel monitoring equipment, such as film badges, pocket chambers, pocket dosimeters, or film rings, and should ensure the use of such equipment by exposed employees. Personnel monitoring equipment means devices designed to be worn or carried by an individual for the purpose of measuring the dose received.

Radiation Areas

Radiation area means any area, accessible to personnel, in which there exists radiation at such levels that a major portion of the body could receive in any 1 h a dose in excess of 5 mrem or in any 5 consecutive days a dose in excess of 100 mrem. High-radiation area also means any area, accessible to personnel, in which there exists radiation at such levels that a major portion of the body could receive in any 1 h a dose in excess of 100 mrem.

Caution Signs

Caution signs, labels, signals, and symbols should use conventional radiation caution colors of magenta or purple on yellow background. The symbol prescribed by this paragraph is the conventional three-bladed design with the words *Radiation Area*. Each radiation area shall be

conspicuously posted with a sign or signs bearing the radiation caution symbol. Each high-radiation area shall be conspicuously posted with a sign or signs bearing the radiation caution symbol and appropriate wording.

Airborne Radioactivity

Airborne radiation can appear in any room, enclosure, or operating area in which radioactive materials exist in concentrations in excess of the amounts specified in Table 1 of Appendix B to 10 CFR 20. Post a sign or signs bearing the radiation caution symbol and the word CAUTION in areas where exposure could occur.

Storage Areas

Each area containing radioactive material exceeding 10 times the quantity of such material as specified in Appendix C to 10 CFR 20 must post conspicuous signs bearing the radiation caution symbol and the word CAUTION. Secure radioactive materials stored in nonradiation areas to prevent unauthorized removal from the place of storage. No employer can dispose of radioactive materials in an improper or illegal manner. They can transfer materials to an authorized recipient.

TB Exposures

Facilities should protect the radiology personnel from TB exposures during x-ray procedures. Exposures to TB can occur if radiology rooms do not contain proper ventilation. Ensure the hospital develops written procedures for the safe handling of TB patients in all radiology areas. TB patients should wear masks and stay in radiology suites the shortest time possible. Healthcare facilities serving populations with a high prevalence of TB may need to supplement general ventilation and use additional engineering approaches.

Ergonomics

Radiology staff can experience work-related MSDs from constant lifting and reaching during x-ray procedures and patient transfers. Employers should assess the radiology area for ergonomic stressors. Train employees in proper lifting techniques. Avoid awkward postures and working above shoulder height. Use lift mechanical aids and ensure sufficient staffing. Provide instructions to patients on ways to help facilitate the lift or transfer procedure.

Slips, Trips, and Falls

Potential exists for slips and falls in the radiology area. Ensure floors don't contain slip hazards such as water, blood, vomit, or excreta. Keep aisles and passageways clear and in good repair with no obstruction across or in the aisles. Provide floor plugs for equipment to prevent the need for placing cords across pathways. Report and clean all spills immediately. Correctly maintain floors by using nonskid waxes.

Bloodborne Pathogens

Use gloves, masks, and gowns if blood or fluid exposure exists. Use appropriate engineering and work practice controls to limit exposure. Wear gloves to protect hands coming into contact with blood, mucous membranes, or nonintact skin. Follow proper work practices when performing vascular access procedures or when handling contaminated items or surfaces.

Storage and Handling Procedures

Properly calibrate radiation measurement instruments before each use. Train personnel in handling radiation wastes. Each department that generates radioactive wastes should develop written procedures that cover handling of, transportation, and disposal. Properly secure and store all waste materials and designate controlled areas. Dispense or draw materials only behind a protective barrier. Label refrigerators that contain stored materials. Notify the radiation control officer when receiving a contaminated shipment.

Medical Radioactive Materials

A radionuclide refers to any type of radioactive material including elements and isotopes of elements. Most radioactive materials used in nuclear medicine consist of isotopes since individual medical treatment may require an isotope with specific radioactive properties. Radioisotopes show how the disease process alters the normal function of an organ. A patient swallows, inhales, or receives an injection of a tiny amount of a radioisotope. Cameras then reveal where the isotope accumulates in the body. Laboratory tests use radioisotopes to measure important substances in the body including thyroid hormones. Radiation treatments for thyroid diseases continue to grow in number. Some facilities use isotopes to sterilize hospital items such as sutures, syringes, catheters, and hospital clothing otherwise destroyed by heat sterilization. Sterilization using radioisotopes can prove valuable because the process permits the items to remain in their sealed packages. NRC rules outline minimum safety requirements for workers and patients.

Shielding

The effectiveness of shielding material relates to its cross section for scattering and absorbing radiation. The radiation that manages to get through falls exponentially with the thickness of the shield. Practical radiation protection depends on juggling the three factors to identify the most cost-effective solution. Different types of ionizing radiation can behave in different ways. This results in the use of different shielding techniques. Particle radiation consists of a stream of charged or neutral particles, charged ions, and subatomic elementary particles. This includes solar wind, cosmic radiation, and neutron flux in nuclear reactors.

ALARP

ALARP stands for *as low as reasonably practicable*. An equivalent term ALARA, *as low as reasonably achievable*, is also commonly used. The application of radiation can aid the patient by providing doctors and other healthcare professionals with a medical diagnosis. However, keeping exposure reasonably low will reduce probability of cancers or sarcomas and eliminate skin reddening or cataracts. Any radiation exposure, no matter how small, can increase the chance of negative biological effects such as cancer. The probability of the occurrence of negative effects of radiation exposure increases with cumulative lifetime dose (Table 14.2).

TABLE 14.2
Ways to Reduce Human Radiation Exposure

- Shielding: Use proper barriers to block or reduce the penetration of ionizing radiation.
- Time: Spend less time in radiation fields.
- Distance: Increase distance between radioactive sources and workers or population.
- Amount: Reduce the quantity of radioactive material for a practice.

Nuclear Regulatory Commission

The NRC, established by the ERA of 1974, ensures civilian uses of nuclear substances meet safety, environmental, and security laws. NRC accomplishes its mission through standards setting, rulemaking, inspections, and enforcement actions. The commission also conducts technical reviews, studies, and public hearings. The NRC issues authorizations, permits, and licenses to ensure nuclear safety. The NRC issues 5-year licenses to healthcare organizations that adhere to prescribed safety standards. To apply for a license, organizations should identify authorized users, designate a radiation safety officer (RSO), and identify the address or location of radioactive materials. Any changes require the organization to file for a license amendment. Some vendors must verify that facilities receiving radioactive materials possess a license. Some radionuclide licenses apply to generators of infectious and medical wastes. A general license is issued to medical practices, clinical laboratories, and healthcare facilities. A specific use license is required for physicians in private practice. Medical use pertains to human administration of radioactive substances or radiation. A broad-scope license can be issued to facilities that provide patient care and conduct research using radioactive materials.

Performance-Based Standards

Some NRC regulations contain detailed procedures, and others leave procedural details to the licensee. Approval of the license remains contingent on NRC evaluation of the proposal submitted with the application. Report all occurrences of therapeutic or diagnostic misadministration to the NRC regional office within 24 h. The NRC requires that organizations meet all radiation protection standards as outlined in 10 CFR 20. Persons working or frequenting areas with radioactive materials must understand the *basic-right-to-know information* contained in 10 CFR 19, *Notices, Instructions, and Reports to Workers.* Agreement states refer to states with a formal agreement with the NRC pursuant to Section 274 of the Atomic Energy Act. Under this agreement, the NRC relinquishes regulatory control over certain by-products, sources, and special nuclear materials used within each state. NRC periodically assesses compatibility and adequacy of the agreement state enforcement efforts.

Radiation Control Planning

Each NRC licensee should maintain a written management plan that requires the participation of all users, organizational administrators, and RSOs. Develop procedures to inform workers about the types and amounts of materials used, dosing information, safety precautions, recurring training, and continuing education. Develop guidelines to keep doses as low as reasonably achievable. The RSO should develop and implement written procedures to cover the purchase, storage, use, and disposal of radioactive by-products. Develop procedures to investigate all incidents, mishaps, accidents, or other deviations from prescribed procedures.

Radiation Safety Committee

The Radiation Safety Committee must approve or disapprove the use of radioactive material within the licensed institution. Decisions must consider the radiological health and safety of patients and staff. Other committee duties include prescribing special conditions for the proposed use of radioactive materials including bioassay requirements, physical examinations, and the minimum level of training required. The committee should address topics such as film badge return rates, exposure guidelines, safety, quality, and regulatory compliance. The committee should review records and reports submitted by the RSO. The committee recommends actions to take for ensuring the safe use of radioisotopes. The committee must maintain written record of all actions taken, and member

must demonstrate their competency or expertise in radiation safety. Committee membership should include expertise in the areas of diagnostic radiology, clinical pathology, and nuclear medicine. Committee should meet at least quarterly.

Radiation Safety Officer

The RSO must qualify to serve based on education, training, and experience. The RSO should advise others on safety matters pertaining to ionizing radiation and supervise radiation safety efforts. The RSO implements the policies established by the Radiation Safety Committee and supervises all aspects of radiation measurement and protection activities. Duties include monitoring activities, maintenance of exposure records, survey methods, waste disposal, and radiological safety practices. The RSO should monitor the education of all users of ionizing radiation. The RSO function must also maintain an inventory of all radioisotopes and ionizing radiation-producing devices. The RSO must ensure documentation of radiation surveys and exposures of personnel. He or she should promptly report to the committee all radiation hazards, serious infractions of rules, or other items relevant to radiation safety. Organizations must maintain the radioisotope inventory, all receipt and disposition logs, radiation survey records, and any NRC documentation required by 10 CFR 20.401.

National Council on Radiation Protection

This group, created by Congress, collects, analyzes, develops, and disseminates information and recommendations on radiation quantities, measurements, and units. NCRP publishes maximum permissible levels of external and internal radiation. The major handbooks are entitled *Maximum Permissible Body Burdens and Maximum Permissible Concentrations of Radionuclides in Air and Water for Occupational Exposure* and *Review of the Current State of Radiation Protection Philosophy*. The NCRP suggests an annual permissible whole-body dose of 5 rem/year, with 3 rem permitted within a 13-week period.

Food and Drug Administration Radiation Safety

The FDA CDRH ensures that the public and professionals remain informed of the risks posed by different types of radiation emissions and radiation-emitting products. CDRH also seeks to ensure that each patient receives the appropriate radiation dose using the appropriate, medically necessary imaging exam at the appropriate time. These efforts recognize the role everyone has in promoting radiation safety. Manufacturers should design safe products. Users should know how to appropriately use radiation-emitting electronic products and understand radiation safety and protection principles. Patients and consumers should know basic radiation risk and protection concepts. Regulators must collect and disseminate appropriate information and take action on this information as necessary. The FDA continues to take efforts to reduce the risks associated with medical uses of ionizing radiation, in order to maximize their benefits. The FDA's Initiative to Reduce Unnecessary Radiation Exposure from Medical Imaging describes actions that support the benefits of medical imaging while minimizing the risks. FDA is also exploring steps to improve patient safety in radiation therapy. CDRH collaborates with the Conference of Radiation Control Program Directors (CRCPD) in a unique federal–state partnership to characterize the radiation doses patients receive and to document the state of the practice of diagnostic radiology. Each year, the Nationwide Evaluation of X-ray Trends (NEXT) survey selects a particular radiological examination for study and captures radiation exposure data from a nationally representative sample of US clinical facilities. CDRH staff compiles, analyzes, and publishes survey results on population exposure, radiographic and fluoroscopic technique factors, diagnostic image quality, and film processing quality. Repeat surveys periodically to track trends as technology and clinical practices change. Since 1973, NEXT has been conducting surveys on

examinations related to the adult chest, abdomen, lumbosacral (LS) spine, upper gastrointestinal fluoroscopy; mammography; computed tomography of the head; dental radiography; and pediatric chest radiography.

Radioactive Waste Management

Radioactive wastes exist in solid, liquid, or gas forms. Solid wastes can include rags and papers from cleanup operations, solid chemicals, contaminated equipment, experimental animal carcasses, or human or experimental animal fecal matter. Consider and evaluate properties of waste when determining the method of disposal. Specific disposal methods vary according to the material involved and licensing authority of users. Radioactive wastes typically remain on site until their half-life is spent and no longer considered hazardous. Segregate low-level radioactive wastes and properly label considering the isotope, form, volume, laboratory origin, activity, and chemical composition. Proper labeling and handling required organizations to make waste management decisions easier. Never mix radioactive and other hazardous wastes. Retain suppliers that accept return of isotope containers.

Develop a plan to ensure that the disposal of radioactive wastes meets government guidelines and regulations. The plan should contain procedures for waste containing radioactive materials as defined by the NRC. Develop an emergency plan to use in a response to a radiation accident or incident. Keep radioactive wastes segregated, centrally processed, and properly labeled. Secure radioactive waste storage areas and identify with radioactive hazard symbol. Consider using sensors to detect radioactive levels in trash and medical waste prior to its leaving the facility. Return all isotope containers to the appropriate distributor.

Nuclear Medicine

Nuclear medicine uses small amounts of radioactive material to diagnose or treat a variety of diseases, including cancer and heart disease. Nuclear medicine or radionuclide imaging procedures help physicians diagnose medical conditions. Depending on the type of nuclear medicine, a radiotracer is injected into a vein, swallowed, or inhaled as a gas. It eventually accumulates in the organ or area of your body being examined, where it gives off energy in the form of gamma rays. This energy can then be detected by a device called a gamma camera, a PET scanner, and/or probe. These devices work together with a computer to measure the amount of radiotracer absorbed by the body. The devices also work to produce special pictures detailing the structure and function of organs and tissues. Nuclear medicine images superimposed by CT or MRI produce special views. This practice is known as imaging fusion or coregistration. These views allow the information from two different studies to become correlated and interpreted as one image that results in a more precise diagnosis. Manufacturers now make single-photon emission computed tomography (SPECT)/CT and PET/CT units that perform both imaging studies at the same time. Iodine therapy uses radioactive material to treat cancer and other medical conditions affecting the thyroid gland. Most nuclear medicine procedures use a gamma camera, a specialized camera encased in metal that is capable of detecting radiation and taking pictures from different angles. It may be suspended over the examination table or beneath the table. New technologies make the diagnosis, management, and treatment of illnesses more sensitive, more specific, more accurate, and ultimately safer for both the patient and the technologist.

Radiological Society of North America

Radiological Society of North America (RSNA), an association of more than 40,000 radiologists, radiation oncologists, medical physicists, and related scientists, promotes excellence in radiology through education and by fostering research, with the ultimate goal of improving patient care.

The society seeks to provide radiologists and allied health scientists with educational sessions and materials of the highest quality and to constantly improve the content and value of these educational activities. The society also seeks to promote research in all aspects of radiology and related sciences, including basic clinical research in the promotion of quality healthcare.

American College of Radiology

American College of Radiology (ACR) members strive to improve quality patient care and remain committed to the advancement of the science of radiology. ACR established guidelines, standards, and accreditations to provide the foundation for achieving quality patient care. ACR accreditation offers radiologists and other providers the opportunity for peer review of their facility's staff qualifications, equipment, quality control, and the resultant image quality. The ACR actively promotes the causes and issues of radiology professionals and their patients at both the federal and state levels and offers a selection of highly respected continuing education materials as well as the opportunity for physicians to learn the latest cutting-edge imaging techniques and image-guided procedures at the one of a kind ACR Education Center.

NONIONIZING RADIATION (29 CFR 1910.97)

This form of radiation lacks the energy of ionizing radiation and causes damage by vibrating the atoms or molecules causing heating by friction. Examples of nonionizing radiation include lasers, MW/radio-frequency (RF) generating devices, UV lamps, MRI machines, cellular phones, and other electrical devices that produce electromagnetic fields. Health effects include retinal and skin damage. Electromagnetic radiation has different effects on humans depending on the wavelength and type of radiation involved. Low-frequency radiation such as that generated by broadcast radio and shortwave radio has generally been considered as not dangerous. Some new information suggests that exposure to electric power frequencies could pose an adverse impact on human health. Exposure to MW radiation can occur in healthcare facilities. Some exposure risks include MW ovens, cancer therapy procedures, thawing organs for transplantation, sterilizing ampoules, and enzyme activation in research animals. The greatest hazard associated with exposure to MW radiation is thermal heating. The exposure limit for MW energy is expressed in voluntary language and has been ruled unenforceable by OSHA. The OSHA Construction Standard does specify the design of an RF warning sign, and 29 CFR 1926.54 limits worker exposure.

Ultraviolet Radiation

UV radiation can emit from germicidal lamps, during some dermatology treatments, from nursery incubators, and even some hospital air filters. Overexposure can result in skin burns and serious eye damage. Long-term exposure can contribute to accelerated skin aging and increased risk of skin cancer. NIOSH recommendations for UV exposure range from 200 to 400 nm, depending on length of exposure. All UV sources capable of causing eye or skin burns should be interlocked so that direct viewing or bodily exposure is not possible. The total intensity of UV light from lamps and reflecting surfaces should not exceed the levels specified in the latest edition of the ACGIH reference *Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices.*

Radio-Frequency and Microwave Radiation

Consider RF and MW as nonionizing radiation sources with insufficient energy to ionize atoms. The primary health effect of RF/MW energy comes as a result of heating. The absorption of RF/MW energy varies with frequency. MW radiation is absorbed near the skin, whereas RF

radiation may absorb in deep body organs. Exposure standards of western countries relate to preventing thermal problems. Research continues on possible *nonthermal* effects. The use of RF/M radiation includes radios, cellular phones, heat sealers, vinyl welders, high-frequency welders, induction heaters, communications transmitters, radar transmitters, ion implant equipment, MW drying equipment, sputtering equipment, and glue curing. The warning symbol for RF hazards should consist of a red isosceles triangle above an inverted black isosceles triangle, separated and outlined by an aluminum-colored border. The upper triangle should contain the following wording: WARNING RADIOFREQUENCY RADIATION HAZARD.

Wireless Medical Telemetry

Wireless medical telemetry helps monitor patient physiological parameters over a distance via RF communications between a transmitter worn by the patient and a central monitoring station. These devices give the advantage of allowing patient movement without tethering the patient to a bedside hard-wired connection. The Wireless Medical Telemetry Service (WMTS) report and order sets aside the frequencies of 608–614, 1395–1400, and 1429–1432 MHz for primary or coprimary use by wireless medical telemetry users. A key feature of the WMTS is the provision for establishment of a frequency coordinator to maintain a database of user and equipment information to facilitate sharing of the spectrum and to help prevent interference among users of the WMTS. The FCC order also provides a definition for wireless medical telemetry, which is consistent with the recommendations made in 1999 by the AHA Task Group on Medical Telemetry. The FCC defines wireless medical telemetry as "the measurement and recording of physiological parameters and other patient-related information via radiated bi- or unidirectional electromagnetic signals." The FCC order also describes the requirements for users of the new WMTS. Eligible WMTS users are limited to authorized healthcare providers, which include licensed physicians, healthcare facilities, and certain trained and supervised technicians. The healthcare facilities eligible for the WMTS include those that offer services for use beyond 24 h, including hospitals and other medical providers. Do not include ambulances and other moving vehicles within this definition.

FDA/CDRH Recommendations for EMC/EMI in Healthcare Facilities

CDRH receives many inquiries from healthcare organizations, medical device manufacturers, clinicians, and the public seeking information about experiences with and prevention of electromagnetic interference (EMI) with medical devices. The following information is intended to help minimize the risks associated with medical device EMI and promote EMC in healthcare facilities. Some recommendations for healthcare facilities to follow include the following:

- Making use of available resources such as EMC professionals and publications and Internet web pages on the subject of medical device EMC
- Assessing the electromagnetic environment of the facility and identifying critical medical device use areas
- Managing the electromagnetic environment, RF transmitters, and all electrical and electronic equipment, including medical devices, to reduce the risk of medical device EMI and achieve EMC
- Coordinating the purchase, installation, service, and management of all electrical and electronic equipment used in the facility to achieve EMC
- Educating healthcare facility staff, contractors, visitors, and patients about EMC and EMI and how they can recognize medical device EMI and help minimize EMI risks
- Establishing and implementing written policies and procedures that document the intentions and methods of the healthcare institution for reducing the risk of medical device EMI and achieving EMC

Consensus Standards

ANSI publishes consensus standards on RF exposures and measurements. The Institute of Electrical and Electronics Engineers (IEEE) Standards Coordinating Committee 28 is the secretariat for ANSI for developing RF standards. It is also the parent organization for the IEEE Committee on Man and Radiation (COMAR), which publishes position papers on human exposure to electromagnetic fields, ANSI C95.1-1992, *Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields* (200 kHz–100 GHz). This consensus standard includes different exposure limits for controlled and uncontrolled sites (FCC OET Bulletin #65 [August 1997]). Appendix A provides a table and figure of RF exposure limits adopted by FCC. FCC received concurrence for these limits from other government agencies, including OSHA and NIOSH, with the reservation that induced current limits be added to the FCC standard.

Other Recognized Standards

- IEC 60601-1-21, *Medical Electrical Equipment—Part 1-2: General Requirements for Safety—Collateral standard: Electromagnetic Compatibility—Requirements and Tests* (Edition 2:2001 with Amendment 1:2004; Edition 2.1 [Edition 2:2001 consolidated with Amendment 1:2004])
- AAMI/ANSI/IEC 60601-1-22, *Medical Electrical Equipment—Part 1-2: General Requirements for Safety—Collateral Standard: Electromagnetic Compatibility—Requirements and Tests*
- ANSI/RESNA WC/Vol. 2-1998, Section 21, Requirements and test methods for EMC of powered wheelchairs and motorized scooters
- ANSI C63:19:2001, *Methods of Measurement of Compatibility between Wireless Communication Devices and Hearing Aids*

MAGNETIC RESONANCE IMAGING

MRIs provide detailed images of organs and tissues throughout the body without the need for x-rays. Instead, MRI uses a powerful magnetic field, radio waves, a rapidly changing magnetic field, and a computer to create images that show whether or not there is an injury or some disease process present. For this procedure, the patient is placed within the MRI scanner. The magnetic field aligns atomic particles called protons that exist in most of the body's tissues. Radio waves then cause these particles to produce signals received within the MR scanner. The signals become specially characterized by using a changing magnetic field and computer processor to create very sharp images of tissues as *slices* that view in any orientation. An MRI exam causes no pain, and the magnetic fields produce no known tissue damage of any kind. The MRI scanner may make loud tapping or knocking noises at times during the exam; using earplugs prevents problems that may occur with this noise. Key safety concerns involve the use of strong magnetic fields, RF energy, time-varying magnetic fields, cryogenic liquids, and magnetic field gradients. Magnetic fields from large bore magnets can literally pick up and pull large ferromagnetic items into the bore of the magnet. Take caution to keep all ferromagnetic items away from the magnet. The kinetic energy of such an object being sucked into a magnet can smash an RF imaging coil. Similar forces work on ferromagnetic metal implants or foreign matter in those being imaged. These forces can pull on these objects cutting and compressing healthy tissue. For these reasons, individuals with foreign metal objects such as shrapnel or older ferromagnetic implants are not imaged. There exist additional concerns regarding the effect of magnetic fields on electronic circuitry, specifically pacemakers. An individual with a pacemaker walking through a strong magnetic field can induce currents in the pacemaker circuitry that will cause it to fail and possibly cause death. Magnetic fields will also erase credit cards and magnetic storage media.

FDA MRI Safety Guidelines

The guidelines state that field strengths not exceeding 2.0 tesla may be routinely used. People with pacemakers should never enter magnetic fields greater than 5 gauss. A 50 gauss magnetic field will erase magnetic storage media. The RF energy from an imaging sequence can cause heating of the tissues of the body. The FDA recommends limited exposure to RF energy. The specific absorption rate (SAR) serves as the limiting measure. The formula is SAR = joules of RF/s/kg of body weight = W/kg. The recommended SAR limitations depend on the anatomy being imaged. The SAR for the whole body should be less than 0.4 W/kg. It should be less than 3.2 W/kg averaged over the head. Any pulse sequence should not raise the temperature by more than 1°C and no greater than 38°C in the head, 39°C in the trunk, and 40°C in the extremities. Some RF coils, such as surface coils, contain failure modes that can cause burns to the patient. Take care to keep these coils in proper operating order. The FDA recommendations for the rate of change of magnetic field state that the dB/dt for the system should be less than that required to produce peripheral nerve stimulation. Imaging gradients do produce high acoustic noise levels (Table 14.3).

Other MRI Safety Recommendations

The ACR has made safety recommendations for the use of MRI machines. The new recommendations include restricting access to MRI rooms, appointing a special director of hospital MRI facilities, and educating those working near or in an MRI department about safety. Consider patients with certain implanted devices, such as many types of intracranial aneurysm clips as contraindicated from MRI imaging since the torque and displacement forces produced on the device can result in the tearing of soft tissues. Other implants, such as certain cardiac pacemakers, can function erratically even in relatively weak magnetic fields. In device labeling for pacemakers, MRI is listed as a contraindication. Prohibit individuals with implanted pacemakers from entering the MRI procedures room or coming within the 5 gauss line around the scanner. With regard to medical devices, electrical currents may occur due to conductive metal implants, such as skull plates, and hip prostheses. When using conductive patient leads during MRI scanning, ensure that the leads do not form loops. Looped patient leads or devices such as the halo device used for spinal immobilization can pick up RF energy resulting in induced currents, heating of the material, and as a result, potentially severe patient burns. To reduce the possibility of burns, thermally insulate electrically conductive material in the bore of the magnet from the patient using blankets or sheets.

Sonography

During patient evaluations, use a high-frequency ultrasound, a diagnostic medical sonographer, to create diagnostic sonographic images. While this module uses the term *sonographer*, the potential hazards and possible solutions discussed also apply to sonologists and students. As sonographers

TABLE 14.3
MRI Safety and Compatibility Standards

- ASTM F2052-00: *Standard Test Method for Measurement of Magnetically Induced Displacement Force on Passive Implants in the Magnetic Resonance Environment*
- ASTM F2119-01: *Standard Test Method for Evaluation of MRI Artifacts from Passive Implants*
- IEC 601-2-33: *Medical Electrical Equipment—Part 2: Particular Requirements for the Safety of Magnetic Resonance Equipment for Medical Diagnosis*

work with ultrasound equipment, they may incur a risk for developing work-related MSDs. Sonographers with heavy workloads and those with experience in the profession can incur risks. According to the Society of Diagnostic Medical Sonography (SDMS), sonographers on average experience pain or other disorder within 5 years of entering the profession. Sonographers can experience a variety of ergonomics-related risks when they are performing specific tasks such as

- Transporting patients and equipment
- Positioning patients and equipment
- Use and orientation of ultrasound equipment

Engineering, administrative, and work practice controls such as room layout and equipment placement, scheduling, staffing, patient assessment, training, and work practices may also need consideration to reduce the risk of developing an injury.

LABORATORY SAFETY

Hospitals operate a variety of clinical laboratory functions. The size and scope of these lab functions will vary depending on the size and type of organization or facility. Many outside clinical laboratories also serve a variety of medical organizations and practices (Table 14.4).

Clinical Laboratory Improvement Amendments

The CMS regulates all laboratory testing (except research) performed on humans in the United States through the Clinical laboratory Improvement Amendments (CLIA). In total, CLIA covers approximately 200,000 laboratory entities. The Division of Laboratory Services, within the Survey and Certification Group, under the Center for Medicaid and State Operations (CMSO) has the responsibility for implementing the CLIA program. The objective of the CLIA is to ensure quality laboratory testing. Although all clinical laboratories should be properly certified to receive Medicare or Medicaid payments, CLIA has no direct Medicare or Medicaid responsibilities.

Joint Commission Laboratory Accreditation

Since 1979, the Joint Commission has been accrediting hospital laboratory services. It has been accrediting independent laboratories since 1995. The Joint Commission accredits approximately 3000 clinical laboratories. The CMS officially recognizes the Joint Commission Laboratory Accreditation Program as meeting the requirements of CLIA of 1988. CLIA regulations require that all laboratories get surveyed on a 2-year cycle. Joint Commission standards and CLIA regulations require that a laboratory uses CMS-approved proficiency testing for all regulated tests conducted by

TABLE 14.4
Clinical Lab Functions in Some Hospital Settings

- Pathology: Processes and tests tissue removed during surgical procedures
- Cytology: Processes specimens to determine abnormalities in cell structure
- Chemistry: Analyzes body fluids to determine glucose, protein, enzyme, and hormone levels
- Serology: Analyzes body fluids for antigens and antibodies
- Hematology: Analyzes blood to determine information relating to red cells, white cells, and platelets
- Microscopy: Analyzes urine and body fluids
- Microbiology: Analyzes specimens to determine causes of infection

the lab. CLIA requires that a laboratory's proficiency testing results monitored on an ongoing basis. Achieving accreditation sends a strong statement about a lab's commitment to provide services of the highest quality. The Joint Commission uses a tracer methodology that reviews the entire scope of the laboratory testing process including pre- and postanalytical processes that occur outside the laboratory. The tracer system follows results to the bedside. Joint Commission lab surveys also evaluate other areas such as environment of care management, emergency management, infection control, and adherence to National Patient Safety Goals.

College of American Pathologists Accreditation

CAP Laboratory Accreditation is an internationally recognized and the only one that utilizes teams of practicing laboratory professionals to serve as inspectors. Designed to go well beyond regulatory compliance, accreditation helps laboratories achieve the highest standards of excellence to positively impact patient care. Accreditation standards focus on detailed checklist requirements. The checklists provide a quality blueprint for laboratories to follow. CAP Laboratory Accreditation meets the needs of a variety of laboratory settings from complex university medical centers to physician office-based laboratories. Because of its comprehensive nature, CAP accreditation can help achieve a consistently high level of service throughout an institution or healthcare system. The CMS grants CAP Laboratory Accreditation deeming authority. The Joint Commission recognizes CAP, and accreditation helps organizations meet state certification requirements. CAP also provides laboratory accreditation to forensic urine drug testing and reproductive laboratories, cosponsored with the American Society for Reproductive Medicine (ASRM). The goal of CAP Laboratory Accreditation focuses on improving patient safety by advancing the quality of pathology and laboratory services. Upon successful completion of the inspection process, the laboratory receives CAP accreditation to become part of an exclusive group meeting the highest standards of excellence.

College of American Pathologists Accreditation Program

The accreditation program seeks to improve patient safety and reduce laboratory-related risks.

The accreditation conforms to ISO 15189:2007 requirements. Laboratories accredited to the ISO standard will be well-positioned themselves to rapidly respond to the changing healthcare environment and demonstrate measurable quality to their customers. The CAP serves as a medical society serving more than 17,000 physician members and the laboratory community throughout the world. It is the world's largest association composed exclusively of board-certified pathologists and pathologists in training and is widely considered the leader in laboratory quality assurance. CAP advocates for high-quality and cost-effective medical care. ISO promotes standardization facilitating the international exchange of goods and services and developing cooperation in the spheres of intellectual, scientific, technological, and economic activities.

COLA Accreditation

Commission on Office Laboratory Accreditation (COLA) was founded in 1988 as a private alternative to help laboratories stay in compliance with the new CLIA. In 1993, CMS granted COLA deeming authority under CLIA, and in 1997, the Joint Commission recognized COLA's laboratory accreditation program. After 35,000 surveys in which COLA's practical, educational accreditation methods helped physician office laboratories stay in compliance with CLIA, COLA has expanded its program offerings to include hospital and independent laboratories. COLA is approved by CMS to accredit laboratories in the following specialties: (1) chemistry, (2) hematology, (3) microbiology, (4) immunology, (5) immunohematology and transfusion services, and (6) pathology (cytology, histopathology, and oral pathology).

OSHA Laboratory Standard (29 CFR 1910.1450)

The OSHA standard requires labs to produce a chemical hygiene plan that addresses the specific hazards found in its location and its approach to them. The standard emphasizes the use of safe work practices and appropriate worker protection as required by the laboratory environment. The standard covers all chemicals that meet the definition of a health hazard as defined in the hazard communication standard published in 29 CFR 1910.1200. The standard does not specify work practices necessary to protect employees from potential hazards associated with chemical use but does require that physical hazards be addressed in the employer's training program. The OSHA Laboratory Standard requires continued compliance with all published PELs and with the employer's written chemical hygiene plan. The standard requires special consideration for particularly hazardous substances including some selected carcinogens. The standard requires consideration of reproductive toxins and substances containing a high degree of acute toxicity. The laboratory standard 29 CFR 1910.1450 can apply to clinical hospital laboratories because of the use of hazardous chemicals. Laboratory use of hazardous chemicals means handling or use of such chemicals in which all of the following conditions are met: (1) chemical manipulations carried out on a laboratory scale, (2) multiple chemical procedures or chemicals used, (3) procedures involved not part of a production process, and (4) protective laboratory practices and equipment used to minimize employee exposures. Please note according to an OSHA interpretation, the standard does not apply to a pharmacy operation mixing cytotoxic drugs (Tables 14.5 through 14.7).

Summary of Safe Laboratory Work Practices

Supervisors must prohibit mouth pipetting or suctioning of blood-related materials. Restrict eating, drinking, smoking, applying cosmetics or lip balm, or handling contact lenses in areas with a reasonable likelihood of occupational exposure to bloodborne pathogens. Never store food or drink in refrigerators, freezers, shelves, cabinets, or on countertops or bench tops where

TABLE 14.5
Key Requirements of the OSHA Laboratory Standard

- Conduct employee exposure monitoring (under certain conditions).
- Develop SOPs.
- Employee training supersedes but emphasizes requirements of the HCS.
- Arrange for medical consultations and examinations.
- Develop a chemical hygiene plan and appoint a chemical hygiene officer.
- Provide hazard identification information such as SDS and labeling requirements.
- Ensure chemical fume hood performance certifications.

TABLE 14.6
Relevant OSHA Standards for Laboratories

- PPE (29 CFR 1910 Subpart I)
- PPE General Requirements (29 CFR 1910.132)
- Respiratory Protection (29 CFR 1910.134)
- Toxic and Hazardous Substances (29 CFR 1910 Subpart Z)
- HCS (29 CFR 1910.1200)
- Bloodborne Pathogens (29 CFR 1910.1030)
- Occupational Exposure to Hazardous Chemicals in Laboratories (29 CFR 1910.1450)

TABLE 14.7
Other Relevant Laboratory Standards and Resources

- ANSI Z358.1-2004, Emergency Eyewash and Shower Equipment, contains provisions regarding the design, performance, installation, use, and maintenance of various types of emergency equipment. In addition to these provisions, some general considerations apply to all emergency equipment.
- ANSI Z9.5-2003, Laboratory Ventilation, is intended for use by employers, architects, occupational and environmental health and safety professionals, and others concerned with the control of exposure to airborne contaminants. The book includes new chapters on performance tests, air cleaning, preventative maintenance, and work practices. It also highlights the standard's requirements and offers good practices for laboratories to follow. The book also offers referenced standards and publications, guidance on selecting laboratory stack designs, an audit form for ANSI Z9.5, and a sample table of contents for a laboratory ventilation management plan.
- ANSI/ASHRAE 110-1995, Method of Testing the Performance of Laboratory Fume Hoods, specifies a quantitative test procedure for evaluation of a laboratory fume hood. A tracer gas is released at prescribed rates and positions in the hood and monitored in the breathing zone of a mannequin at the face of the hood. Based on the release rate of the tracer gas and average exposure to the mannequin, a performance rating is achieved.
- NFPA 45, Standard on Fire Protection for Laboratories Using Chemicals, 2004 edition, applies to laboratories that handle hazardous chemicals.
- NIOSH Pocket Guide to Chemical Hazards (NPG) provides a source of general industrial hygiene information on several hundred chemicals and classes for workers, employers, and occupational health professionals.
- NIOSH Master Index of Occupational Health Guidelines for Chemical Hazards summarizes pertinent information about the properties and hazards of many chemicals found in laboratories.
- AIHA Laboratory Health and Safety Committee provides resources to aid in prevention, identification, and control of potential exposures to chemical, biological, ergonomic, ionizing, and nonionizing radiation and physical hazards in laboratories.
- Hazardous Substances Data Bank (HSDB), National Library of Medicine (NLM), provides a toxicology data file that focuses on the toxicology of potentially hazardous chemicals. It is enhanced with information on human exposure, industrial hygiene, emergency handling procedures, environmental fate, regulatory requirements, and related areas.
- *Biosafety in Microbiological and Biomedical Laboratories*, 5th edition, provides guidance for implementing safety and hazard control practices in research laboratories.

blood or other potentially infectious materials exist. Use splatter guards to prevent splashing from reaching employees. Use hands-free sensor-controlled automatic sinks with foot, knee, or elbow controls. Other safety suggestions include using centrifuge tubes with caps, working in appropriate biological safety cabinets (BSCs), checking daily for proper air exchange and air flow, and maintaining records of ventilation systems and other equipment. Workers should never stand on chairs, lab stools, boxes, or drums to reach high shelves or the ceiling area. Use step-ladders or step stools specially designed for such purposes. Wash hands and arms several times during the course of the day to remove bits of irritating chemicals, animal dander, or biohazards. Maintain adequate ventilation at all times. Check hood drafts regularly, and direct questions about the proper functioning of the hood to the maintenance department or the chemical hygiene officer. Stay aware that static electricity can develop when transferring poor conductor liquids one container to another. Watch for electrical charges that also develop when compressed gases release rapidly from a cylinder. These charges can jump air gaps and form sparks that may ignite flammable vapors or gases. Ensure the proper grounding of cylinders by connecting the container and receiver to a ground wire. Electrical charges may also build up on personnel wearing shoes with rubber or plastic soles. Report sluggish drains to the maintenance department immediately. Never pour chemicals down a drain that could interact with the pipe material or cause a chemical reaction. Never pour any flammable materials down a drain. Refer to NFPA 45, Fire Protection Standard for Laboratories Using Chemicals, for information on construction, ventilation, and fire protection requirements.

Centrifuges

Cover all centrifuges during operation. Centrifuge tubes should fit the metal buckets and should never contain defects or cracks. Cushions at the bottom of the cups should be in good condition. Implement an inspection and maintenance schedule centrifuges and associated equipment installed in the laboratory. Equip all electrical heating equipment with over-temperature shutoff controls. Make thermal gloves, beaker and crucible tongs, and test tube holders available for handling hot items.

Laboratories and the OSHA Bloodborne Pathogens Standard

Take appropriate actions to prevent exposure of laboratory employees to bloodborne pathogens while handling contaminated lab samples such as blood or other body fluids. Require workers to wear appropriate PPE as required by the OSHA standard. OSHA sets additional requirements for biomedical research labs and facilities. Exposure of laboratory employees to bloodborne pathogens can occur while handling contaminated lab samples such as blood or other body fluids. Wear appropriate PPE as required by the standard. The type and amount of PPE depends on the anticipated exposure. Post a hazard warning sign incorporating the universal biohazard symbol on all access doors when potentially infectious materials including infected animals remain present in the work area. The hazard warning sign must meet OSHA 29 CFR 1910.1030 requirements. Conduct all activities involving other potentially infectious materials using BSCs or other physical containment device within the containment module. Prohibit work with other potentially infectious materials on open benches. Use only certified BSCs or other appropriate combinations of personal protection or physical containment devices. Detail any requirements for special protective clothing, respirators, centrifuge safety cups, sealed centrifuge rotors, and containment caging for animals to prevent exposures to droplets, splashes, spills, or aerosols. Each work area must contain a sink for washing hands and a readily available eye wash facility. Recommend that sinks permit foot, elbow, or automatic operation and locate sinks near an exit door in the work area. Each laboratory must provide hand-washing and eye wash facility that is readily available within the work area.

Establish controls to prevent employee exposure from needlestick injuries or cuts from sharp objects when working with specimens, centrifuge tubes, or overfilled sharps containers. Use engineering controls such as safer needle devices and work practice controls to include altering the way a task is performed to reduce chance of injury. OSHA, FDA, and NIOSH now recommend not using glass capillary tubes due to exposure risks during breakage. HIV and HBV Research Laboratories must only use hypodermic needles and syringes for parenteral injection and aspiration of fluids from laboratory animals and/or diaphragm bottles. Research facilities must only use needle-locking syringes or disposable syringe needle units for the injection or aspiration of other potentially infectious materials.

Tuberculosis

Require the use of appropriate controls such as limiting access, sealing windows, providing directional airflow, preventing recirculation of laboratory exhaust air, and filtering exhaust air. Use BSCs whenever working with infectious materials that could aerosolize. Processes that can expose employees to aerosolized materials include (1) pouring liquid cultures, (2) using fixed volume automatic pipetting devices, (3) mixing liquid cultures with a pipette, (4) preparing specimens and culture smears, and (5) dropping and spilling tubes containing suspensions of bacilli.

Morgue

Employee exposures include biological risks from infectious diseases and agents such as staph, strep, and HBV. Formaldehyde exposures from contact with cadavers pose a real hazard. Use appropriate PPE. Additional protections may apply during autopsies. Ensure the operation of appropriately

designed ventilation systems. Locate local vacuum systems for power saws in the morgue. Provide appropriate ventilation systems such as downdraft tables that capture the air around the cadaver. Use splatter guards to prevent splashes from reaching employee. Require the wear of surgical caps or hoods and shoe covers or boots when anticipating high contamination.

Chemical and Fire Hazards

Laboratory workers can experience routine exposure to hazardous chemicals such as acetone, carbon monoxide, formaldehyde, hydrogen sulfide, mercury, nitric acid, and xylene. Many exposures occur annually in laboratories, resulting in chemical-related illnesses such as dermatitis, eye irritation, and even fatal pulmonary edema. Employers must include information on additional protective measures for work that involves carcinogens, reproductive toxins, and acutely toxic substances. Establish a designated area with appropriate warning signs of the hazards present. Provide information on safe and proper use of a fume hood or equivalent containment device. Develop procedures for decontaminating the designated area including the safe removal of contaminated waste including biohazards. Employers must ensure that hazardous chemical container labels are not removed or defaced. Safety data sheets must accompany incoming shipments of chemicals, and employers must make them available to exposed employees. Develop plans and conduct drills to prepare for emergencies such as fire, explosion, accidental poisoning, chemical spill, vapor release, electric shock, bleeding, and personal contamination. Employers must provide appropriate safety equipment and first aid kits. Safety equipment may include fire extinguishers, fire blankets, AEDs, safety showers, eye wash fountains, spill control materials, and fume exhaust hoods. Test or check safety equipment on a monthly basis.

Chemical Exposure Response

Determine exposure outcomes considering the following issues: (1) route of exposure, (2) physical properties of the chemical, and (3) individual susceptibility to the chemical. Report all exposure incidents to the laboratory manager or supervisor or principal investigator, regardless of severity. When decontaminating skin, immediately flush with water for at least 15 min. Use shower and eye wash stations as appropriate. Check the SDS to determine if any delayed effects should be expected. Discard contaminated clothing or launder them separately from other clothing. Studies indicate nasal tumors occurred in exposed animals. Consider formaldehyde as a suspected carcinogen. When any possibility exists that employee's eyes may be splashed with solutions containing 0.1% or greater formaldehyde, the employer must provide acceptable eye wash facilities within the immediate work area for emergency use.

Standard Operating Procedures

Develop SOPs relevant to safety and health considerations to be followed when laboratory work involves the use of hazardous chemicals. This is especially the case if your lab operations include the routine use of select carcinogens, reproductive toxins, and substances of acute toxicity. SOPs can function as stand-alone documents or supplemental information included as part of research notebooks, experiment documentation, or research proposals. The key idea with laboratories having SOPs is to ensure a process is in place so that an experiment is well thought out and includes and addresses relevant health and safety issues.

Laboratory Equipment

Laboratory equipment may include refrigerators, centrifuges, microscopes, glassware, vacuum systems, stirring and mixing devices, heating devices, and autoclaves. Laboratory workers should

understand all potential equipment hazards. Laboratory workers should follow cleaning, maintenance, and calibration schedules. Electrically powered equipment, such as hot plates, stirrers, vacuum pumps, electrophoresis apparatus, lasers, heating mantles, ultrasonic devices, power supplies, and MW ovens, can pose significant hazards when mishandled or not maintained. Require grounded plugs on all electrical equipment and ground fault interrupters (GFIs) at needed locations. Compressed gases can pose toxic, flammable, oxidizing, corrosive, inert, or a combination of hazards. Use appropriate care when handling and storing compressed gas cylinders.

Microtome Safety

Consider modern microtomes as precision instruments designed to cut uniformly thin sections of a variety of materials for detailed microscopic examination. For light microscopy, the thickness of a section can vary between 1 and 10 μm. All microtomes consist of a base or the microtome body, knife attachment and knife, and the material or tissue holder. With most microtomes, a section is cut by advancing the material holder toward the knife while the knife is held rigidly in place. The cutting action can occur in either in a vertical or horizontal plane. Microtome knives constitute one of the ever-present and continuing hazards faced by medical laboratory personnel in the production of quality sections for diagnosis. Sharp microtome knives pose cutting hazards to users. However, injuries need not occur if workers take precautions and handle microtome knives with care and respect at all times. Always use knife guards on microtomes and carry a solid microtome knife in its box. Attach a handle before removing the knife from the box and never attempt to catch a dropped knife. Take extra care when tightening the screws used for holding disposable blades firmly in blade holders. Recommend workers take tetanus boosters every 5–10 years. Glass knives, prepared on knife-making machines by breaking hardened glass under pressure, pose an extra hazard. Splintering may occur when making new glass knives, and safety glasses should be worn to prevent eye damage.

Pressure and Vacuum Systems

Working with hazardous chemicals at high or low pressures requires planning and special precautions. Implement procedures to protect against explosion or implosion through appropriate equipment selection and the use of safety shields. Take care when selecting select glass apparatus and ensure that selected models can safely withstand designated pressure extremes. Always provide guards on all vacuum pumps. Vacuum work can result in an implosion and the possible hazards of flying glass, splattering chemicals, and fire. Correctly install all vacuum operations and know the potential risks.

Fume Hoods and Laboratory Ventilation

A well-designed chemical fume hood, when properly installed and maintained, offers a large degree of protection to the user. A fume hood functions as a ventilated enclosure that contains gases, vapors, and fumes to prevent their release in the laboratory. Hoods can also limit the effects of a spill by partially enclosing the work area and drawing air into the enclosure by means of an exhaust fan. An exhaust fan situated on the top of the laboratory building pulls air and airborne contaminants into the hood through ductwork and exhausts them to the atmosphere. In a well-designed, properly functioning fume hood, only about 0.0001%–0.001% of the material released within the hood actually escapes from the hood and enters the laboratory. Base the necessity of a fume hood by conducting a hazard analysis. The analysis should include a review of the quantity and toxicity of the materials used and the experiment conducted. Also consider volatility of the materials present, potential for their release, the number and sophistication of manipulations, and the skill of the lab person performing the work. Many laboratories use equipment and apparatus

that can generate airborne contaminants that cannot be controlled by a fume hood. Examples include gas chromatographs, ovens, and vacuum pumps.

Employee Training

Employers must provide training on safe lab work practices. Topics should include issues such as hazard awareness, handling of chemicals, procedures, and PELs. Provide workers with information on health and hygiene, physical hazards, electrical safety, emergency procedures, PPE, working alone in the laboratory, security, and handling visitors. Conduct worker training prior to initial assignment and whenever new exposure situations occur. Training must include location of the facility hygiene plan and the requirements of the OSHA Laboratory Standard. Provide information about OSHA PELs and RELs if no regulatory standard applies. Educate workers on the procedures for handling, storing, and disposing of hazardous chemicals. Review the elements of the chemical hygiene plan. Review specific employer procedures, engineering controls, work practices, and PPE. Ensure employees understand detection methods, observation guidelines, and monitoring procedures. Training should emphasize visual appearances and presence of odors that can help detect the presence of hazardous chemicals. Consider conducting regular departmental safety meetings to discuss the results of inspections and aspects of laboratory safety.

Medical Examinations and Consultations

The OSHA Laboratory Standard does not mandate medical surveillance for all laboratory workers. The employer must provide workers an opportunity for medical attention. This includes follow-up examinations and treatment recommended by an examining physician when an employee exhibits signs or symptoms associated with exposure to a hazardous chemical or the worker is routinely exposed above the action level or PEL for a regulated substance. Offer medical consultation to any employee potentially exposed through a spill, leak, or explosion of a hazardous chemical or substance. Employers must provide information about the hazardous chemical, conditions under which the exposure occurred, and a description of symptoms experienced by the worker. Employers must obtain from a treating physician any written opinion requiring follow-up examinations or medical tests.

Supervisor Responsibilities

Supervisors must ensure that employees know, understand, and follow the chemical hygiene plan and related SOPs. Supervisor must ensure availability of proper PPE and employees know its proper use. Perform quarterly chemical hygiene and housekeeping inspections. Perform semiannual chemical inventories of all laboratories and storage areas. Determine PPE for the procedures and chemicals in use in their area. Supervisor must conduct self-inspections to assure that healthful working conditions regulatory compliance.

Safety Personnel Responsibilities

Safety personnel can help lab safety by providing training, resources, and consultation for a variety of laboratory safety issues, including chemical safety, biological safety, electrical safety, laser safety, radiation safety, and other topics. They can also review the chemical hygiene plan, help develop and maintain laboratory safety manuals, conduct exposure monitoring, inspect fume hoods, and perform safety audits.

Laboratory Personnel Safety Responsibilities

Lab personnel must plan and conduct each laboratory operation in accordance with the chemical hygiene plan. Employees must also keep lab work areas in good order. Employers must educate

personnel on how to correctly select and use required PPE. Provide employees with a system to report exposures, injuries, or problems to supervisors or the chemical hygiene officer.

Animal Research Facilities

Use care when handling animals to avoid being bitten or scratched. Use proper restraining or protective devices whenever possible. Wear protective gloves when dissecting or conducting necropsy. Use first aid procedures to treat animal bites and scratches and report all incidents immediately. Immediately report allergic reactions to animals or to the drugs used in treating animals. When using animals to study the progress of disease, it is the responsibility of the supervisor to explain methods of protection to all workers. Thoroughly disinfect living area of infected animals. Render all animal carcasses noninfectious by autoclaving or incineration. Four standard biosafety levels describe for activities involving infectious disease work with commonly used experimental animals—animal biosafety levels 1, 2, 3, and 4—and provide increasing levels of protection to personnel and the environment. One additional biosafety level designated BSL-3-Agriculture addresses activities involving large or loose-housed animals and/or studies involving agents designated as high-consequence pathogens by the USDA.

Laboratory Hazardous Waste Disposal

Lab workers must know waste characteristics, proper packaging standards, labeling requirements, and waste collection or containment policies. Labs should maintain chemical inventory to avoid purchasing unnecessary quantities of chemicals and to develop a program for dating stored chemicals. Other helpful information needed to ensure proper disposal includes the following: (1) procedures for drain disposal of chemical waste, (2) policies on disposing of empty chemical containers, and (3) knowledge of federal, state, and local regulations for proper disposal. Determine procedures for special types of wastes including batteries, mercury-containing items, used oil, and the recycling chemicals.

Autoclaves

Autoclaves provide steam sterilization using a combination of temperature and pressure for a set time. While autoclaving does sterilize products, it does not clean the product, so take measure to clean lab ware to remove any soil or debris. Use a manual cleaner, ultrasonic cleaner, or laboratory washer. Because of the high temperature required for autoclaving, some plastics cannot survive autoclaving due to heat requirements. These would include polyethylene, polystyrene, or polyurethane. It is important for anyone to use high-temperature sterilization processes to determine if their lab ware can tolerate high-heat applications.

Good Clinical Laboratory Practices (GCLP)

To maintain a good clinical laboratory practice (GCLP) environment for clinical trials, labs must implement all key GCLPs. These elements include (1) developing effective organization and personnel management, (2) designing testing facilities, (3) appropriately validating assays, (4) using relevant positive and negative controls for the assays, and (5) creating a system for recording, reporting, and archiving data. Conducting audits helps ensure compliance with GCLP guidance. GCLP compliance will help laboratories ensure production of accurate, precise, and reproducible data to support sponsor confidence and withstand regulatory agency review. GCLP embraces both the research and the clinical labs. GCLP standards encompass applicable portions of 21 CFR Part 58 (GLP) and 42 CFR part 493 (CLIA). Due to the ambiguity in the CFR regulations, the GCLP standards described merging guidance from regulatory authorities as well as other organizations and

accrediting bodies, such as the CAP and the ISO. The GCLP standards provide single, unified document to guide the conduct of laboratory testing for human clinical trials. The intent of GCLP guidance is to help laboratories ensure the quality and integrity of data. The guidelines also encourage accurate reconstruction of experiments, monitoring of data quality, and comparing of test results.

Laboratory Physical Environments

Provide an environment in which laboratory testing does not compromise the staff safety quality of the preanalytical, analytical, and postanalytical processes. Design the laboratory to assure proper equipment placement, adequate ventilation, and sufficient storage areas. Ensure the lab design supports archiving of data in a secured fire-proof, fire-resistant, or fire-protected environment. Provide access to authorized personnel only. Laboratory designs must provide sufficient work areas to support worker effectiveness and safety. Maintain the laboratory's ambient temperature and humidity to ensure equipment and testing remain in tolerance limits set or established by the manufacturer. Use ambient temperature logs to document the acceptable temperature range, record actual temperatures, and provide documentation of corrective action taken to maintain acceptable temperature ranges. Clean and maintain all floors, walls, ceilings, and bench tops in the laboratory.

BIOSAFETY

Biosafety planning can reduce or eliminate exposure of individuals and the environment to potentially hazardous biological agents. Biosafety is achieved by implementing various degrees of laboratory control and containment, through laboratory design and access restrictions, personnel expertise and training, use of containment equipment, and safe methods of managing infectious materials in a laboratory setting. The objective of biosecurity is to prevent loss, theft, or misuse of microorganisms, biological materials, and research-related information. Biosafety and biosecurity share common components. Base both upon risk assessment and management methodology. There are four biosafety levels, which consist of combinations of laboratory practices and techniques, safety equipment, and laboratory facilities. Each combination is specifically appropriate for the operations performed in the location. Facilities must address documented or suspected routes of transmission of the infectious agents including laboratory functions or activities. A fundamental objective of any biosafety program is the containment of potentially harmful biological agents. The term *containment* is used in describing safe methods, facilities, and equipment for managing infectious materials in the laboratory environment where handled or maintained. The purpose of containment is to reduce or eliminate exposure of laboratory workers, other persons, and the outside environment to potentially hazardous agents. The use of vaccines may provide an increased level of personal protection. The risk assessment related to working with a specific agent will determine the appropriate combination of these elements. The most important element of containment is strict adherence to standard microbiological practices and techniques. Persons working with infectious agents or potentially infected materials must know potential hazards and be proficient in the practices and techniques required for handling such material safely. The director or person in charge of the laboratory is responsible for providing or arranging the appropriate training of personnel.

The BSC serves as the principal device used to provide containment of infectious droplets or aerosols generated by many microbiological procedures. Three types of BSCs (class I, II, and III) are used in microbiological laboratories. Laboratory directors must provide for facilities commensurate with the laboratory's function and the recommended biosafety level for the agents being manipulated. The recommended secondary barriers will depend on the risk of transmission of specific agents. For example, the exposure risks for most laboratory work in BSL-1 and BSL-2 facilities will involve direct contact with the agents or inadvertent contact exposures through contaminated work environments. Secondary barriers in these laboratories may include separation of the laboratory

work area from public access, availability of a decontamination facility, and hand-washing facilities. When the risk of infection by exposure to an infectious aerosol is present, higher levels of primary containment and multiple secondary barriers may become necessary to prevent infectious agents from escaping into the environment. Such design features include specialized ventilation systems to ensure directional airflow, air treatment systems to decontaminate or remove agents from exhaust air, controlled access zones, airlocks at laboratory entrances, or separate buildings or modules to isolate the laboratory. Design engineers for laboratories may refer to specific ventilation recommendations as found in the ASHRAE Laboratory Design Guide published by the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE).

Biological Safety Officer (BSO)

The responsibilities of each biological safety officer (BSO) now extend beyond those described in the NIH Guidelines and depend on the size and complexity of the program. When working with known agents, the BSO ensures the use of appropriate biosafety precautions. When information comes to light to suggest that virulence, pathogenicity, antibiotic resistance patterns, vaccine, treatment availability, or other factors become significantly altered, the BSO may prescribe more or less stringent practices.

Biosafety Level 1

This level provides basic containment measures that depend on following standard microbiological practices. This level does not prescribe special primary or secondary barriers except for a sink for washing hands. Safety equipment and facilities must meet requirements for undergraduate and secondary education, including teaching laboratories. This level classifies other work facilities by the characteristics of microorganisms not known to cause disease in healthy adult humans. Many agents not ordinarily associated with disease can become opportunistic pathogens in the young, the aged, those at high medical risk, and persons with suppressed immune systems. Never consider vaccine strains that underwent multiple in vivo passages as virulent.

Biosafety Level 2

This level stresses the use of secondary barriers and making waste decontamination available to reduce potential environmental contamination. Use biosafety level 2 protection for work done with human-derived blood, body fluids, or tissues in which the presence of an infectious agent may be unknown. Primary hazards to people working with these agents relate to accidental percutaneous events, mucous membrane exposures, or ingestion of infectious materials. Use extreme caution when working with contaminated needles or sharp instruments. Use caution when performing procedures with a high aerosol spray or splash potential that could increase the risk of such exposure. Conduct such work in primary containment equipment or devices such as a BSC or safety centrifuge cups.

Use other primary barriers such as splash shields, face protection, gowns, and gloves. Biosafety level 2 addresses practices, equipment, and facilities relevant to risks in clinical, diagnostic, teaching, and other facilities that work with a broad spectrum of indigenous, moderate-risk agents. With good microbiological techniques, workers can handle safely in activities conducted on the open bench unless a potential exists for producing splashes or aerosols.

Biosafety Level 3

This level places emphasis on primary and secondary barriers that protect personnel working in contiguous areas. All laboratory manipulations should occur in BSCs or other enclosed equipment such as a gas-tight aerosol-generation chamber. Secondary barriers for this level include controlled

access to the laboratory and a specialized ventilation system that minimizes the release of infectious aerosols from the laboratory. Biosafety level 3 practices, equipment, and facilities apply to clinical, diagnostic, teaching, research, and production facilities working with indigenous or exotic agents. This type of work raises the potential for respiratory transmission that may cause serious or potentially lethal infections. Primary hazards to personnel working with these agents relate to automatic inoculation situations, ingestion, and exposure to infectious aerosols.

Biosafety Level 4

Complete isolation of aerosolized infectious materials is accomplished primarily by working in a class III BSC or a full-body, supplied air, positive pressure suit. The biosafety level 4 facility itself is generally a separate building or completely isolated zone with complex, specialized ventilation and waste management systems to prevent the release of viable agents to the environment. The primary hazards to personnel working with level 4 agents relate to respiratory exposures to infectious aerosols, mucous membrane exposures to infectious droplets, and autoinoculation. All manipulations of potentially infectious diagnostic materials, isolates, and naturally or experimentally infected animals pose a high risk of exposure and infection to laboratory personnel, the community, and the environment. Biosafety level 4 practices apply to safety equipment and facilities working with dangerous and exotic agents that pose a significant life-threatening risk. Agents with a close or identical antigen relationship to other biosafety level 4 agents should be handled at the same level.

Biological Safety Cabinets

Classify BSCs according to airflow velocities, air patterns, exhaust system, and cabinet construction. The appropriate cabinet will protect the operator, the environment, and the biological specimen from contamination. The average face velocity runs between 75 and 100 fpm and draws un-recirculated airflows away from the operator. Use class I cabinets for biosafety level 1, 2, or 3 containment. If connected to an exhaust duct with a face velocity of 100 fpm, this class of cabinets can be used with volatile toxic chemicals or radionuclides. All exhaust air must be HEPA filtered.

BSC class II cabinets protect personnel, the environment, products, and specimens. These cabinets contain an open front and an inward airflow of 75–100 fpm to protect the operator. The laminar air that comes in contact with the product is first HEPA filtered to protect the product from contamination. The exhaust air then goes through a second HEPA filter to protect the environment. Use class II cabinets with products requiring biosafety levels 1, 2, or 3 containment.

BSC class III ventilated cabinets function as gas tight and totally enclosed to offer total containment of the biological hazard. All work performed is accomplished through attached rubber gloves. Supply air is HEPA filtered to protect the product. Exhaust air is HEPA filtered twice to provide environmental protection. Class III cabinets must be connected to double-door autoclaves or disinfectant dunk tanks to sterilize and disinfect materials that enter or exit the work area. Use class III cabinets when working with biological agents that require biological levels 1, 2, 3, or 4 containment.

Service and Certification

The American Society of Health System Pharmacists (ASHP) recommends servicing of BSCs by a qualified technician every 6 months or any time the cabinet is moved or repaired. Technicians servicing these cabinets or changing the HEPA filters should be aware of risks and should use the same PPE as recommended for large spills. Certification of the BSC includes performance testing. Helpful information on such testing can be found in the ASHP 1990 technical assistance bulletins. Change HEPA filters when they restrict airflow or if contaminated by an accidental spill. They should be bagged in plastic and disposed of as HDs. Any time the cabinet is turned off or transported, it should be sealed with plastic.

Biosecurity

The need for a biosecurity program should reflect sound risk management practices based on a site-specific risk assessment. A biosecurity risk assessment should analyze the probability and consequences of loss, theft, and potential misuse of pathogens and toxins. Risk assessment and risk management processes can divide into five main steps: (1) identify and prioritize biologicals and/or toxins, (2) identify and prioritize the adversary/threat to biological and/or toxins, (3) analyze the risk of specific security scenarios, (4) design and develop an overall risk management program, and (5) regularly evaluate the institution's risk posture and protection objectives.

If an entity possesses, uses, or transfers select agents, it must comply with all requirements of the National Select Agent Program. For additional guidance on CDC and USDA Select Agent Programs, refer to 42 CFR Part 73, 7 CFR Part 331, and 9 CFR Part 121.

PHARMACY SAFETY

Because of the complexity of medications including specific indications, effectiveness of treatment regimens, safety of medications, and patient compliance issues, many pharmacists practicing in hospitals gain more education and training after pharmacy school through a pharmacy practice residency and sometimes followed by another residency in a specific area. Those pharmacists often referred to as clinical pharmacists specialize in various disciplines of pharmacy. For example, pharmacists can specialize in hematology/oncology, HIV/AIDS, infectious disease, critical care, emergency medicine, toxicology, nuclear pharmacy, pain management, psychiatry, anticoagulation clinics, herbal medicine, neurology/epilepsy management, pediatrics, neonatal pharmacists, and more.

Hospital pharmacies usually stock a larger range of medications, including more specialized medications, than would be feasible in the community setting. Most hospitals dispense medications as a unit dose or a single dose of medicine. Hospital pharmacists and trained pharmacy technicians compound sterile products for patients including total parenteral nutrition (TPN) and other medications given intravenously. This is a complex process that requires adequate training of personnel, quality assurance of products, and adequate facilities. Some hospital pharmacies outsource high-risk preparations and some other compounding functions to companies who specialize in compounding. The high cost of medications and drug-related technology, combined with the potential impact of medications and pharmacy services on patient safety, makes it imperative that hospital pharmacies perform at the highest level possible.

Clinical Pharmacy

Clinical pharmacists provide direct patient care services that optimize the use of medication and promote health, wellness, and disease prevention. Clinical pharmacists care for patients in all healthcare settings, but the clinical pharmacy movement initially began inside hospitals and clinics. Clinical pharmacists often collaborate with physicians and other healthcare professionals to improve pharmaceutical care. Clinical pharmacists now serve as an integral part of the interdisciplinary approach to patient care. They work collaboratively with physicians, nurses, and other healthcare personnel in various medical and surgical areas. They often participate in patient care rounds and drug product selection. In most hospitals in the United States, potentially dangerous drugs that require close monitoring are dosed and managed by clinical pharmacists. Pharmacies must comply with Joint Commission, AOA, or other Medicare accreditation/certification standards. OSHA regulates worker safety in pharmacies including exposures to hazardous materials and drugs. In hospital settings, the pharmacy plays a key role in providing quality care. The pharmacy serves other functions including directing special drug programs, providing services to satellite locations, and managing drug information systems. The pharmacy department also plays a key role in preventing

medication errors. The on-site licensed pharmacists prepare pharmacy compounds and mix all sterile medications, intravenous admixtures, or other drugs except in emergency situations.

General Safety Considerations

Use safety materials and equipment while preparing hazardous medications. Avoid contamination by using clean or sterile technique as appropriate. Maintain clean, uncluttered, and functionally separate areas for product preparation. Visually inspect the integrity of the medications. Workers not aware of proper work practices and controls may be exposed to hazardous drugs through the skin, mouth, or by inhalation. The OSHA Technical Manual and new NIOSH Guidelines provide guidance regarding the safety, use, administration, storage, and disposal of hazardous drugs.

Pharmacy Safety

The ASHP recommends that pharmacies develop and implement a safety management program. Pharmacy representation on the safety committee is important not only to the department but also to the effectiveness of the safety committee. Concern over safe handling of medication errors and hazardous drug safety has increased the pharmacy's presence on the committee. The pharmacy director must ensure that the department conducts an effective orientation and on-the-job training program to address

- The importance of practicing safety on the job
- The department's disaster planning and emergency response roles
- Hazards found in specific jobs or processes
- Organizational/departmental safety policies and procedures

Personnel must be familiar with the organization's emergency management plan. Pharmacy personnel must be trained in the department's responsibilities in supporting the plan. The department should develop a plan for obtaining and distributing drugs during emergency situations. Pharmacy staff members should know

- Fire identification and reporting procedures
- The classes and hazards of fire
- How to activate the fire alarm and notify others
- How to select and use the proper fire extinguisher
- Techniques for controlling smoke and fire
- Evacuation routes and egress responsibilities

OSHA Hazard Communication Standard

OSHA requires a written plan that contains information related to worker training, warning labels, and access to SDSs. Employees must understand the requirements of the HCS including operations or procedures with hazard exposures. The HCS applies to drugs and pharmaceuticals that the manufacturer has determined to be hazardous. It could also apply to hazardous substances known to be present in the workplace that could pose exposures under normal conditions or in a foreseeable emergency. The exemptions to the standard include the following:

- Drugs that are in solid, final form for direct administration to the patient.
- Final form exemption would also apply to tablets or pills that are occasionally crushed, if the pill or tablet is not designed to be dissolved or crushed prior to administration.
- Consumer products subjected to the labeling requirements of the terms as defined in the Consumer Product Safety Act and the Federal Hazardous Substances Act.

Pharmacy Ergonomics

Pharmacy personnel may develop MSDs such as carpal tunnel syndrome or tendonitis from activities that involve repetitive tasks, forceful exertions, awkward postures, or contact stress. Use assistive devices if possible. The modification of pharmacy tasks decreases incidence of work-related MSDs. Redesign the process to incorporate variation into the task. Provide ergonomically comfortable work stations including wrist pads, adjustable padded chairs, keyboard tray, and monitors at a comfortable height.

Workplace Violence

Pharmacists may be exposed to workplace violence due to the availability of drugs and money in the pharmacy area. OSHA recommends that employers establish and maintain a violence prevention program. Install Plexiglas in the payment window in the pharmacy area. Provide better visibility and lighting in the pharmacy area. Conduct training for staff in recognizing and managing hostile and assaultive behavior. Implement security devices such as panic buttons, beepers, surveillance cameras, alarm systems, two-way mirrors, card-key access systems, and security guards.

General Medication Labeling

Standardize labeling to meet organization policy, applicable law, or practice standards. Properly label all medication when prepared if not administered immediately. Appropriately label any container including plastic bags, syringes, bottles, or boxes that can be labeled and secured. Label with drug name, strength, and amount, if not apparent from the container. Include expiration date when not used within 24 h. Label compounded IV admixtures and nutrition solutions with the date prepared and the diluents. When preparing medications for multiple patients or when the preparing person will not administer the medication, include the patient name and location on the label.

Closed Pharmacy Procedures

Develop a process for providing medications to meet patient needs when the pharmacy is closed. Store the medications in a night cabinet, automated storage and distribution device, or a selected section of the pharmacy. Only permit trained designated prescribing professionals or nurses to access medications. Establish quality control procedures such as a second check by another individual or a secondary verification such as bar coding to prevent medication retrieval errors. Arrange for a qualified pharmacist to stay available on call or at another location to answer questions or provide for medications beyond those accessible to nonpharmacy staff. Implement changes as needed to reduce the amount of times nonpharmacist healthcare professionals obtain medications after the pharmacy is closed.

Drug Recalls or Safety Alerts

When the organization has been informed of a medication recall or discontinuation by the manufacturer or the FDA for safety reasons, retrieve the medications within the organization and handle per organization policy, law, or regulation.

Recalls generally occur by lot number; an organization may retrieve all lots of a recalled medication instead of recording and identifying medications by their lot number. When the organization has been informed of a medication recall or discontinuation by the manufacturer or the FDA for safety reasons, notify everyone that orders, dispenses, and/or administers the recalled or discontinued medications.

High-Risk Medications

Refer to lists of high-risk or high-alert drugs available from the Institute for Safe Medication Practices (ISMPs) or the United States Pharmacopeia (USP). The organization should develop a list of high-risk or high-alert drugs based on its utilization patterns, administered drugs, and internal data about medication errors. High-risk drugs may include investigational drugs, controlled medications, drugs not approved by the FDA, medications with a narrow therapeutic range, psychotherapeutic medications, and look- or sound-alike medications. As appropriate to the services provided, the organization develops processes for procuring, storing, ordering, transcribing, preparing, dispensing, administering, and/or monitoring high-risk or high-alert medications.

Investigational Medication Safety

The organization protects the safety of patients participating in investigational or medication studies by ensuring adequate control and support. The organization should show sensitivity to the use of particular populations for experimentation and research and review all investigational medications to evaluate safety. Develop a written process for reviewing, approving, supervising, and monitoring investigational medications used. Review and accommodate, as appropriate, the patient's continued participation in the protocol. Specify that the pharmacy controls the storage, dispensing, labeling, and distribution of the investigational medications.

Evaluation of Medication Management

Evaluate medication management system for risk points and identify areas to improve safety. Routinely evaluate literature for new technologies or successful practices demonstrated to enhance safety for improving the medication management system. Review internally generated reports to identify trends or issues within the system. When the organization receives a medication recall or discontinuation notice for safety reasons, identify all patients who received the medication. Return any medications when allowed by law, regulation, and organization policy. Control and account for previously dispensed but unused, expired, or returned medications. The pharmacy remains responsible for controlling and accounting for all unused medications returned to the pharmacy.

Drug Quality and Storage

The ASHP sets guidelines on drug quality and specifications. Pharmacy procedures should require that all drugs and medications meet the standards of the USP/National Formulary (NF). Drugs not included in the USP/NF should be approved by the FDA. Obtain drugs from known sources and that meet identity, purity, and potency requirements. Drugs should comply with FDA current manufacturing practices. Store drugs for external use separately from medications taken internally. Never keep respiratory care drugs and those used to prepare irrigation solutions with other injectable drugs. Never store large quantities of acids or other hazardous materials close to floor level. Never store large or heavy drug containers in lower shelves. Identify hazardous storage areas and post appropriate caution or warning signs. Never store in a refrigerator that contains food or drink. Consider the following factors when assessing sources of drugs and medications:

- Data on sterility and analytical controls
- Bioavailability and bioequivalence information
- Information about raw materials and finished products
- Miscellaneous information on the quality of the drug or medication

HAZARDOUS DRUG SAFETY

NIOSH released new hazardous drug guidelines in 2004 for healthcare organizations. OSHA currently enforces safety issues using the general duty clause and existing standards dealing with hazard communication and PPE. Consider all drugs with toxic, irritating, sensitizing, or organ-targeting characteristics as hazardous. Both clinical and nonclinical workers may experience exposures to hazardous drugs when they create aerosols, generate dust, clean up spills, or touch contaminated surfaces during the preparation, administration, or disposal of hazardous drugs. Exposures to hazardous drugs may occur through inhalation, skin contact, skin absorption, ingestion, or injection. Inhalation and skin contact/absorption remain the most likely routes of exposure, but unintentional ingestion from hand to mouth contact and unintentional injection through a needlestick or sharps injury can also occur. In most cases, the percentage of air samples containing measurable airborne concentrations of hazardous drugs was low. Recently, several studies examined environmental contamination of hazardous drug preparation and administration areas. Factors that affect worker exposures include the following:

- Drug handling circumstances (preparation, administration, or disposal)
- Amount of drug prepared
- Frequency and duration of drug handling
- Potential for absorption
- Use of ventilated cabinets

Current Standards

No NIOSH RELs, OSHA PELs, or ACGIH TLVs exists for hazardous drugs. PELs, RELs, and TLVs exist for inorganic arsenic compounds, which include the antineoplastic drug arsenic trioxide. Some pharmaceutical manufacturers develop risk-based occupational exposure limits (OELs) for use in their own manufacturing setting. Look for this information on available SDSs or request from the manufacturer. RCRA regulations require that hazardous waste be managed by following a strict set of regulatory requirements. The RCRA list of hazardous wastes includes only about 30 pharmaceuticals, 9 of which classify as antineoplastic drugs. Recent evidence indicates that a number of drug formulations exhibit hazardous waste characteristics. Dispose of hazardous drug waste in a manner similar to that required for RCRA-listed hazardous waste. Hazardous drug waste includes partially filled vials, undispensed products, unused IVs, needles and syringes, gloves, gowns, underpads, contaminated materials from spill cleanups, and containers such as IV bags or drug vials that contain more than trace amounts of hazardous drugs and not contaminated by blood or other potentially infectious waste.

NIOSH Revision of ASHP Definition

The 1990 ASHP definition of hazardous drugs was revised by the NIOSH Working Group on Hazardous Drugs for this Alert. Drugs considered hazardous include those that exhibit one or more of the following characteristics in humans or animals:

- Carcinogenicity
- Teratogenicity or other developmental toxicity
- Reproductive toxicity
- Organ toxicity at low doses
- Genotoxicity

Developing a Hazardous Drug List

Compliance with the OSHA HCS entails (1) evaluating whether these drugs meet one or more of the criteria for defining hazardous drugs and (2) posting a list of the hazardous drugs to ensure worker safety. Institutions may wish to compare their lists to the sample listing in this document or on the NIOSH website. Hazardous drug evaluation remains a continual process. Local hazard communication plans should provide for assessment of new drugs as they enter the marketplace. Toxicological data are often nonexistent for investigational drugs. However, if the mechanism of action suggests that there may be a concern, it is prudent to handle them as hazardous drugs until adequate information becomes available to exclude them. Some drugs defined as hazardous may not pose a significant risk of direct occupational exposure because of their dosage formulation. However, they may pose a risk if solid drug formulations become altered, such as by crushing tablets or making solutions from them outside a ventilated cabinet.

Where to Find Information Related to Drug Toxicity

Pharmacy or nursing departments often develop lists of hazardous drugs. These comprehensive lists should include all hazardous medications routinely used or likely used by a local practice. Some of the resources that employers can use to evaluate the hazard potential of a drug include

- Material SDSs
- Product labeling approved by FDA and packaging inserts
- Special health warnings from drug manufacturers, FDA, and other professional groups
- Reports and case studies published in medical and other healthcare profession journals
- Evidence-based recommendations from other facilities that meet criteria defining hazardous drugs

The NIOSH list was compiled from information provided by (1) four institutions that generated lists of hazardous drugs for their respective facilities, (2) the American Hospital Formulary Service Drug Information (AHFS DI) monographs, and (3) several other sources. Institutions may want to adopt this list or compare theirs with the list on the NIOSH website.

2010 NIOSH Update of Hazardous Drug Alert for Healthcare Settings

NIOSH has published an update to their 2004 alert: *Preventing Occupational Exposures to Antineoplastic and Other Hazardous Drugs in Health Care Settings*. This latest update adds 21 drugs to Appendix A, the list of drugs considered hazardous. The update added the following nine chemotherapy drugs to the previous list published in the 2004 alert (Table 14.8). These chemotherapy drugs include

- Bortezomib
- Clofarabine
- Dasatinib
- Decitabine
- Nelarabin
- Pemetrexed
- Sorafenib
- Sunitinib malate
- Vorinostat

TABLE 14.8
Other Hazardous Drugs Listed in the 2010 Update

- Alefacept
- Bosentan
- Entecavir
- Lenalidomide
- Medroxyprogesterone acetate
- Palifermin
- Paroxetine hydrochloride
- Pentetate calcium trisodium
- Rasagiline mesylate
- Risperidone
- Sirolimus
- Zonisamide

Hazardous Drug Safety Plan

Accomplish a workplace analysis of all hazardous drug areas. Develop, implement, maintain, and review annually the written hazardous drug safety plan designed to protect those who handle are exposed to hazardous medications. NIOSH and the OSHA provide guidance in the development of a drug safety and health plan. Nursing stations on floors where hazardous drugs will be administered should provide spill and emergency skin and eye decontamination kits available. Maintain copies of relevant SDSs for guidance. Plan contents should include the following:

- Labeling, storage, spill control, and response actions
- Detailed procedures for preparation and administration
- Use and maintenance of equipment used to reduce exposures such as ventilated cabinets, closed system drug transfer devices, needleless systems, and PPE
- Work practices covering manipulation techniques
- General hygiene practices, such as no eating or drinking in the drug handling areas such as the pharmacy or clinical areas
- Provide both general and specific safety training in handling hazardous drugs
- Training about location and proper use of spill kits
- Ensure training meets all relevant OSHA requirements
- Procedures for cleaning and decontamination of the work areas and for proper waste handling and disposal of all contaminated materials including patient wastes

During the preparation of hazardous drugs, use a ventilated cabinet to reduce the potential for occupational exposure. Performance test methods and criteria for BSCs may be found in *Primary Containment for Biohazards: Selection, Installation and Use of Biological Safety Cabinets*, second edition, CDC/NIH, 2000. A current field certification label should be prominently displayed on the ventilated cabinet per NSF/ANSI 49.

Protocols should specify that unventilated areas such as storage closets not be used for drug storage or any tasks involving hazardous drugs. Hazardous drugs should also be stored and transported in closed containers that minimize the risk of breakage. The storage area should contain sufficient general exhaust ventilation to dilute and remove any airborne contaminants. Depending upon the physical nature and quantity of the stored drugs, consideration should be given to installing a dedicated emergency exhaust fan sufficient in size to quickly purge to the outdoors any airborne

contaminants within the storage room and to prevent airborne contamination in adjacent areas in the event of a spill. Limit access to areas where personnel prepare, receive, or store hazardous drugs. Place signs to restrict entry. Design bins or shelves for storing hazardous drugs to prevent breakage and to limit risk of falling. Apply warning labels to all hazardous drug containers, shelves, and bins. Recommend hazardous drugs requiring refrigeration be stored separately from nonhazardous drugs. The most significant risk for exposure during distribution and transport is from spills, resulting from damaged containers. PPE is generally not required when packaging is intact during routine activities. Any person opening a container to unpack the drugs should wear chemotherapy gloves, protective clothing, and eye protection. Wear chemotherapy gloves in transporting the vial of syringe to the work area due to possible contamination.

Transfer Procedures

Transfers from primary packaging such as vials to dosing equipment to infusion bags, bottles, or pumps should be carried out using closed systems whenever possible. Devices that contain the product within a closed system during drug transfers limit the potential for aerosol generation as well as exposure to sharps. Evidence has documented a decrease in drug contaminants present within a class II BSC when a closed system transfer device was used. However, a closed system transfer device is not an acceptable substitute for a ventilated cabinet and should only be used in conjunction with a ventilated cabinet.

Caregiver Exposure Precautions

Exposure can occur in personnel handling patient linens and excreta from patients receiving hazardous drugs within the last 48 h. In some cases, take precautions for up to 7 days. Wear two pairs of appropriate gloves and a disposable gown. Wear face shields if a potential exists for splashing. Wash hands with soap and water after removal of gloves.

Administering Aerosolized Drugs

Ribavirin, a synthetic nucleoside with antiviral activity, can be effective against respiratory syncytial virus. It is reconstituted from a lyophilized powder for aerosol administration. Ribavirin is usually administered in the aerosolized form via mask or oxygen tent for 12–18 h/day for 3–7 days. A small particle aerosol generator creates respirable particles of 1.3 μm median diameter. Under current practice, excess drug is exhausted into the patient's room, causing additional exposures. Studies show that Ribavirin is a reproductive risk in rodents and rabbits. Human studies on nurses who administer the drug by oxygen tent method absorbed a dose that exceeded the safety factor of the short-term daily dose level. Minor pulmonary function abnormalities did occur in healthy adult volunteers in clinical studies. When administering aerosolized drugs, additional precautions should be observed:

- Use of NIOSH-approved respirators.
- If possible, administer in booths with local exhaust or isolation rooms with HEPA-filtered systems.
- Permit only trained personnel to administer hazardous drugs.
- Require caregivers to wear disposable gloves and gowns.
- Work at waist level if possible and avoid working above the head.
- Warn pregnant staff or women breast-feeding to avoid contact with these drugs.

Aerosolized pentamidine is an FDA approved for the treatment and prophylaxis of some types of pneumonia. Pentamidine administered as an aerosol must be reconstituted from a lyophilized

powder. No studies exist to evaluate the potential carcinogenic, mutagenic, or reproductive effects of pentamidine. Studies among healthcare workers reveal uptake by those personnel who administer the drug. Side effects include coughing, sneezing, mucous membrane irritation, headache, and bronchospasms.

Hazardous Drug Wastes

OSHA covers bags containing materials contaminated with hazardous drugs under the HCS. Recommend the use of thick, leak-proof plastic bags, colored differently from other hospital bags. Use these bags for routine collection of discarded gloves, gowns, and other disposable materials. Label as Hazardous Drug–related wastes. The OSHA Technical Manual suggests keeping waste bags inside a covered waste container clearly labeled Hazardous Drug WASTE ONLY. At least one such receptacle should be located in every area preparing or administering hazardous drugs. Never move waste from one area to another. Seal bags when filled and tape covered waste container. Label needle containers and breakable items of hazardous waste as Hazardous Drug waste only. The Bloodborne Pathogens Standards require the use of properly labeled, sealed, and covered disposal containers for wastes containing blood or other potentially infectious materials. Hazardous drug–related wastes should be disposed of according to EPA's state and local regulations for hazardous waste. This disposal can occur at either an EPA compliant incinerator or a licensed sanitary landfill for toxic wastes. Commercial waste disposal must be performed by a licensed company. While awaiting removal, maintain waste in a secured area in covered, labeled drums with plastic liners.

Spill Control

Spills should be managed according to workplace hazardous drug spill policy and procedures. The size of the spill might determine both who can conduct the cleanup and decontamination. Make spill kits and other cleanup materials available in area handling hazardous drugs. However, OSHA requires that persons who wear respirators such as those contained in some spill kits follow a complete respiratory protection program including fit testing. The written program should address the protective equipment required for differing amounts spilled, the possible spreading of material, restricted access to hazardous drug spills, and signs to be posted. Dispose of all cleanup materials as hazardous chemical waste container in accordance with RCRA regulations.

Medical Surveillance

In addition to preventing exposure to hazardous drugs and careful monitoring of the environment, medical surveillance is an important part of a safe handling program. NIOSH recommends employees handling hazardous drugs to participate in medical surveillance efforts provided at their workplace. The OSHA Technical Manual recommends that workers handling hazardous drugs receive monitoring as part of the medical surveillance program that includes the taking of a medical and exposure history, physical examination, and some laboratory measures. Professional organizations also recommend medical surveillance as the recognized standard of occupational health practice for hazardous drug handlers.

Ventilated Cabinets

Conduct all tasks related to mixing, preparing, or manipulating hazardous drugs within a ventilated cabinet designed specifically to prevent hazardous drugs from being released into the surrounding environment. Follow aseptic requirements established by state boards of pharmacy. Recommend the use ventilated cabinets when concerned about hazardous drug containment and

aseptic processing. Use a class I BSC or an isolator for containment when not required to process with asepsis. In some application, a containment isolator may suffice. For mixing requiring an aseptic technique, use the class II, type B2. If possible, use class III cabinets as isolators intended for asepsis and containment. Equip all ventilated cabinets with a continuous monitoring device to confirm adequate airflow prior to each use. Filter exhaust from these controls with a HEPA filter. Exhaust 100% to the outside if feasible. Install outside exhaust system to prevent entrainment by the building envelope or HVAC systems. Place fan downstream of the HEPA filter to ensure contaminated ducts remain under negative pressure. Never use a ventilated cabinet with air recirculation unless the hazardous drug in use will not volatilize during process manipulation or after capture by the HEPA filter. Use the information on volatilization provided by the drug manufacturer or determined from air sampling data. Refer to NSF/ANSI 49 for additional information regarding placement of the cabinet, exhaust system, and stack design. Never consider additional engineering or process controls such as needleless systems, glove bags, and closed system drug transfer devices as substitutions for ventilated cabinets. Clean the cabinet according to the manufacturer's instructions. Some manufacturers recommend weekly decontamination, as well as whenever spills occur or when the cabinet requires moving, service, or certification. Decontamination should consist of surface cleaning with water and detergent followed by thorough rinsing. The use of detergent is recommended because there is no single accepted method of chemical deactivation for all agents involved. Avoid quaternary ammonium cleaners due to the possibility of vapor buildup in recirculated air. Use ethyl alcohol or 70% isopropyl alcohol if the contamination is soluble only in alcohol. Alcohol vapor buildup has also been a concern, so the use of alcohol should be avoided in BSCs where air is recirculated. Avoid spray cleaners due to the risk of spraying the HEPA filter. Never use ordinary decontamination procedures, which include fumigation with a germicidal agent when handling dangerous drug wastes.

Recordkeeping

Maintain any workplace exposure records created in connection with hazard drug handling for at least 30 years. Maintain medical records for the duration of employment plus 30 years in accordance with the Access to Employee Exposure and Medical Records Standard (29 CFR 1910.1020). In addition, sound practice dictates that training records should include the following information:

- Dates of the training sessions
- Contents or a summary of the training sessions
- Names and qualifications of the persons conducting the training
- Names and job titles of all persons attending the training sessions

Maintain training records for 3 years from the date on which the training occurred.

PROPOSED UNIVERSAL WASTE RULE FOR PHARMACEUTICALS

The proposed rule encourages generators to dispose of nonhazardous pharmaceutical waste as universal waste, thereby removing this unregulated waste from wastewater treatment plants and municipal solid waste landfills. The addition of hazardous pharmaceutical waste to the universal waste rule will facilitate the collection of personal medications from the public at various facilities so that they can be more properly managed. This proposed rule applies to hazardous pharmaceutical wastes generated by the following types of facilities: pharmacies, hospitals, physicians' offices, dentists' offices, other healthcare practitioners, outpatient care centers, ambulatory healthcare services, residential care facilities, veterinary clinics, and reverse distributors. This rule does not apply to pharmaceutical manufacturing or production facilities. EPA understands that many healthcare facilities may not understand the applicability of RCRA hazardous

waste regulations to their hazardous pharmaceutical wastes, and thus, EPA anticipates that this proposed rule will also alert generators to the applicability of the RCRA hazardous waste regulations to their waste streams. The EPA believes that hazardous pharmaceutical wastes meet the factors considered when determining if waste is appropriate for inclusion in the universal waste rule. Specifically, most hazardous pharmaceutical wastes present a relatively low risk during accumulation and transport due to their form and packaging, which is typically in small, individually packaged dosages, such as pills or capsules.

Current RCRA Requirements

Under current RCRA requirements, any facility that generates RCRA hazardous pharmaceutical waste falls under RCRA generator regulations. Under the universal waste program, generators of hazardous pharmaceutical wastes may option to manage these wastes as *universal wastes.* If a facility opts to manage its hazardous pharmaceutical waste under the universal waste option, then that facility will become a *handler* of pharmaceutical universal waste, rather than a *generator* of hazardous pharmaceutical waste. Compared to a generator of hazardous pharmaceutical waste, a handler of pharmaceutical universal waste can note the following benefits: (1) an increased accumulation threshold, (2) an increased on-site accumulation limit, (3) an increased storage time limit, (4) no manifest requirement, and (5) basic training requirements.

Approximately 31 commercial chemical products listed on RCRA's P and U lists have pharmaceutical uses. The EPA bases their P and U lists on chemical designations; this number does not completely represent the total number of brand name pharmaceuticals that may actually be listed as hazardous wastes. In addition, waste pharmaceuticals may also pose hazards because they exhibit one or more of the four characteristics of hazardous waste: ignitability, corrosivity, reactivity, and toxicity. Characteristic pharmaceutical wastes include those that exhibit the ignitability characteristic, such as solutions containing more than 24% alcohol. An example of a pharmaceutical that may exhibit the reactivity characteristic is nitroglycerine. Pharmaceuticals exhibiting a corrosive characteristic generally apply to compounding chemicals, including strong acids, such as glacial acetic acid, and strong bases, such as sodium hydroxide. Depending on the concentration in different preparations, pharmaceuticals may also exhibit the toxicity characteristic because of some contaminants such as arsenic, barium, cadmium, chromium, selenium, and silver.

USP 797: Compounding Sterile Preparations

The FDAMA of 1997 included a section on pharmacy compounding. The law introduced limits on pharmacy compounding and attempted to protect patients from unnecessary use of compounded drugs. Unfortunately, the power of regulation granted to the FDA by the FDAMA was ruled unconstitutional by the Supreme Court in 2001. The new USP Chapter 797, Pharmaceutical Compounding: Sterile Preparations, became enforceable by regulatory agencies on January 1, 2004. The provisions and requirements of USP 797 were designed to achieve compounding accuracy and sterility to ensure the safety of patients. USP 797 combined process and preparation quality controls with formal staff training and competency assessment guidelines. USP 797 addresses responsibilities of compounding personnel, how to determine risk levels, and maintaining quality after a medication leaves the pharmacy. The development USP 797 came after decades of increasing safety and quality consciousness.

Compounding medications continues as a high-risk and labor-intensive process. The implementation of USP 797 ensured that pharmacies will not overlook problems or evade compliance with necessary provisions. Pharmacies must comply with the USP 797 sterile compounding requirements during inspections, enforcement actions, and accreditation surveys. The ASHP Accreditation Services Division requires that a pharmacy complies with all federal, state, and local regulations concerning pharmacy practice.

USP 797 2008 Revision

The 2008 revision shifted emphasis to human factors and diminished mandates for primary engineering controls. New technological advances can supersede the written requirements of the Chapter 797, *if* such advances can be shown to produce equivalent, or better, results than the ideas in Chapter 797. The revision added a new risk level category of "immediate use" to the previous categories of low, medium, and high risk. An immediate-use CSP is defined as a compound prepared with no more than three sterile, commercially supplied nonhazardous drugs, using commercial sterile devices, for an infusion that will start within 1 h of preparation and be completed within 12 h. It should be emphasized here that this does not include any chemotherapeutic or other hazardous drug preparations. The revision also specified that this immediate-use classification is *not* intended to circumvent USP 797 intent. Never store immediate-use compounds for later use. Eliminating requirement for an ISO 7 buffer basically eliminated the engineering control mandates that caused so much concern. The revision also increased beyond-use dating for medium-risk compounding to a maximum of 9 days refrigerated instead of 7. This allows alternate-site pharmacies to a week's worth of in-date IVs, such as TPNs and antibiotics. Multidose vials (MDVs) now contain specific maximum beyond-use dates of 28 days. Single-dose vials (SDVs) contain new guidelines that restrict beyond-use dating. Never store ampoules for any period of time. CSPs must develop adequate controls from preparation until the time of the administration to meet USP 797 requirements. The revision also addressed radiopharmaceuticals. The revision also addressed clean rooms and environmental sampling. Air sampling is now required only monthly for low- and medium-risk certified compounding areas and weekly for high risk. The revision addressed protective garb requirements and IPA glove washing. Under the revision, garbing order is more clearly defined to focus on moving from dirtiest to cleanest in the process. It makes sense to start with a hair net and beard mask and finish with a gown, gloves, and shoe covers and finish with a 70% IPA glove washing.

REVIEW EXERCISES

14.1 Describe the origin and characteristics of the following forms of ionizing radiation:
- Alpha particles
- Beta particles
- Gamma rays
- X-rays

14.2 Define the following radiation-related terms:
- Absorbed dose
- Curie (Ci)
- RAD (radiation-absorbed dose)
- Radioactive half-life
- REM (roentgen equivalent man)
- ALARP

14.3 Describe the concept of radiation shielding.
14.4 What role does the NRC play in healthcare radiation safety?
14.5 Describe the key duties of a Radiation Safety Committee.
14.6 What is the mission of the NCRP?
14.7 What is the key goal of the FDA CDRH in relation to radiation safety?
14.8 Define nonionizing radiation and provide several examples generating devices.
14.9 List at least three safety concerns involving the use of MRI devices.
14.10 List and define at least five types of healthcare laboratories.
14.11 What was the purpose of the CLIA?
14.12 List at least five mandates of the OSHA Laboratory Standard.
14.13 What is formaldehyde and how does OSHA safety standards relate to worker exposures?

14.14 List and describe the four biosafety levels.
14.15 What two nongovernmental organizations main lists for high-risk medications?
14.16 Describe investigational medications.
14.17 What nongovernmental organization sets guidelines on drug quality and specifications?
14.18 List the occupational exposure routes for hazardous medications.
14.19 List the five characteristics as defined by NIOSH that would make a drug to be considered hazardous.
14.20 What was the purpose for the development of the USP 797?

Appendix A: Hazard Control Management Evaluation Scoring System (HCESS)

I MANAGEMENT LEADERSHIP AND EMPLOYEE PARTICIPATION

A	Score:
Hazard Control Policies and Procedures	(4) Workforce accepts, can explain, and fully understands the hazard control policy and procedures. (3) Majority of personnel can explain policy and procedures. (2) Some personnel can explain policy policies and procedures. (1) Written (or oral, where appropriate) policies and procedures. (0) No such policies or procedures exist.
Comments:	

B	Score:
Goals and Objectives	(4) Workforce involved in objectives development and can explain desired results/ measures. (3) Majority of personnel can explain desired results and measures for achieving them. (2) Some personnel can explain desired results and measures for achieving them. (1) Written (or oral, where appropriate) goals and objectives. (0) No safety and health goals and objectives exist.
Comments:	

C1	Score:
Leadership	(4) All personnel acknowledge that top management provides essential hazard control leadership. (3) Majority of personnel see top management as active in hazard control function. (2) Top management influence seen through safety presentations, training, and documents. (1) Some evidence of top management involvement in hazard control efforts. (0) No evidence of top management involvement in hazard control activities.
Comments:	

C2	Score:
Leadership Example	(4) All personnel acknowledge that top management always sets positive example. (3) Majority of personnel credit top management for setting positive examples. (2) Top management generally sets positive example. (1) Some evidence for top management generally says and does the right things to support hazard control. (0) Top management does not appear to follow hazard control policies established for others.
Comments:	

D	Score:
Worker Involvement	(4) All personnel responsible for actively identifying and resolving hazard control–related issues. (3) Most personnel believe their involvement helps identify and resolve hazard control–related issues. (2) Some personnel believe their involvement positively impacts hazard control efforts. (1) Employees generally believe that supervisors will consider their input and suggestions. (0) Employee involvement in hazard control not encouraged or rewarded.
Comments:	

E	Score:
Hazard Control Responsibilities	(4) All personnel can explain organizational hazard control expectations and performance requirements. (3) Majority of personnel can explain hazard control expectations and performance requirements. (2) Some personnel can explain hazard control expectations and performance requirements. (1) Performance expectations including hazard control elements spelled out for everyone. (0) Specific hazard control responsibilities and performance expectations generally unknown.
Comments:	

F	Score:
Resources and Authority	(4) All personnel believe they posses necessary authority and resources to meet their responsibilities. (3) Majority of personnel believe they possess necessary authority and resources to do their jobs. (2) Authority and resources spelled out for all, and some demonstrate a reluctance to use them. (1) Authority and resources exist, but most still controlled by supervisors. (0) Authority and resources come from supervision without any delegation.
Comments:	

G	Score:
Program Effectiveness	(4) Hazard control performance measured against established goals, clearly displayed, and recognized. (3) Personnel held accountable for safe performance with appropriate rewards and consequences. (2) Accountability systems in place, but rewards/consequences do not always follow performance. (1) Personnel generally held accountable but consequences more negative rather than positive. (0) Accountability inconsistent and mostly prompted by serious negative events.
Comments:	

H	Score:
Hazard Control Management Quality Review	(4) In addition to a comprehensive review, a process in place to drive continuous correction. (3) Comprehensive review conducted annually and drives appropriate modifications. (2) Quality review conducted, but does not appear to drive all necessary changes. (1) Changes policies driven by events such as accidents or compliance activities. (0) No evidence of any quality or evaluation review process.
Comments:	

II HAZARD AND BEHAVIOR ANALYSIS

A1	Score:
Quality Review	(4) In addition to corrective action, regular expert surveys result in updated hazard inventories. (3) Comprehensive expert surveys conducted periodically and drive appropriate corrective action. (2) Comprehensive expert surveys conducted, updates or corrective action sometimes lag. (1) Qualified experts conduct surveys in response to accidents, complaints, or compliance activities. (0) No evidence for the organization conducts any comprehensive hazard surveys.
Comments:	

A2	Score:
Hazard Review	(4) All planned/new facility, process, material, or equipment fully reviewed by competent personnel. (3) Hazard review of each planned/new facility, process, material, or equipment is conducted by experts. (2) High hazard planned/new facilities, processes, materials, and equipment reviewed. (1) Hazard reviews of new facilities, processes, materials, and equipment driven by problems. (0) No system or requirement exists for hazard reviews of planned or new operations.
Comments:	

A3	Score:
Job Hazard Analysis	(4) Employees involved in the development of current hazard analysis on their jobs. (3) Hazard analysis program exists for some jobs/processes and understood by affected employees. (2) Hazard analysis program exists for a few jobs/processes and understood by affected employees. (1) Hazard analysis program exists, but few employees involved and most not aware of results. (0) No routine hazard analysis process in place at facility.
Comments:	

A4	Score:
Self-Inspection Program	(4) Employees/supervisors well trained and conduct routine joint inspections with all finding corrected. (3) Employees trained in inspection techniques, and all routinely participate in workplace inspections. (2) Routine inspections conducted by selected personnel with appropriate corrective actions taken. (1) An inspection program exists, but few employees involved and coverage/corrective actions spotty. (0) No routine inspection program in place at facility.
Comments:	

B	Score:
Hazard Reporting and Correction	(4) Employees trained and empowered to correct any hazards identified by using own initiative. (3) Comprehensive hazard data collection and analysis in place to drive the correction process. (2) System exists for hazard reporting and employees can use it, but system slow to respond. (1) System exists for hazard reporting, but employees find it difficult to use or unresponsive. (0) No hazard reporting system exists, or employees appear uncomfortable reporting hazards.
Comments:	

C	Score:
Accident Investigation and Root Cause Analysis	(4) All loss-producing incidents and near misses investigated, and root cause analyses conducted as required. (3) OSHA-reportable incidents investigated and effective preventions implemented. (2) OSHA-reportable incidents investigated, and cause determination and corrections at times inadequate. (1) Some investigations take place, but the root causes seldom identified and corrections spotty. (0) Incidents not investigated or investigations limited to reports required for compliance purposes.
Comments:	

D	Score:
Accident Trending	(4) All employees fully aware of incident trends, causes, and prevention methods. (3) Trends analyzed and displayed, common causes communicated, management ensures prevention. (2) Data collected and analyzed, and common causes communicated to concerned supervisors. (1) Data collected and analyzed but not widely communicated for prevention purposes. (0) No consistent effort to analyze incident data for trends, causes, and prevention.
Comments:	

III HAZARD PREVENTION AND CONTROL

A	Score:
Controls	(4) Hazard controls concentrate on engineering fixes with reinforced/enforced safe work procedures. (3) Controls based on priority of engineering controls, work practices, administrative controls, and personal protective equipment (in that order). (2) Hazard controls fully in place, but the order of priorities varies with situation. (1) Hazard controls generally in place, but priorities and completeness vary. (0) Hazard controls not incomplete, ineffective, or inappropriate in this workplace.
Comments:	

B	Score:
Preventive Maintenance	(4) Personnel trained to recognize and perform preventive, periodic, and routine as required. (3) Effective preventive maintenance schedule in place and applicable to all equipment. (2) Preventive maintenance schedule in place and usually followed except for higher priorities. (1) A preventive maintenance schedule in place but not performed as scheduled. (0) Very little attention paid to preventive maintenance needs.
Comments:	

C1	Score:
Emergency Planning	(4) All personnel know immediately how to respond as a result of effective planning, training, and drills. (3) Most employees have the understanding of responsibilities with regard to planning, training, and drills. (2) Effective emergency response team in place, but others mostly uncertain of their responsibilities. (1) Effective emergency response plan, but training/drills inadequate and roles not well understood. (0) Little effort made to prepare for emergencies.
Comments:	

C2	Score:
Emergency Planning (Equipment)	(4) Facility fully equipped, all systems/equipment in place/tested, and all personnel know what to do. (3) Facility fully equipped with appropriate emergency procedures, and most know what to do. (2) Emergency procedures and equipment in place, but only emergency teams know what to do. (1) Emergency procedures and equipment in place, but employees show little awareness. (0) No real evidence exists of an effective effort at providing emergency equipment and other guidance.
Comments:	

D1	Score:
Medical Surveillance	(4) Occupational health providers available on-site and involved in hazard identification and training. (3) Occupational health providers there as needed and are generally involved in assessment/training. (2) Occupational health providers consulted about significant health concerns. (1) Occupational health providers are available but normally concentrate on clinical issues. (0) Occupational health provider assistance is rarely requested or provided.
Comments:	

D2	Score:
Injury Response	(4) Personnel fully trained in emergency, and medicines are always available. (3) Personnel with basic first aid skills are always available, and emergency care is nearby. (2) Personnel with basic first aid skills are usually available, and community assistance is nearby. (1) Either on-site or nearby community aid is always available. (0) On-site or community aid cannot be ensured at all times.
Comments:	

IV EDUCATION AND TRAINING

A	Score:
Employee Training	(4) Employees are involved in hazard assessment and help develop/deliver training, and all are trained. (3) Facility committed to high-quality training; everyone to participate, and regular updates provided. (2) Facility provides legally required training and makes an effort to include all personnel. (1) Training is provided if needed and experienced personnel assumed to know the material. (0) Facility depends on experience and informal peer training to meet needs.
Comments:	

B1	Score:
Supervisor Training	(4) All supervisors assist in worksite analysis, ensure physical protection, reinforce training, enforce discipline, and can explain work procedures. (3) Most supervisors assist in worksite analysis, ensure physical protection, reinforce training, enforce discipline, and can explain work procedures. (2) Supervisors received basic training in, appear to understand, and can demonstrate the importance of worksite analysis, physical protection, training reinforcement, discipline, and procedures. (1) Supervisors make efforts to meet their safety/health responsibilities but have limited training. (0) No formal effort to train supervisors in safety and health responsibilities is apparent.
Comments:	

B2	Score:
Top Management Education	(4) All managers receive formal hazard control education and understand all objectives. (3) All managers follow and can explain their roles in hazard management control efforts. (2) Managers generally show an understanding of their hazard control roles and responsibilities. (1) Managers generally able to describe their hazard control roles but often have trouble modeling it. (0) Managers show little understanding of their safety and health management responsibilities.
Comments:	

Safety and Health Program Element	Possible Score	Actual Score
Management leadership	36	___
Workplace analysis	28	___
Hazard prevention and control	24	___
Education and training	12	___
Total	**100**	___

Appendix B: Worker Perception Survey Questions

1. Did you receive adequate job-related training prior to assuming your current position?
2. Do supervisors discuss accidents, incidents, and injury events with involved workers?
3. Do supervisors enforce hazard control and safety rules fairly and correct unsafe behaviors?
4. Do supervisors take appropriate disciplinary action when work rules are not followed?
5. Do you perceive the major cause of accidents to be unsafe work conditions?
6. Does the organization actively promote and encourage employees to work safely?
7. Do you believe senior leaders view hazard control and safety as an important organizational priority?
8. Do supervisors seem more concerned with their personal records than accident?
9. Would some type of *safety incentive* program motivate you to work more safely?
10. Does the organization conduct required hazard surveys thoroughly?
11. Do you feel that supervisors receive adequate safety and health training?
12. Do supervisors provide sufficient training on the proper selection and use of personal protective equipment?
13. Do you understand what a performance-based OSHA standard means?
14. Have you received any safety-related training since your orientation or follow-up training?
15. Does the organization keep records of safety inspections and identified hazards?
16. Do you feel that employees are influenced by the organizational hazard control efforts?
17. Does the organization provide you information about the costs, trends, types, and causes of accidents?
18. Do you feel the organization conducts accident investigations to assign blame?
19. Do you feel that the organization deals with problems caused by alcohol or substance abuse?
20. Does the organization conduct postaccident drug testing for all involved workers?
21. Do safety leadership personnel and supervisors conduct unscheduled hazard surveys and inspections?
22. Do you understand how the worker's compensation system works?
23. Does the organization provide special education and training for all shift workers?
24. Does the organization make safety a part of all job reviews or evaluations?
25. Do you think injured workers should participate in an early-return-to–work initiative?
26. Is off-the-job safety an integral part of the overall hazard control and safety efforts?
27. Do supervisors report accidents promptly?
28. Do you wish to view the facility accident and injury record and compare it with similar facilities?
29. Do you feel your coworkers support the organization hazard control management efforts?
30. Do supervisors take hazard control and job safety seriously?
31. Does the organization take a proactive or reactive role when promoting hazard control?
32. Does the organization encourage supervisor to recognize those that work safely?
33. Do workers participate in the development of safe work practices and hazard control policies?
34. Do you feel workers play an important role in making hazard control and safety decisions?
35. Does senior management support supervisor when they make decisions affecting hazard control?
36. Do coworkers understand the relationship between their job tasks and safety?
37. Do you know where to access the written emergency action plan?
38. Do you know where to access the hazard communication program?
39. Do you feel that you received appropriate hazard control orientation and training before beginning this job?
40. Do you feel that the company has too many rules governing safety and health issues?
41. Does supervisor enforce hazard control and safety rules in the same manner as other job-related policies?
42. Does the organization set hazard control or safety-related goals and objectives?
43. Does senior management communicate goals to all workers in the organization?
44. What role do employees take in the goals-setting process?
45. Who serves as the key person in the hazard control management function?

46. Do you feel the organization quickly evaluates hazards and takes appropriate actions?
47. Can supervisors reward workers for good safety performance?
48. Do you think alcohol and drugs increase the risk of an accident?
49. Do workers caution others about unsafe conditions and behaviors?
50. Can you initiate actions to correct an unsafe situation?
51. Do you know how to report unsafe conditions, hazards, or behaviors?
52. Do workers fear the threat of reprisal when reporting safety deficiencies?
53. Do you feel hazard control and safety issues receive the same priority as other organizational issues?
54. Does the organization value its good compliance record over other hazard control objectives?
55. Do supervisors model safe behaviors to their workers?
56. Do supervisors promote safety with statements such as “This is management’s idea”?
57. Do all employees receive an adequate safety orientation?
58. Do you feel the safety orientation program adequately prepares you to work safely?
59. Does senior management recognize and recognize safety-related work behaviors?
60. Do safety meetings directly impact safety performance on the job?
61. Do workers have the opportunity to attend safety meetings and training classes?
62. Do supervisors handle workers with personal problems in an effective manner?
63. Do you view your job as stressful?
64. Do you know your organizational or departmental hazard control and safety goals?
65. Do supervisors consistently require use of personal protective equipment?
66. Can workers use alcohol or drugs on the job without detection?
67. Do supervisors sometimes overlook risks and hazards to get the job done?
68. Do hourly workers serve on the hazard control or safety committee?
69. Do you know the name of the organizational hazard control manager?
70. Does adherence with some established safety rules hinder job accomplishment?
71. Do you feel overworked?
72. Do you feel pushed on the job?
73. Does the organization mandate overtime work?
74. Do you feel satisfied with your job?
75. Do you feel that you can achieve the goals of your job?
76. Does the organization recognize you for doing a good job?
77. Do superiors assign you responsibility without delegating authority?
78. Do you feel you overwhelmed with too much responsibility?
79. Do you enjoy your job?
80. Does your immediate supervisor ask you for input?
81. Do you consider yourself loyal to the organization?
82. Do you feel any organization loyalty directed at you?
83. Do you believe in the importance of teamwork in your work area?
84. Does the organization provide you with adequate job-related training?
85. Do superiors ever judged you by things beyond your control?
86. Do you consider job security an important issue?
87. Do organizational hazard control plans, policies, and procedures protect the employee?
88. Do you believe that accidents will just happen?
89. Can the organizations truly prevent accidents?
90. Do workers feel free to discuss accident causal factors with investigators?
91. Do you feel that your job exposes you to more hazards than most other workers?
92. Do you understand the purpose of job safety analysis?
93. Do you understand your responsibilities during an emergency or disaster?
94. Do you feel you have had sufficient education and training to accomplish your job in a safe manner?
95. Do supervisors use safety practices and set an example for subordinates?
96. Do senior managers visit job areas and discuss the importance of working safely?
97. How would you classify hazard control efforts in your facility? Reactive_____Proactive_____

98. Do leaders and supervisors promote hazard control as the right thing to do or do they promote compliance?
99. Does the organization require supervisor to conduct job-related safety training?
100. Do you know the most hazardous substance used in the workplace?
101. Do you know the two safest egress routes from your work area to a safe place?
102. Does the organization conduct realistic emergency egress drills on a regular basis?

103. What hazard or safety issue causes you the most concern?

_____

_____

_____

_____

104. How would you improve the effectiveness of the hazard control management?

_____

_____

_____

_____

105. What actions would you suggest for improving senior management involvement and employee participation in the organizational hazard control efforts?

_____

_____

_____

_____

Appendix C: Sample Hazard Control Policy Statement

Our organization maintains a *hazard control function* that strives to maintain a safe and healthy work environment for everyone. Our hazard control function, led by_____, uses a proactive approach to accident and injury prevention. Our senior leaders understand that hazard control remains one of my top operational priorities. The Master Hazard Control Management Plan, developed using organizational member input, directs the actions necessary to ensure the attainment of our goals and objectives. The plan addresses the following key issues:

- Accident prevention and hazard control
- Reporting of accidents, incidents, close call, and workplace
- Safety orientation, education, and training
- Hazardous material and waste management
- Emergency preparedness
- Safety operational practices
- Security of life and property
- Life safety, fire prevention, and safe egress
- Compliance with all regulatory standards and codes

The Master Hazard Control Management Plan also outlines key hazard control responsibilities for all organizational members including senior leaders, unit managers, and hazard control staff members. Our organization requires all organizational members to participate in the hazard control efforts. As previously stated, our organization considers hazard control as an organizational function and not just a written program. Our *strategic hazard control objective* remains a simple one—prevent harm by maintaining a hazard-free operational environment.

_____ _____

Chief Executive Officer Date

Appendix D: Hazard Correction Status Form

Department/Committee: _____ Date:_____

Department or hazard location _____

Method of identification _____

Hazard description: _____

_____

_____

_____

Review Date	Plan of Action	Next Review Date

Description of hazard control implemented _____

_____

_____

Name of person(s) responsible for action _____

Follow-up evaluation comments _____

_____

_____

Final resolution date and comments: _____

_____

Appendix E: Sample Elements

Hazard Control Status Report

Facility/Department_____Reporting period_____

A. Brief summary of key hazard control and safety issues
B. Facility security–related information
C. Orientation, training, and education summary
D. Status of hazard control policy and procedural reviews
E. Emergency drills and exercises
    1. Type and scope
    2. Improvement areas
F. Hazardous material and waste issues
    1. Key exposure incidents
    2. New hazardous substances
G. Fire and life safety issues
H. Information Collection and Evaluation System (ICES)
    1. Key accident investigation information
    2. Reports of illnesses and injuries
    3. Hazards identified and reported
I. Surveillance activities
    1. Self-inspections
    2. Hazard surveys
    3. Compliance inspections
    4. Insurance-related audits
J. Hazard analysis and control
    1. Controls and corrections implemented
    2. Major trends uncovered
    3. Job hazard analysis
K. Hazard control–related equipment and facility issues
    1. Lockout/tagout procedures
    2. Periodic/preventive maintenance issues
L. General comments and other information

Appendix F: Improvement Principles

Organizations can apply the principles of quality improvement to hazard control efforts in a number of ways.

Develop a policy: The organization should publish a hazard control policy that outlines objectives and goals. Leaders must communicate the policy to all members of the organization. Require that everyone must participate and support hazard control efforts.

Promote the importance of inspections: Members at every organizational level must understand the purpose of hazard control inspections, audits, and survey.

Constantly improve the hazard control functions: Leaders, managers, and hazard control personnel must endorse the *philosophy* of continuous improvement.

Leadership and management: Managers and supervisors must use effective management principles and leadership concepts to improve organizational efficiency. Top management must provide staff members with the tools and the time to pursue improvement ideas.

Promote trust and innovation: Provide a climate where organizational members at all levels can identify problems and make suggestions to improve operations. Trust creates an atmosphere that promotes innovation. Encourage coordination and open communication among all operational departments.

Eliminate meaningless slogans: Hazard control and safety messages must clearly define safe work practices, rules, or job procedures.

Promote pride in quality work: Hazard control objectives must stress the importance of accomplishing jobs or tasks safely and correctly. Most individuals take pride in doing quality work. Provide organizational members with good equipment, a safe work area, and effective training.

Encourage members to work on self-improvement: Enhance organizational performance improvement efforts by affording everyone the opportunity to engage in educational and other personal development opportunities.

Facilitate change: Managers and supervisors must change or modify their management style to benefit the improvement of the organization. Leaders must not only accept change but promote the need for change when warranted.

Appendix G: Causal Factors Chart

Causal Factors	Identification of Factors	Possible Corrective Actions
Environmental: unsafe procedure or process	Hazardous processes; management failed to adequately plan	Job hazard analysis or formulation of safe job practices
Defective, overused	Buildings, machines, or equipment worn, cracked, broken, or defective	Inspection; replacement; proper maintenance
Improperly guarded	Work areas, machines, or equipment that are unguarded or inadequately guarded	Inspection; check plans, blueprints, purchase orders, contracts, and materials; provide guards for existing hazards
Defective design	Failure to consider safety in design, construction, or installation of buildings, machinery, and equipment; too large, too small, or not strong enough	Unreliable source of supply; check plans, blueprints, purchase orders, contracts, and materials; provide guards for existing hazards
Unsafe dress or apparel	Management failed to provide/specify the use of goggles, respirators, safety shoes, hard hats, or safe apparel	Provide proper apparel or personal protective equipment; specify acceptable dress, apparel, or protective equipment
Unsafe housekeeping	Poor job area layout; lack of required equipment for good housekeeping—shelves, boxes, bins, aisle markers, etc.	Provide suitable layout and equipment necessary for good housekeeping
Improper ventilation	Poor ventilated or unventilated work areas	Improve the ventilation
Improper illumination	Poorly illuminated or no illumination at all	Improve the illumination
Behavior related: lack of knowledge or skill	Unaware of safe practice; unskilled; not properly instructed or trained	Job training
Improper attitude	Worker properly trained but failed to follow instructions due to one of the following: willful, reckless, absentminded, emotional, or angry	Supervisor; discipline; personnel work
Physical deficiencies	Poor eyesight, defective hearing, heart trouble, hernia, etc.	Preplacement physical examination; periodic physical examination; proper placement of employees; identification of workers with temporary bodily defects

Appendix H: Ergonomic Symptoms Report

Name_____ Department_____

Job title_____ Shift_____

Identify all affected areas

☐ **Forearm**	☐ **Wrist**	☐ **Knee**	☐ **Elbow**	☐ **Upper back**
☐ **Lower back**	☐ **Hand**	☐ **Fingers**	☐ **Ankle**	☐ **Foot**
☐ **Shoulder**	☐ **Thigh**	☐ **Lower leg**	☐ **Neck**	

Check terms that best describe your problem

☐ **Aching**	☐ **Numbness**	☐ **Tingling**	☐ **Loss of color**
☐ **Burning**	☐ **Swelling**	☐ **Weakness**	☐ **Stiffness**
☐ **Cramping**	☐ **Other**_____		

1. List how and when the problem first occurred.
   _____
2. List the length and description of each episode.
   _____
3. How often did the problem occur during the past year?
   _____
4. What do you think caused the problem?
   _____
5. Describe the problem at its worst.
   _____
6. Describe any medical treatment for this problem.
   _____
7. What medical treatment helps the problem?
   _____
8. Describe the frequency and type of treatment during the past year.
   _____
9. How many workdays did you lose because of this problem during the past year?
   _____
10. Have you been placed in another job or a modified duty status because of the problem?
    _____
11. What would help the problem?
    _____

12. Do you work another job in addition to this one? Yes_____No_____
13. If you answered yes to Item 12, please describe the requirements of the job. _____
    _____
    _____
14. List off-the-job activities, hobbies, or interests. _____
    _____
15. What other did you work at during the past 12 months for more than two weeks? _____
    _____
16. Provide any other helpful information. _____
    _____

_____ _____

Name/Signature Date

Appendix I: Hazardous Exposure Limits and Terms

Exposure Limit	Agency	Definition
TLV	ACGIH	Threshold limit value—The airborne concentration of a substance to which most workers can be exposed on a daily basis without adverse health effects.
TWA	ACGIH	Time-weighted average—The average concentration of a substance for a normal 8 h workday and 40 h workweek.
STEL	ACGIH OSHA	Short-term exposure limit—A 15 min TWA that should not be exceeded at any time during the workday. There should be 60 min between each 15 min exposure, up to four times a day.
CEILING (TLV-C)	ACGIH OSHA	Ceiling limit—The airborne concentration that is not to be exceeded at any time during the workday.
PEL	OSHA	Permissible exposure limit—Limit based on 8 h TWAs. Exposures below the PEL do not require respiratory protection.
REL	NIOSH	Recommended exposure limit—A TWA for up to a 10 h workday during a 40 h workweek.
IDLH	NIOSH	Immediately dangerous to life or health—Levels may cause severe health effects that may impair a person or prevent the ability to escape from a dangerous situation.
Acute exposure	Single exposure or several short-term exposures to a toxic substance.	
Chronic exposure	Long-term exposure at a rate at which the body cannot get rid of the toxic substance.	
Toxicity	A hazardous substance that poses a poison hazard to human health: • Immediate toxicity occurs rapidly after a single exposure episode. • Delayed toxicity occurs after a lapse of time. • Systematic toxicity is characterized by effects at a place other than the point of entry. • Local toxicity occurs when effects arise at the point of entry.	

TLVs are given in parts per million (ppm) or milligrams per cubic meter of air (mg/m^3).
PEL values can be found in 29 CFR 1910.1000.

Appendix J: Revised Hazard Communication Standard

Pictograms and Hazards

Health Hazard

- Carcinogen
- Mutagenicity
- Reproductive toxicity
- Respiratory sensitizer
- Target organ toxicity
- Aspiration toxicity

Flame

- Flammables
- Pyrophoric substances
- Self-heating
- Emits flammable gas
- Self-reactive substances
- Organic peroxides

Exclamation Mark

- Irritant (skin and eye)
- Skin sensitizer
- Acute toxicity (harmful)
- Narcotic effects
- Respiratory tract irritant
- Hazardous to ozone layer (Nonmandatory)

Gas Cylinder

- Gases under pressure

Corrosion

- Skin corrosion/burns
- Eye damage
- Corrosive to metals

Exploding Bomb

- Explosives
- Self-reactive substances
- Organic peroxides

Flame over Circle

- Oxidizers

Environment (Nonmandatory)

- Aquatic toxicity

Skull and Crossbones

- Acute toxicity (fatal or toxic)

Appendix K: Hazard Communication Training Record

Employee name: _____

Employer:_____

I, the undersigned, attended an organization that provided Hazard Communication Training Session that covered Phase I and II topics as indicated in the following text.

PHASE I TOPICS

1. Requirements and overview of the Hazard Communication Standard
2. Operations, locations, and processes with hazardous materials
3. The location and availability of the written HAZCOM plan
4. Methods and observations used to evaluate hazards and how to detect the presence of hazardous materials in work areas
5. The session also covered the following topics:
   - Description of labeling system
   - Safety data sheet (SDS) information
   - Information on unlabeled pipes
   - Hazards of nonroutine tasks
   - How to obtain and use local hazard information

_____ _____

Employee signature Trainer's initials/Date

PHASE II TOPICS

1. The physical and health hazards of chemicals used in the department or work area
2. Measures workers must take to protect themselves from exposure
3. Specific procedures implemented to protect workers such as
   - Safety rules
   - Engineering controls
   - Emergency response procedures
   - Correct use of personal protective equipment

_____ _____

Employee signature Trainer's initials/Date

Appendix L: Numerical Hazardous Material Ratings

Numerical Hazard Ratings

Health hazards

4	*Deadly*: The slightest exposure to this substance could be life threatening. Only specialized protective clothing should be worn when working with this substance.
3	*Extremely dangerous*: Serious injury could result from exposure to this substance. Do not expose any body surface to this material. Full protective measures should be taken.
2	*Dangerous*: Exposure to this substance would be hazardous to health. Protective measures are indicated.
1	*Slight health hazard*: Irritation or minor injury would occur from exposure to this substance. Protective measures are indicated.

Flammability

4	*Flash point below 73°F*: Substance is very volatile, explosive, or flammable. Use extreme caution when handling or storing the substance.
3	*Flash point below 100°F*: Flammable, explosive, or volatile under most normal temperature conditions. Exercise great caution in using and storing a substance.
2	*Flash point below 200°F*: Moderately heated conditions may ignite this substance. Use caution in handling or storage.
1	*Flash point above 200°F*: This substance must be preheated to ignite.

Reactivity

4	*May detonate*: Capable of explosion at normal temperatures. Evacuate area if exposed to heat or fire.
3	*Explosive*: Substance is capable of explosion by strong initiating source such as heat, shock, or water.
2	*Unstable*: Subject to violent chemical changes at normal or elevated temperatures. Potential violent explosive reaction may occur if exposed to water.
1	*Normally stable*: May become unstable at elevated temperatures.

Color ratings

Blue (health hazard)	May cause health problems if acute exposure occurs by ingestion, inhalation, or physical contact.
Red (flammability)	Evaluates the risk of materials to fire burst based on factors relative to the substance and surrounding environment.
Yellow (reactivity)	Advises that a substance may react violently under certain conditions or exposures.
White (specific hazard)	Refers to substances with specific hazards or properties such as oxidizers.

Appendix M: Model Hazard Communication Plan

GENERAL

The following hazard communication plan established for this worksite. This plan will be available for review by all employees during their work shift.

HAZARD DETERMINATION

This worksite relies on material safety data sheets (MSDS) obtained from product suppliers to meet the OSHA hazard determination requirements.

LABELING

A. The site supervisor will be responsible for ensuring that all containers entering the workplace are properly labeled.
   1. All labels shall be checked for to determine the identity of the material.
   2. Ensure the label contains appropriate hazard warnings.
   3. Verify that labels contain the name and address of the responsible party such as manufacturer, distributor, or importer.

B. Each employee or supervisor shall be responsible for ensuring that all portable containers used in their work area are labeled with the appropriate material identity and hazard warnings.

SAFETY DATA SHEETS (SDSs)

A. The site supervisor will be responsible for compiling and maintaining the master MSDS file. The file will be kept in/at the following location:_____.
B. Additional copies of MSDSs for employee use are located in/at the following location:_____.
C. MSDSs will be available for review to all employees during each work shift, and copies will be made available upon request to the site supervisor.
D. If a required MSDS is not received with the shipment, the site supervisor shall contact the supplier, in writing, to request the MSDS.
E. If an MSDS is not received after two such requests, the site supervisor should contact the local OSHA office for assistance in obtaining the MSDS.

EMPLOYEE INFORMATION AND TRAINING

A. The site supervisor shall coordinate and maintain records of employee hazard communication training, including records of completion.
B. Before their initial work assignment, each new employee will be trained on the OSHA requirements under the standard. The training session will provide the following information and education:
   1. The requirements of the OSHA Hazard Communication Standard.
   2. All operations in their work area where hazardous chemicals are present.

3. The location and availability of the written hazard communication plan, the list of hazardous chemicals, and the location of the MSDSs.
4. Methods, symptoms, and observations that can be used to detect the presence or release of hazardous chemicals in the work area.
5. The physical and health hazards of the hazardous chemicals and measures the employees should take to protect from these hazards.
6. Details of the hazard communication program including an explanation of labeling system and MSDSs and how employees can obtain and use hazard information.
7. The employee shall be informed that the employer is prohibited from discharging, or discriminating against, an employee who exercises his/her rights to obtain information regarding hazardous chemicals used in the workplace.

C. Before any new physical or health hazard is introduced into the workplace, each employee who may be exposed to the substance will be given information in the same manner as during the hazard communication training class. Employees transferring to another department within the same organization will be trained on hazardous materials present in the new assignment.

HAZARDOUS NONROUTINE TASKS

Occasionally, employees may be required to perform nonroutine tasks. Prior to starting work, each employee will be given information about the hazards of the area or procedure. This information will include (1) specific chemical hazards, (2) protection/safety measures the employee can take to lessen risks of performing the task, and (3) measures the company has taken to eliminate or control the hazard. It is the policy of this worksite that no employee will begin performance of a nonroutine task without first receiving appropriate safety and health training. Hazardous nonroutine tasks we have at our facility include the following: (list hazardous nonroutine tasks)

MULTIEMPLOYER WORKSITES: INFORMING CONTRACTORS

A. If our company exposes any employee of another employer to any hazardous chemicals that we produce, use, or store, the following information will be supplied to that employer: (1) the hazardous chemicals they may encounter, (2) measures their employees can take to control or eliminate exposure to the hazardous chemicals, (3) the container and pipe labeling system used on-site, and (4) where applicable, MSDSs can be reviewed or obtained.
B. Periodically, our employees may potentially be exposed to hazardous chemicals brought on our site by another employer. When this occurs, we will obtain from that employer information pertaining to the types of chemicals brought on-site and measures that should be taken to control or eliminate exposure to the chemicals.
C. It is the responsibility of the site supervisor to ensure that such information is provided and/or obtained prior to any services being performed by the contractor or vendor. To ensure that this is done, the following mechanism will be followed: (list all methods used to ensure the required information is provided or obtained)

PIPES AND PIPING SYSTEMS

Information on the hazardous contents of pipes and piping systems will be identified as necessary by label, sign, placard, or written operating instructions. Natural gas, steam, and compressed air-lines should be identified if they pose a hazard to employees. Follow ANSI A13.1-1981 for appropriate color schemes.

LIST OF HAZARDOUS CHEMICALS

A list of all hazardous chemicals used at this worksite is attached to this document. Further information regarding any of these chemicals can be obtained by reviewing its respective MSDS.

Materials that can be purchased by the ordinary household consumer, and that are used in the same fashion and amount as the ordinary household consumer, are not required to be included in this list.

The list may be developed by category of chemical, alphabetical, or in any sequence deemed appropriate for the worksite. Ensure employees understand how to use the hazardous chemical listing.

HAZARDOUS MATERIALS AND SUBSTANCES LIST

Hazardous chemical (use the same name as depicted on the container label and SDS).

Appendix N: List of Selected NFPA Codes and Standards

NFPA 1 Uniform Fire Code
NFPA 10 Standard for Portable Fire Extinguishers
NFPA 12 Standard on Carbon Dioxide Extinguishing Systems
NFPA 13 Standard for the Installation of Sprinkler Systems
NFPA 25 Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems
NFPA 30 Flammable and Combustible Liquids Code
NFPA 45 Standard on Fire Protection for Laboratories Using Chemicals
NFPA 50 Standard for Bulk Oxygen Systems
NFPA 51B Standard for Fire Prevention during Welding, Cutting, and Other Hot Work
NFPA 55 Standard for the Storage, Use, and Handling of Compressed Gases
NFPA 70 National Electrical Code7 National Electrical Code
NFPA 70B Recommended Practice for Electrical Equipment Maintenance
NFPA 70E Standard for Electrical Safety Requirements for Employee Workplaces
NFPA 72 National Fire Alarm Code
NFPA 75 Standard for the Protection of Information Technology Equipment
NFPA 77 Recommended Practice on Static Electricity
NFPA 80 Standard for Fire Doors and Fire Windows
NFPA 82 Standard on Incinerators and Waste and Linen Handling Systems and Equipment
NFPA 85 Boiler and Combustion Systems Hazards Code
NFPA 90A Standard for the Installation of Air Conditioning and Ventilating Systems
NFPA 90B Standard for the Installation of Warm Air Heating and Air Conditioning Systems
NFPA 91 Standard for Exhaust Systems for Air Conveying of Vapors, Gases, Mists, and Particulate Solids
NFPA 92A Recommended Practice for Smoke Control Systems
NFPA 96 Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations
NFPA 99 Standard for Health Care Facilities
NFPA 101 Life Safety Code
NFPA 101A Guide on Alternative Approaches to Life Safety
NFPA 101B Code for Means of Egress for Buildings and Structures
NFPA 105 Standard for the Installation of Smoke Door Assemblies
NFPA 110 Standard for Emergency and Standby Power Systems
NFPA 111 Standard on Stored Electrical Energy Emergency and Standby Power Systems
NFPA 115 Standard on Laser Fire Protection
NFPA 170 Standard for Fire Safety Symbols
NFPA 220 Standard on Types of Building Construction
NFPA 221 Standard for Fire Walls and Fire Barrier Walls
NFPA 230 Standard for the Fire Protection of Storage
NFPA 232 Standard for the Protection of Records
NFPA 434 Code for the Storage of Pesticides
NFPA 450 Guide for Emergency Medical Services and Systems
NFPA 471 Recommended Practice for Responding to Hazardous Materials Incidents
NFPA 472 Standard for Professional Competence of Responders to Hazardous Materials Incidents
NFPA 704 Standard System for the Identification of the Hazards of Materials for Emergency Response
NFPA 1600 Emergency Management and Business Continuity
NFPA 801 Standard for Fire Protection for Facilities Handling Radioactive Materials
NFPA 900 Building Energy Code

NFPA 1600 Standard for Disaster/Emergency Management and Business Continuity Programs
NFPA 1620 Recommended Practice for Pre incident Planning
NFPA 1994 Standard on Protective Ensembles for Chemical/Biological Terrorism Incidents
NFPA 1999 Standard on Protective Clothing for Emergency Medical Operations
NFPA 5000 Building Construction and Safety Code

Appendix O: Personal Protective Equipment Hazard Assessment Form (Sample)

Department/Facility _____ **Date** _____

A. Eye and face
1. Airborne particles _____
2. Biohazards _____
3. Hazardous chemicals _____
4. Welding operations_____
5. Caustic liquids _____
6. Gases or vapors _____
7. Laser hazards _____
8. Landscaping hazards _____
9. Other _____

B. Head
1. Falling or flying objects _____
2. Work being performed overhead _____
3. Electrical hazards _____
4. Construction hazards _____
5. Forklift hazards _____
6. Other _____

C. Other
1. Lifting _____
2. Repetitive motion or prolonged standing _____
3. Bloodborne pathogen exposures _____
4. Infection risks _____

D. Foot
1. Falling and rolling objects _____
2. Slip and trip hazards _____
3. Electrical hazards _____
4. Wet or slippery surfaces _____
5. Chemical exposures _____
6. Environmental _____
7. Other _____

E. Hand
1. Skin absorption _____
2. Cuts or lacerations _____
3. Abrasions _____
4. Punctures _____
5. Chemical exposures _____
6. Thermal burns _____

7. Harmful temperature extremes _____
8. Machine hazards
9. Other _____

F. Respiratory exposures

1. Harmful dusts _____
2. Hazardous drugs _____
3. Fumes or mists _____
4. Smoke or welding operations _____
5. Vapors _____
6. Biohazards_____
7. Asbestos _____
8. Other _____

G. Torso

1. Hot metals _____
2. Cuts _____
3. Acid exposures _____
4. Ionizing radiation _____
5. Other _____

H. Comments

_____

_____

_____

I. Certification

The assessment used the following methods to determine existence of workplace hazard requiring PPE.

- Walk-through survey
- Specific job analysis
- Review of accident statistics
- Review of safety equipment selection guideline materials
- Selection of appropriate or required PPE

Assessment conducted by _____ Date _____

Assessment certified by _____ Date _____

Appendix P: HAZWOPER Training Requirements (29 CFR 1910.120)

First, responders at the *awareness level* must undergo sufficient training or document sufficient experience to objectively demonstrate competency in the following areas:

- Understand hazardous substances and the risks associated with them in an incident
- Understand potential outcomes associated by hazardous substances
- Ability to recognize the presence of hazardous substances in an emergency
- Ability to identify the hazardous substances if possible
- Understand their role as an awareness individual in the employer's emergency response plan including site security control and the DOT Emergency Response Guidebook
- Ability to realize the need for additional resources and make appropriate notifications to the communications center

First responders at the *operations level* must undergo training to prepare them for defensive response actions such as containing a release from a safe distance, preventing a release from spreading, and limit exposures. First responders at the operational level must undergo at least 8 h of training or document sufficient expertise to objectively demonstrate competency in the following areas in addition to those listed for the awareness level:

- Knowledge of the basic hazard and risk assessment techniques
- Know how to select and use proper personal protective equipment provided to the first responder operational level
- Understand basic hazardous materials terms
- Know how to perform basic control, containment, and/or confinement operations using the capabilities of the resources and personal protective equipment available
- Know how to implement basic decontamination procedures
- Understand relevant standard operating procedures and termination procedure

Hazardous materials technicians respond for the purpose of stopping the release. They assume a more aggressive role than the personnel at the operations level. Hazardous materials technicians must undergo at least 24 h of training equal to the first responder operations level and in addition have competency in the following areas, and the employer shall so certify:

- Know how to implement the employer's emergency response plan
- Possess the ability to function in an assigned role in the incident command system
- Know how to select and use proper specialized chemical personal protective equipment
- Understand hazard and risk assessment techniques
- Perform advance control, containment, and/or confinement operations
- Understand and implement decontamination
- Understand termination procedures
- Understand basic chemical and toxicological terminology and behavior

Hazardous materials specialists respond and provide support to hazardous materials technicians. Their duties require more specific knowledge of the various substances. They also serve as the site

liaison with federal, state, local, and other government authorities. Hazardous materials specialists must undergo at least 24 h of training equal to the technician level and in addition have competency in the following areas and the employer shall so certify:

- Know how to implement the local emergency response plan
- Understand classification, identification, and verification of known and unknown materials by using advanced survey instruments and equipment
- Know about the state emergency response plan
- Select and use proper specialized chemical personal protective equipment
- Understand in-depth hazard and risk techniques
- Perform specialized control, containment, and/or confinement operations
- Determine and implement decontamination procedures
- Possess the ability to develop a site safety and control plan
- Understand chemical, radiological, and toxicological terminology and behavior

Incident commanders, who will assume control of an incident scene beyond the first responder awareness level, must undergo at least 24 h of training equal to the first responder operations level and in addition have competency in the following areas as certified by the employer:

- Know and be able to implement the employer's incident command system
- Know how to implement the employer's emergency response plan
- Know and understand hazards and risks associated with working in chemical protective clothing
- Know how to implement the local emergency response plan
- Know about the state emergency response plan and about the federal regional response team
- Know and understand the importance of decontamination procedures

Appendix Q: Retention of Occupational Safety and Health Act Records

Records To Be Retained	Period of Retention/Filing Requirements
300 Log and summary of occupational injuries and illnesses • Briefly describing recordable cases of injury and illness • Extent and outcome of each accident • Summary totals for calendar year (OSHA Form 300A or equivalent form) certified by an authorized company official	Five years following the end of year to which records relate Must post OSHA Form 300A by February 1 and keep posted through April 30
Supplementary records • Containing more detailed information for each occurrence of injury or illness (OSHA Form 101 or equivalent)	Five years following the end of year to which records relate
Employee medical records • Excluding health insurance claims if maintained separately • Certain minor first aid records • Records of employees who worked less than 1 year and who received records upon termination	Duration of employment plus 30 years, unless a specific OSHA standard requires a different time period
Records of biological or environmental monitoring of exposure to hazardous materials and related analyses	30 years
Safety data sheets	30 years

Appendix R: Model Respirator Plan for Small Businesses

GENERAL INFORMATION

The purpose of this respirator plan is to protect all employees from respiratory hazards through the effective use of respirators. The Respirator Plan Administrator (RPA) appointed at this location is _____. The employer has expressly authorized the RPA to audit and change respirator usage procedures whenever there is a chance of exposure to an air contaminant or airborne disease at the worksite. This authority includes designating mandatory respirator usage areas and/or job-related tasks. The RPA is solely responsible for all aspects of this plan and has full authority to make decisions relevant to respirator usage. This authority includes training workers, purchasing the necessary equipment to implement the program, and developing local respiratory protection procedures.

LOCAL WRITTEN OPERATING PRACTICES

The RPA will develop written *operating practices* that detail specific instructions covering the basic elements in this plan. These local operating practices will be attached to the plan. These practices can only be amended by the RPA.

The RPA will develop detailed written standard operating procedures governing the selection and use of respirators, using the OSHA standard and the NIOSH Respirator Decision Logic as guidelines. Outside consultation, manufacturer's assistance, and other recognized authorities will be consulted if there is any doubt regarding proper selection and use of respirators. *These detailed operating practices will be included as attachments to this respirator plan.*

RESPIRATORS' SELECTION

Respirators will be selected on the basis of exposures. All selections will be made by the RPA, and only NIOSH-certified respirators will be selected and used.

TRAINING AND USE

Respirator users will be instructed and trained in the proper use of respirators and their limitations. Both supervisors and workers will be trained by the RPA. The training should provide the employee an opportunity to handle the respirator, have it fitted properly, test its face piece-to-face seal, wear it in normal air during a familiarity period, and finally to wear it in a test atmosphere. Fit testing will be accomplished for all tight-fitting respirators used at this location.

FITTING INSTRUCTIONS

Every respirator wearer will receive fitting instructions, including demonstrations and practice in how the respirator should be worn, how to adjust it, and how to determine if it fits properly. Respirators should not be worn when conditions prevent a good face seal. Such conditions may be a growth of beard, sideburns, a skull cap that projects under the face piece, or temple pieces on glasses. No employees of this facility, who are required to wear tight-fitting respirators, may have

beards. Also the absence of one or both dentures can seriously affect the fit of a face piece. The worker's diligence in observing these factors will be evaluated by periodic checks. To assure proper protection, the user seal check will be done by the wearer each time she/he puts on the respirator. The manufacturer's instructions will be followed.

ASSIGNMENT OF RESPIRATORS

When practicable, the respirators will be assigned to individual workers for their exclusive use. No disposable respirators will be regularly cleaned and disinfected. Those issued for the exclusive use of one worker will be cleaned after each day's use, or more often if necessary. Those used by more than one worker will be thoroughly cleaned and disinfected after each use. The RPA will establish a respirator cleaning and maintenance facility and develop detailed written cleaning instructions. Disposable respirators will be discarded if they are soiled or are no longer functional. For additional information, refer to the manufacturer's instructions. Respirators used routinely will be inspected during cleaning. Worn or deteriorated parts will be replaced.

EMPLOYEE SCREENING

Persons will not be assigned to tasks requiring the use of respirators unless it has been determined that they are physically able to perform the work and use the respirator. The employer will designate a healthcare professional to determine and assess worker health and physical ability to wear a respirator. The respirator user's medical status will be reviewed annually.

EVALUATIONS

The employer will ensure that an annual inspection/evaluation of the program is conducted to determine the continued effectiveness of the program. The RPA will make frequent inspections of all areas where respirators are used to ensure compliance with the respiratory protection requirements.

EVALUATION CHECKLIST

In general, the respiratory protection plan should be evaluated for each job or at least annually, with program adjustments, as appropriate, made to reflect the evaluation results. Functions can be separated into administration and operation.

ADMINISTRATION

1. Is there a written policy that acknowledges employer responsibility for providing a safe and healthful workplace, and assigns program responsibility, accountability, and authority?
2. Is program responsibility vested in one individual who is knowledgeable and who can coordinate all aspects of the program at the healthcare facility?
3. Can administrative and engineering controls eliminate the need for respirators?
4. Are there written procedures/statements covering the following topics?
   _____ a. Designation of an administrator
   _____ b. Respirator selection
   _____ c. Purchase of NIOSH-certified respirators
   _____ d. Medical aspects of respirator usage
   _____ e. Issuance of equipment
   _____ f. Fitting
   _____ g. Training

_____ h. Maintenance, storage, and repair
_____ i. Inspection
_____ j. Use under special conditions
_____ k. Work area surveillance

OPERATION

5. Equipment selection
   a. Are work area conditions and worker exposures properly surveyed?
   b. Are respirators selected on the basis of the hazard of exposure?
   c. Are selections made by individuals knowledgeable in selection procedures?
6. Are only NIOSH-certified respirators purchased and used? Do they provide adequate protection for the specific hazard?
7. Has a medical evaluation of the prospective user been made to determine physical and psychological ability to wear the selected respiratory protective equipment?
8. Where practical, have respirators been issued to the users for their exclusive use, and are there records covering issuance?
9. Respiratory protective equipment fitting
   a. Are the users given the opportunity to try on several respirators to determine whether the respirator they will be subsequently wearing is the best fitting one?
   b. Is the fit tested at appropriate intervals?
   c. Are those users who require corrective lenses properly fitted?
   d. Is the face piece tested in a test atmosphere?
   e. Are workers prohibited from wearing respirators in contaminated work areas when they have facial hair or other characteristics that may cause face seal leakage?
10. Respirator use in the work area
    a. Are respirators being worn correctly (i.e., head covering over respirator straps)?
    b. Are workers keeping respirators on all the time while in the designated areas?
11. Maintenance of respiratory protective equipment
    a. Are nondisposable respirators cleaned and disinfected after each use when different people use the same device, or as frequently as necessary for devices issued to individual users?
    b. Are proper methods of cleaning and disinfecting utilized?
    c. Are respirators stored in a manner so as to protect them from dust, sunlight, heat, damaging chemicals, or excessive cold or moisture?
    d. Are respirators stored in a storage facility so as to prevent them from deforming?
    e. Is storage in lockers permitted only if the respirator is in a carrying case or carton?
12. Inspection
    a. Are respirators inspected before and after each use and during cleaning?
    b. Are qualified individuals/users instructed in inspection techniques?
    c. Are records kept of the inspection of respiratory protective equipment?
13. Repair
    a. Are replacement parts used in repair those of the manufacturer of the respirator?
    b. Are repairs made by trained individuals?
14. Training and feedback
    a. Are users trained in proper respirator use, cleaning, and inspection?
    b. Are users trained in the basis for selection of respirators?
    c. Are users evaluated, using competency-based evaluation, before and after training?
    d. Are users periodically consulted about program issues such as discomfort, fatigue, etc.?

SAMPLE RESPIRATOR INSPECTION RECORD

TYPE_____

NO._____ DATE: _____

A. Face piece
B. Inhalation valve
C. Exhalation valve assembly
D. Headbands/straps
E. Filter cartridge
F. Cartridge/canister
G. Harness assembly
H. Hose assembly
I. Speaking diaphragm
J. Gaskets
K. Connections
L. Other defects

DEFECTS FOUND:

CORRECTIVE ACTION:

MEDICALLY SCREEN ALL USERS

Conduct a medical evaluation of workers to determine fitness to wear respirators. The use of respirators can place several physiological stresses on wearers-stresses that particularly involve the pulmonary and cardiac systems. However, respirators typically used by healthcare workers are generally lightweight, and the physiological stresses they create are usually small. Therefore, most workers can safely wear respirators. Current OSHA regulations (29 CFR 1910.139) state that workers should not be assigned tasks requiring respirators unless they have been determined to be physically able to perform the work while using the equipment. The regulations also note that a physician should determine the criteria on which to base this determination.

No general consensus exists about what elements to include in medical evaluations for respirator use in general industry. Some institutions use only a questionnaire as a screening tool; others routinely include a physical examination and spirometry; and some include a chest x-ray. No generally accepted criteria exist for excluding workers from wearing respirators. Specifically, no spirometric criteria exist for exclusion. However, several studies have shown that most workers with mild pulmonary function impairment can safely wear respirators. There are some restrictions, such as the type of respirator or workload, for those with moderate impairment. There should be no respirator wear for individuals with severe impairment. Some respirators have a latex component and should not be worn by those who are allergic to latex.

Because most healthcare workers wear the very light disposable half-mask respirator, recommend that a health questionnaire be the initial step in the evaluation process. Refer to OSHA 29 CFR 1910.134 paragraph *e* for guidance on medical evaluation. Appendix B of the Standard contains a sample medical questionnaire. If results from this evaluation are essentially normal, the employee can be cleared for respirator wear. Further evaluation, possibly including a directed physical examination and/or spirometry, should be considered in cases in which potential problems are suggested on the basis of the questionnaire results.

Appendix S: Sample Accident Investigation Report

Facility/department_____

Date of event_____ Date reported_____

Names of persons involved _____

Time of accident _____ Location of accident _____

Name of supervisor _____

Machines/tools/processes/operations involved _____

_____

Brief description of injuries _____

_____

Property damage _____

Witnesses _____

_____

Contributing causes (check each appropriate causal factor)

[ ] Improper instruction	[ ] Improper maintenance	[ ] Unsafe position
[ ] Physical impairment	[ ] Lack of training	[ ] Human error
[ ] Poor ventilation	[ ] Improper clothing	[ ] Horseplay
[ ] Lack of supervision	[ ] Improper procedure	[ ] No authority to operate
[ ] Unsafe arrangement	[ ] Failure to use PPE	[ ] Unsafe equipment
[ ] Poor housekeeping	[ ] Failure to secure	[ ] Inoperative safety device
[ ] Improper guarding	[ ] Safety rule violation	[ ] Using wrong tool
[ ] Failure to lockout	[ ] Other (Describe)_____	

_____

Summary of initial investigation: _____

_____

Corrective actions taken _____

_____

Other comments _____

_____

Supervisor signature and date _____

Appendix T: Workplace Violence Prevention Policy

A. POLICY STATEMENT

The safety and security of organization personnel, patients, and visitors is of vital importance. Threats, threatening behavior, or acts of violence against personnel, patients, visitors, or contractors will not be tolerated. It is the policy of the organization to provide a safe environment in order to conduct the mission of the organization in the most effective manner possible.

A.1. A safe environment will be attained by
   1. Appropriate employee screening
   2. Employee education and training
   3. Surveillance of the work area
   4. Effective management of situations involving violence or threats of violence

A.2. This policy supports the written procedures set forth by the organization's safety and health workplace violence plan, which is incorporated into this policy by reference.

B. DEFINITIONS

B.1. Workplace: Any location, either permanent or temporary, wherein an employee performs any work-related duty. This includes, but is not limited to, the building or facility and the surrounding perimeters, including the parking lots, field locations, alternate work locations, and travel to and from work assignments.

B.2. Workplace violence: Any physical assault, threatening behavior, or verbal abuse by employees or third parties that occurs in the workplace. It includes, but is not limited to, beating; stabbing; suicide; attempted suicide; shooting; rape; psychological trauma such as threats, obscene phone calls, and intimidating presence; and harassment of any nature such as stalking, shouting, or swearing.

C. PROCEDURES

C.1. The organization will not tolerate the following conduct or behavior:
   1. Threats, direct or implied
   2. Physical conduct that results in harm to people or property
   3. Possession of weapons on any property or workplace of the organization
   4. Intimidating conduct or harassment that results in fear for personal safety

C.2. Inappropriate and threatening behaviors include, but are not limited to, the following:
   1. Unwelcome name-calling, obscene language, and other verbally abusive behavior
   2. Throwing objects, regardless of the type or whether a person is the target of a thrown object
   3. Touching a person in an intimidating, malicious, or sexually harassing manner
   4. Acts such as hitting, slapping, poking, kicking, pinching, grabbing, and pushing
   5. Physical and intimidating acts such as obscene gestures, getting in your face, and fist shaking

D. REPORTING AND INVESTIGATING

D.1. Any employee who experiences, observes, or has knowledge of actual or threatened workplace intimidation or violence has a responsibility to report the situation as soon as possible.

1. In the case of an actual or imminent act or threat of violent behavior.
2. In all cases, the report should be immediately made to the employee's supervisor or department head, and to the compliance committee.

D.2. All reports of workplace intimidation or violence will be investigated impartially and as confidentially as possible.

D.3. Employees are required to cooperate in any investigations. A timely resolution of each report should be reached and communicated to all parties involved as soon as possible.

D.4. Any form of retaliation against employees for making a bona fide report concerning workplace intimidation or violence is prohibited and must be immediately reported to the compliance committee.

E. REPORTING NONWORK-RELATED VIOLENCE

E.1. Employees, who are victims of domestic or nonwork-related violence, or who believe they are potential victims of such violence, or who believe they are potential victims of such violence and fear it may enter the workplace, are encouraged to promptly notify their supervisor or department head. All such reports will be investigated as described earlier.

F. NONDISCIPLINARY AND DISCIPLINARY ACTION

F.1. Upon completion of an investigation, incidents will be reviewed before proceeding with nondisciplinary or disciplinary action, according to the provisions of the performance and corrective action policy.

F.2. Examples of actions that might be taken when an employee has been found to have violated the policy include, but are not limited to, the following:

1. Mandatory participation and counseling
2. Corrective action up to and including termination
3. Criminal arrest and prosecution
4. Initiation of a court order

F.2.a. Those who believe they are victims of intimidation or violence, whether workplace or nonwork-related, should contact their supervisor or department head to inquire about available employee assistance and to obtain advice about dealing with the situation.

G. WEAPONS POLICY

G.1. The possession, carrying, or use of weapons on the organization's property is strictly prohibited. This includes firearms, edged weapons, illegal knives, martial arts weapons, clubs, and any device capable of projecting a ball, pellet, arrow, bullet, shell, or other similar devices. Violation of this policy is grounds for immediate termination. Refer to the firearms and other weapons policy, which is incorporated into this policy by reference.

Appendix U: OSHA Construction Safety Plan Outline

A. Initiate and maintain such programs as necessary for compliance
B. Demonstrate a management commitment to safety and health
1. Provide employees with sanitary and safe working conditions [29 CFR 1926.20(a)]
2. Assign safety and health responsibilities [29 CFR 1926.20(b)]
3. Give safety and health designees authority to correct hazards [29 CFR 1926.32(f)]
4. Ensure employees can voice safety and health concerns without reprisal [29 CFR 1903.11(d)]
5. Inform employees of hazards [29 CFR 1926.21(b), 29 CFR 1926.33, 29 CFR 1926.59, 29 CFR 1926.454, 29 CFR 1926 Subpart Z]
6. Coordinate hazard communication with other on-site employers [29 CFR 1926.59, 29 CFR 1926.65, 29 CFR 1926.652]
7. Post the OSHA State or Federal Poster [29 CFR 1903.2(a)]
C. Hazard identification and determination
1. Evaluate operations, procedures, facilities, and equipment to identify hazards [29 CFR 1926.20(a), 29 CFR 1926.21(b)]
2. Monitor exposure levels [29 CFR 1926.55, 29 CFR 1926.62, 29 CFR 1926 Subpart Z, 29 CFR 1926.1101]
3. Ensure regular safety and health inspections [29 CFR 1926.20(b)(2), 29 CFR 1926.703(b), 29 CFR 1926.1081]
4. Conduct accident investigations [29 CFR 1904.4]
5. Determine if engineering or administrative controls or personnel protective equipment are to be used [29 CFR 1926.103, 29 CFR 1926.951]
D. Hazard elimination and control
1. Ensure machines and tools are in safe working order and in compliance with relevant standards [29 CFR 1926.20(b)(3), 29 CFR 1926.550(a), 29 CFR 1926.951]
2. Institute engineering and work practice controls to eliminate health hazards [29 CFR 1926.55, 29 CFR 1926.103, 29 CFR 1926 Subpart Z]
3. Perform housekeeping to remove hazards posed by scrap and debris in work areas [29 CFR 1926.25, 29 CFR 1926.852, 29 CFR 1926.152(c)(5), 29 CFR 1926.900(k)(5)]
4. Provide appropriate personal protective equipment when other controls are infeasible [29 CFR 1926.28(a), 29 CFR 1926 Subpart E]
5. Guarantee safe means of egress [29 CFR 1926.34]
E. Emergency response planning
1. Develop emergency response plans [29 CFR 1926.35, 29 CFR 1926.65(q)]
2. Develop fire prevention and protection programs [29 CFR 1926.24, 29 CFR 1926.352, 29 CFR 1926 Subpart F]
F. First aid and medical
1. Provide medical services, first aid treatment, and supplies [29 CFR 1926.50(a), 29 CFR 1926.103, 29 CFR 1926.50(c), 29 CFR 1926.50(d), 29 CFR 1926 Subpart Z]
2. Ensure availability of emergency rescue for injured employees [29 CFR 1926.50(e), 29 CFR 1926.106(a), 29 CFR 1926.21(b)(6), 29 CFR 1926.802(b)]
3. Postemergency numbers for physicians, hospitals, or ambulances [29 CFR 1926.50(f)]

G. Training
1. Train employees to recognize hazards [29 CFR 1926.21(b)(2), 29 CFR 1926.65, 29 CFR 1926.302(e), 29 CFR 1926.1060]
2. Train workers to recognize and avoid unsafe conditions [29 CFR 1926.21(b)(2), 29 CFR 1926.65, 29 CFR 1926.454, 29 CFR 1926.901(c)]
3. Provide training on safe work practices and applicable standards [29 CFR 1926.21(b)]
4. Provide training on safe operation of equipment and machinery [29 CFR 1926.20(b)(4), 29 CFR 1926.302(e)]
5. Provide training on hazards of access ladders and stairways [29 CFR 1926.1060(a), 29 CFR 1926.454, 29 CFR 1926.800(b) and (c)]
6. Provide training on confined and enclosed space entry hazards and precautions [29 CFR 1926.21(b)(6), 29 CFR 1926.353(b), 29 CFR 1926.801].
H. Recordkeeping and abatement verification
1. Record injuries and fatalities [29 CFR 1904.5, 29 CFR 1904.8]
2. Maintain medical records [29 CFR 1926.33]
3. Maintain exposure records [29 CFR 1926.33]
4. Maintain appropriate documents and tags for abatement verification [29 CFR 1903.19]

Appendix V: Hazard Control–Related Acronyms

AAS	Atomic absorption spectroscopy
ABC	Airway, breathing, circulation
ABIH	American Board of Industrial Hygiene
ABSA	American Biological Safety Association
ACBM	Asbestos-containing building material
ACCSH	Advisory Committee on Construction Safety and Health
ACGIH	American Conference of Governmental Industrial Hygienists
ACM	Asbestos-containing material
ACP	Area contingency plan
ACRSP	Association of Canadian Registered Safety Professionals
ACS	American Chemical Society
ADA	Americans with Disabilities Act
ADR	Alternative Dispute Resolution
AE	Atomic emission
AEL	Acceptable exposure limit
AGA	American Gas Association
AGST	Aboveground storage tank
AHM	Acutely hazardous material
AIChE	American Institute of Chemical Engineers
AIDS	Acquired immune deficiency syndrome
AIHA	American Industrial Hygiene Association
ALARA	As low as reasonably achievable
ALJ	Administrative law judge
ALS	Advanced life support
ANPR	Advanced notice of proposed rulemaking
ANSI	American National Standards Institute
APF	Assigned protection factor
APHA	American Public Health Association
API	American Petroleum Institute
APIH	Association of Professional Industrial Hygienists
APR	Air-purifying respirator
ASHRAE	American Society of Heating, Refrigerating, and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASP	Associate safety professional
ASQC	American Society for Quality Control
ASSE	American Society of Safety Engineers
AST	Aboveground storage tank
ASTM	American Society for Testing Materials
ATC	Automatic temperature compensation
ATCM	Air toxics control measure
ATSDR	Agency for Toxic Substances and Disease Registry
AWT	Advanced wastewater treatment
BACT	Best available control technology

BBP	Bloodborne pathogens
BBS	Behavior-based safety
BCHCM	Board of Certified Hazard Control Management
BCSP	Board of Certified Safety Professionals
BCT	Best conventional pollutant control technology
BLS	Basic life support
BLS	Bureau of Labor Statistics
BPT	Best practicable control technology currently available (CCAA)
BS	British Standards
BSC	Biological safety cabinet
BSI	British Standards Institute
BTU	British thermal unit
CAA	Clean Air Act
CAIR	Comprehensive Assessment Information Rule
CAMEO	Computer-aided management of emergency operations
CAP	College of American Pathologists
CAS	Chemical Abstracts Service
CAV	Constant air volume
CCP	Cooperative Compliance Program
CCPS	Center for Chemical Process Safety
CDC	Centers for Disease Control and Prevention
CEPP	Chemical emergency preparedness program
CEPS	Cluster environmental protection specialist
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CET	Certified environmental trainer
CFC	Chlorofluorocarbon
CFM	Cubic feet per minute
CFR	Code of Federal Regulations
CGA	Compressed Gas Association
CGL	Comprehensive General Liability Insurance
CHCM	Certified hazard control manager
CHCM-SEC	Certified hazard control manager—security
CHEMTREC	Chemical Transportation Emergency Center
CHEP	Certified healthcare emergency professional
CHMM	Certified hazardous materials manager
CHO	Chemical hygiene officer
CHP	Certified health professional
CHP	Certified health physicist; Chemical Hygiene Plan
CHSP	Certified healthcare safety professional
CHSP-FSM	Certified healthcare safety professional—fire safety manager
CHST	Construction safety and health technician
CIH	Certified industrial hygienist
CIIT	Chemical Industry Institute of Technology
CPC	Chemical protective clothing
CPL	Compliance directive
CPR	Cardiopulmonary resuscitation
CPSC	Consumer Products Safety Commission
CPSM	Certified product safety manager
CPSO	Certified patient safety officer
CR	Case report number
CSGs	Clinical service groups

CSP	Certified safety professional
CTD	Cumulative trauma disorder
CWA	Clean Water Act
dBA	Decibels (A scale)
DES	Department of Emergency Services
DHHS	Department of Health and Human Services
DHS	Department of Homeland Security
DM	Dust and mist
DNR	Department of Natural Resources
DO	Dissolved oxygen
DOD	Department of Defense
DOE	Department of Energy
DOI	Department of the Interior
DOJ	Department of Justice
DOL	Department of Labor
DOT	Department of Transportation
DVO	Diffuse viewing only
EAP	Emergency action plan
EAP	Employee Assistance Program
ED	Emergency Department
EDP	Electronic data processing
EEOC	Equal Employment Opportunity Commission
EHS	Environment, Health and Safety; or Environmental Health and Safety
EHS	Extremely hazardous substance
EIS	Environmental Impact Statement (NEPA)
ELF–EMF	Extremely low-frequency electric and magnetic fields
EM	Emergency management
EMA	Emergency Management Agency
EMR	Electromagnetic radiation
EMS	Emergency Management Services; Emergency Medical Service
EOC	Emergency Operations Center
EOC	Environment of Care standards
EP	Extraction procedure
EPA	Environmental Protection Agency
EPCRA	Emergency Planning and Community Right-To-know Act
EPs	Elements of performance
ERA	Environmental Risk Assessment
ERC	Emissions Reduction Credit
ERG	Emergency response guide
ERP	Emergency response plan
ERPG	Emergency response planning guideline
ERRIS	Emergency and Remedial Response Inventory System
ERT	Emergency response team
ES&H	Environment, Safety, and Health
ESA	Endangered Species Act
ESA	Environmental site assessment
ESC	Evidence of standards compliance
ESCBA	Escape self-contained breathing apparatus
EtO	Ethylene oxide
FAQs	Frequently asked questions
FBI	Federal Bureau of Investigation

FDA	Food and Drug Administration
FEMA	Federal Emergency Management Agency
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
FM	Factory Mutual; fire marshal
FMCSR	Federal Motor Carrier Safety Regulations
FMEA	Failure mode and effect analysis
FMECA	Failure mode, effects, and criticality analysis
FOIA	Freedom of Information Act
FR	Flame resistant
FR	Federal Register
FS	Feasibility study
FSAR	Final Safety Analysis Report
FTA	Fault tree analysis
FTU	Fixed treatment unit
FWPCA	Federal Water Pollution Control Act
GACT	Generally available control technology
GAO	General Accounting Office
GC/MS	Gas chromatography/mass spectrometry
GERT	General employee radiation training
GFCI	Ground-fault circuit interrupter
GLC	Ground-level concentration
GLP	Good laboratory practice
gpm	Gallons per minute
GSA	General Service Administration
GW	Groundwater
HAPs	Hazardous air pollutants
HASP	Health and safety plan
HazCom	Hazard Communication
HAZMAT	Hazardous materials
HAZWOPER	Hazardous waste operations and emergency response
HBV	Hepatitis B virus
HCA	Hazard Communication Act
HCFCs	Hydro chlorofluorocarbons
HCl	Hydrogen chloride
HCO	Health care organization
HCS	Hazard Communication Standard
HEPA	High-efficiency particulate air (filtration)
HF	Hydrogen fluoride
HID	High-intensity discharge
HIV	Human immunodeficiency virus
HMEP	Hazardous materials emergency preparedness
HMIG	Hazardous materials identification guide
HMIS	Hazardous materials information system
HMRT	Hazardous materials response team
HMTC	Hazardous materials technical center
HP	Health physicist
HRS	Hazard ranking system
HS	Hazardous substance
HSWA	Hazardous and Solid Waste Amendments
HVAC	Heating, ventilation, and air conditioning
HWMU	Hazardous Waste Management Units

IAFF	International Association of Firefighters
IAP	Incident action plan
IAQ	Indoor air quality
IARC	International Agency for Research on Cancer
IATA	International Air Transport Association
IBNR	Incurred but not reported
IBR	Incorporated by reference
IC	Incident Command
ICAO	International Civil Aviation Organization
ICC	Interstate Commerce Commission
ICP	Incident command post
ICS	Incident command system
IDLH	Immediately dangerous to life and health
IEC	International Electro-technical Commission
IHMM	Institute of Hazardous Materials Management
IR	Infrared
ISEA	Industrial Safety Equipment Association
ISO	International Organization for Standardization
IUPAC	International Union of Pure and Applied Chemistry
JC	Joint Commission
JHA	Job hazard analysis
JIC	Joint Information Center
LCD	Liquid crystal display
LEA	Local enforcement agency
LEC	Local emergency coordinator
LED	Light-emitting diode
LEL	Lower explosive limit
LEPC	Local Emergency Planning Committee
LIMS	Laboratory Information Management System
LSO	Laser safety officer
LUST	Leaking underground storage tank
LWDII	Lost workday due to injury and illness
MAWP	Maximum allowable working pressure
MCL	Maximum concentration limits or Maximum contaminant level
MCS	Multiple chemical sensitivity
MECO	Modern Engineering Company
mg/m^3	Milligrams per cubic meter
mil	1 mil = 1/1000 of an inch
MIS	Management information systems
mL	Milliliter (also mL)
MMAD	Mass median aerodynamic diameter
MOA	Memorandum of agreement
MOS	Measures of success
MOU	Memorandum of understanding
mppcf	Million particles per cubic foot
MS	Mass spectroscopy
MSDS	Material Safety Data Sheet
MTD	Maximum tolerated dose
MTU	Mobile treatment unit
MUTCD	Manual for Uniform Traffic Control Devices
NAICS	North American Industry Classification System

NAS	National Academy of Sciences
NCP	National Contingency Plan
NCP	National Oil & Hazardous Substances Pollution Contingency Plan
NCRIC	National Chemical Response and Information Center
NDPES	National Pollutant Discharge Elimination System
NEIC	National Enforcement Investigations Center
NEMA	National Electrical Manufacturers Association
NEPA	National Environmental Policy Act
NESHAPs	National Emission Standards for Hazardous Air Pollutants
NFC	National Fire Code
NFPA	National Fire Protection Association
NFR	National Fire Rating
NH_3	Ammonia
NHTSA	National Highway Traffic Safety Administration
NiCad	Nickel–cadmium
NIEHS	National Institute of Environmental Health Sciences
NIH	National Institutes of Health
NIHL	Noise-induced hearing loss
NIIMS	National Interagency Incident Management System
NIOSH	National Institute of Occupational Safety and Health
NIST	National Institute of Standards and Technology
NMFC	National Motor Freight Class
NMR	Nuclear Magnetic Resonance Spectroscopy
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NPL	National Priority List
NRC	Nuclear Regulatory Commission; National Response Center
NRDA	Natural Resource Damage Assessment
NRDAR	Natural Resource Damage Assessment and Restoration
NRR	Noise reduction rating
NRS	National Response System
NRT	National Response Team
NRTL	Nationally recognized testing laboratory
NSC	National Safety Council
NSF	National Sanitation Foundation
NSF	National Science Foundation
NSFCC	National Strike Force Coordination Center
NTIS	National Technical Information Service
NTP	National Toxicology Program
NWPA	Nuclear Waste Policy Act
OBES	Office of Basic Energy Sciences
OCMV	Open container in motor vehicle
OECM	Office of Enforcement and Compliance Monitoring
OMB	Office of Management and Budget
OPA	Oil Pollution Act of 1990
ORM	Other regulated material
ORR	Operational readiness review
OSC	On-scene coordinator
OSHA	Occupational Safety and Health Administration
OSHRC	Occupational Safety and Health Review Commission
OSWER	Office of Solid Waste and Emergency Response

OTA	Office of Technology Assessment
OV/AG	Organic vapor/acid gas
PAPR	Powered air-purifying respirator
PCB	Polychlorinated biphenyls
PE	Professional engineer
PEL	Permissible exposure limit
PFA	Priority focus areas
PFP	Priority focus process
PFS	Professional food systems
PHA	Preliminary hazards analysis
PHA	Process hazards analysis
PHS	Particularly hazardous substance
PIH	Poison inhalation hazard
PL	Public Law
POA	Plan of action
POP	Performance-oriented packaging
POTW	Publicly owned treatment works
ppb	Parts per billion
PPE	Personal protective equipment
ppm	Parts of contaminant per million parts of air or fluid
PPR	Periodic performance review
PRCS	Permit-required confined space
PRP	Potentially responsible party
PSA	Preliminary site assessment
PSEL	Plant-specific emission limit
PSI	Pollution standards index
psi	Pounds per square inch
psig	Pounds per square inch gauge
PSM	Process safety management
PVA	Polyvinyl alcohol
QA/QC	Quality assurance/quality control
QRA	Quantitative risk assessment
R&D	Research and development
RCRA	Resource Conservation and Recovery Act
RFI	Radiofrequency interference
RFI	Requirement for improvement
RIH	Registered Industrial Hygienist
RMI	Repetitive motion injury
RMP	Risk management program
rms	Root mean square
RP	Responsible party
RRT	Regional response team
RSI	Repetitive strain injury
RSO	Radiological safety officer or radiation safety officer
RSPA	Research and Special Programs Administration
RTK	Right to know
SARA	Superfund Amendments and Reauthorization Act
SATA	Site assessment and technical assistance
SCBA	Self-contained breathing apparatus
SDWA	Safe Drinking Water Act
SEI	Safety Equipment Institute

SERC	State Emergency Response Commission
SHEM	Safety, Health, and Environmental Management
SHEP	Safety, Health, and Environmental Program
SIC	Standard Industrial Classification
SIP	State Implementation Plan
SITE	Superfund Innovative Technology Evaluation
SOP	Standard operating procedure
SPCC	Spill prevention, control, and countermeasures
SQG	Small-quantity generator
STEL	Short-term exposure limit
STP	Standard temperature and pressure
SUD	Safe use determination
SWA	Solid Waste Act
SWMP	Storm Water Monitoring Program
SWMU	Solid Waste Management Unit
SWPPP	Storm Water Pollution Prevention Program
TCLP	Toxicity characteristic leaching procedure
TDS	Totally dissolved solid
TLSI	The Laboratory Safety Institute
TLV	Threshold limit value
TPQ	Threshold planning quantity
TQM	Total quality management
TSCA	Toxic Substance Control Act
TSDF	Treatment, storage, and disposal facility
TSI	Transportation Safety Institute
TSR	Technical safety requirement
TWA	Time-weighted average
UBC	Uniform Building Code
UC	Unified command
UEL	Upper explosive limit
UFC	Uniform Fire Code
UGST	Underground storage tank
UGT	Underground tank
UL	Underwriters Laboratories
UM	Uniform Manifest
USC	United States Code
USCG	United States Coast Guard
USDA	U.S. Department of Agriculture
USDW	Underground source of drinking water
USEPA	United States Environmental Protection Agency
USFDA	United States Food and Drug Administration
USM	United States Marshal
USP	United States Pharmacopeia
UST	Underground storage tank
UV	Ultraviolet
VDT	Video display terminal
VGA	Video graphics array
VHAP	Volatile hazardous air pollutant
VOC	Volatile organic compound
VPP	Voluntary protection program
WBGT	Wet bulb globe temperature

WEEL	Workup environmental exposure limit
WHMIS	Workplace hazardous materials information system
WHO	World Health Organization
WMD	Weapons of mass destruction
WPS	Worker Protection Standard
WWTP	Wastewater treatment plant

Appendix W: Bloodborne Training Requirements

Employers must be sure that all employees with occupational exposure participate in a training program that is provided at no cost to the employee and during working hours. Training shall be provided at the time of the initial assignment of tasks where occupational exposure may take place and at least annually thereafter. For employees who have received training on bloodborne pathogens in the year preceding the effective date of the standard, only training with respect to the provisions of the standard that were not included need be provided. Annual training for all employees must be provided within 1 year of their previous training. Employers will provide additional training when changes such as modification of tasks or procedures or institution of new tasks or procedures affect the employee's occupational exposure. The additional training may be limited to addressing the new exposures created. Material appropriate in content and vocabulary to educational level, literacy, and language of employees shall be used. The training program should contain at a minimum the following elements:

- An accessible copy of the regulatory text of this standard and an explanation of its contents
- A general explanation of the epidemiology and symptoms of bloodborne diseases
- An explanation of the modes of transmission of bloodborne pathogens
- An explanation of the employer's exposure control plan and the means by which the employee can obtain a copy of the written plan
- An explanation of the appropriate methods for recognizing tasks and other activities that may involve exposure to blood and other potentially infectious materials
- An explanation of the use and limitations of methods that will prevent or reduce exposure including appropriate engineering controls, work practices, and personal protective equipment (PPE)
- Information on the types, proper use, location, removal, handling, decontamination, and disposal of PPE
- An explanation of the basis for selection of PPE
- Information on the hepatitis B vaccine, including information on its efficacy, safety, method of administration, the benefits of being vaccinated, and that the vaccination will be offered free of charge
- Information on the appropriate actions to take and persons to contact in an emergency involving blood or other potentially infectious materials
- An explanation of the procedures to follow if an exposure incident occurs, including the method of reporting the incident and the medical follow-up that will be made available
- Information on the postexposure evaluation and follow-up that the employer is required to provide for the employee following an exposure incident
- An explanation of the signs and labels or color coding required
- An opportunity for interactive questions and answers with the person conducting the training session

The person conducting the training should be knowledgeable in the subject matter covered by the training program as it relates to the workplace.

SAMPLE BLOODBORNE TRAINING PROGRAM

Learning Objective A

Participants will be able to

- Describe the OSHA Bloodborne Pathogens standard
- State which employees are covered under the standard
- Describe what is required to meet the standard
- Discuss the following:
  - Provisions of the OSHA Bloodborne Pathogens standard
  - Workers covered by the standard
  - How to meet the OSHA standards
  - Training program requirements

Additional training is necessary if new equipment is introduced to the work area. Standards include the *potential* for exposure, not just exposure.

A written exposure control plan is necessary for the safety and health of workers.

Participants should be able to

- Identify job classifications where there is exposure to blood or other potentially infectious materials
- Explain the protective measures currently in effect in the acute-care facility and methods of compliance to be implemented, including hepatitis B vaccination and postexposure follow-up procedures, how hazards are communicated to employees, PPE, housekeeping, and recordkeeping
- Establish procedures for evaluating the circumstances of an exposure incident

Learning Objective B

Participants will be able to explain the transmission, course, and effects of bloodborne pathogens by acquiring an understanding of the following:

- Definition of bloodborne pathogens
- Types of bloodborne pathogens
- Hepatitis B virus (HBV)—definition, symptoms, course, and effects
- Human immunodeficiency virus (HIV)—definition, symptoms, course, and effects
- Mode of transmission of bloodborne pathogens (including modes of transmission other than occupational transmission)

Employees should be reminded that

- HBV is more persistent than HIV.
- Nonintact skin makes employees vulnerable to infection.
- Clean work surfaces decrease the risk of infection.
- You cannot identify whether someone is HBV or HIV positive just by appearances.
- Due to the length of time before symptoms appear, employees may not be aware that they have contracted a disease.
- All exposures must be reported.
- Hand washing is important for preventing the transmission of bloodborne pathogens.
- Work surfaces must be cleaned with an appropriate disinfectant.
- PPE must be used as per the employer.

With regard to workplace transmission, employees should be made aware that HBV, HIV, and other pathogens may be present in

- Body fluids such as saliva, semen, vaginal secretions, cerebrospinal fluid, synovial fluid, pleural fluid, peritoneal fluid, pericardial fluid, amniotic fluid, and any other body fluids visibly contaminated with blood
- Saliva and blood contacted during dental procedures
- Unfixed tissue or organs other than intact skins from living or dead humans
- Organ cultures, culture media, or similar solutions
- Blood, organs, and tissues from experimental animals infected with HIV or HBV

Employees should learn that the means of transmission include

- An accidental injury by a sharp object contaminated with infectious material, such as
  - Needles
  - Scalpels
  - Broken glass
  - Exposed ends of dental wires
  - Anything that can pierce, puncture, or cut your skin
- Open cuts, nicks, and skin abrasions, even dermatitis and acne, as well as the mucous membranes of the mouth, eyes, or nose
- Indirect transmission, such as touching a contaminated object or surface and transferring the infectious material to the mouth, eyes, nose, or open skin

Learning Objective C

Participants will be able to describe the types of hepatitis B vaccines and their usage and contraindications and should be able to identify who should receive the vaccine. The following points should be addressed:

- Types of hepatitis B vaccines available.
- What workers should receive the hepatitis B vaccine?
- When and how the vaccine is given?
  - Vaccine must be given to employee during work hours.
  - Vaccine is given in three doses according to a dose schedule.
  - Vaccine is given in the upper arm area (deltoid muscle).
  - Vaccine is provided by the employer at no out-of-pocket expense to the employee.
  - Employers cannot require employees to bill their insurance plans for the cost of the vaccine.
  - Employers cannot require that employees stay at a specific job for a specific amount of time to receive the vaccine free of charge.
  - No prescreening is required, and the employer cannot make this a requirement for receiving the vaccine.
- To whom the vaccine does not have to be offered:
  - Employees who have previously completed the hepatitis B vaccination series
  - When immunity is confirmed through antibody testing
  - Contraindications to receiving the vaccine exist
- Side effects of the vaccine
- Dosage (10 μg or 1.0 mL)
  - Dose 1—at target date
  - Dose 2—30 days later
  - Dose 3—6 months after first dose

Learning Objective D

The participants will be able to describe the controls that reduce exposure to bloodborne pathogens:

- Provide an overview of four prevention strategies: engineering controls, work practice controls, PPE, and universal precautions.
- Differentiate between engineering and work practice controls.
- Discuss hand washing and location of hand washing facilities.
- Go over work practice requirements.
- Discuss sharps, including how to handle contaminated sharps (disposable/reusable).
- Describe the PPE used in the facility and give examples.
- Emphasize that PPE must be readily available and sized appropriately.
- Make it clear that PPE must be provided and maintained at no cost to the employee.
- Advise employees what to do if
  - PPE becomes contaminated
  - Personal clothing becomes contaminated
- Discuss gloves and activities that may alter the integrity of gloves (e.g., cleaning with surfactants).
- Give examples of the limited exceptions to using PPE.
- Describe the concept of universal precautions.
- Describe acceptable containers.
- Describe biohazard containers.
- Describe surfaces in the facility that could be contaminated with blood or other potentially infectious materials.
- Explain how to clean work surfaces in the facility (e.g., what cleaners are used).
- Explain the cleaning schedule established in the facility.
- Explain how to clean up broken glass or a contaminated spill.
- Explain how to clean reusable sharps (if appropriate to the facility).
- Explain how laundry is handled in the facility.
- Caution employees to be careful when handling contaminated laundry.
- Advise employees to watch for hidden sharps.

Ask participants if they have any questions about this material.

- Summary:
  - Use puncture-resistant, leak-proof containers, color-coded red or labeled depending on the standard, to discard contaminated items such as needles, broken glass, scalpels, or other items that could cause a cut or puncture wound.
  - Use puncture-resistant, leak-proof containers, color-coded red or labeled, to store contaminated reusable sharps until they are properly reprocessed.
  - Store and process reusable contaminated sharps in a way that ensures safe handling, for example, use a mechanical device to retrieve used instruments from soaking pans in decontamination areas.
  - Use puncture-resistant, leak-proof containers to collect, handle, process, store, transport, or ship blood specimens and potentially infectious materials.
  - Label these specimens if they are shipped outside the facility.
  - Labeling is not required when specimens are handled by employees trained to use universal precautions with all specimens and when these specimens are kept within the facility.
  - Wash hands when gloves are removed and as soon as possible after contact with blood or other potentially infectious materials.

Provide and make available a mechanism for immediate eye irrigation in the event of an exposure incident.
Do not bend, recap, or remove contaminated needles unless required to do so by specific medical procedures or the employer can demonstrate that no alternative is feasible.
In these instances, use mechanical means such as forceps, or a one-handed technique to recap or remove contaminated needles.
Do not shear or break contaminated needles.
Discard contaminated needles and sharp instruments in puncture-resistant, leak-proof, red or biohazard-labeled containers that are readily accessible, maintained upright, and not allowed to be overfilled.
Do not eat, drink, smoke, apply cosmetics, or handle contact lenses in areas of potential occupational exposure.
Do not store food or drink in refrigerators or on shelves where blood or potentially infectious materials are present.
Use red labels or affix biohazard labels to containers when storing, transporting, or shipping blood or other potentially infectious materials.

- Universal precautions:
  - Workers should protect their skin from contact with any body fluids.
  - Workers should wear gloves when handling anything that contains these fluids.
  - Workers should use such a barrier when handling blood, body fluids (e.g., urine, vomit), mucous membranes, or skin that is not attached.
  - If the splatter of blood is anticipated, then workers should wear masks, protective eyewear, and aprons.
  - Workers should wash hands and other skin surfaces immediately and thoroughly if they become contaminated with blood or other body fluids.
  - Workers should wash their hands thoroughly after removing protective gloves.
  - All healthcare workers should be careful not to be injured by needles, scalpels, and other sharp instruments or devices during procedures.
  - Workers should take special care when cleaning up after surgical procedures or disposing of any needles or instruments so other workers do not come into contact with these instruments.
  - Workers should use puncture-resistant containers to collect and dispose of these objects.
  - Workers should take care at all times when working near sharp instruments and the disposal containers.
  - Workers can minimize the need for emergency mouth-to-mouth resuscitation by using other ventilation devices to perform these operations where necessary; this precaution is taken even though saliva has not been implicated in HIV transmission.
  - Healthcare workers who have exudative lesions or weeping dermatitis should refrain from all direct patient care and handling patient equipment until the condition is resolved.
  - Pregnant healthcare workers should be completely familiar with and particularly careful to observe the precautions to minimize the risk of HIV transmission to their infants.

Learning Objective E

Participants will be able to determine whether an exposure incident could occur within their worksite and describe steps to take after an exposure incident. Discussion should address the following topics:

- Local exposure control plan
- Defining an occupational exposure incident

- Information given to healthcare professionals
- Steps to minimize exposure
- Potential exposure incidents applicable to the worksite

Sessions must be comprehensive in nature and include information on bloodborne pathogens as well as on OSHA regulations and the employer's exposure plan. The person conducting the training must be knowledgeable in the subject matter. The training program must accomplish the following:

- Explain the regulatory text and make a copy available.
- Explain the epidemiology and symptoms of bloodborne diseases.
- Explain the modes of transmission of bloodborne pathogens.
- Explain the employer's written exposure control plan.
- Describe the methods to control transmission of HBV and HIV.
- Explain how to recognize occupational exposure.
- Inform workers about the availability of free hepatitis B vaccinations, vaccine efficacy, safety, benefits, and administration.
- Explain the emergency procedures and reporting of exposure incidents.
- Inform workers of the postexposure evaluation and follow-up available from healthcare professionals.
- Describe how to select, use, remove, handle, decontaminate, and dispose of personal protective clothing and equipment.
- Explain the use and limitations of safe work practices, engineering controls, and PPE.
- Explain the use of label, signs, and color coding required by the standard.
- Provide an interactive question and answer session on the training.

Appendix X: Patient and Resident Moving Guidelines

GUIDELINE 1: LIFTING AND LATERAL TRANSFERS

Lifting

Use upright, neutral working postures and proper body mechanics:

- Bend your legs, not your back. Use your legs to do the work.
- When lifting or moving people, always face them.
- Do not twist when turning. Pick up your feet and pivot your whole body in the direction of the move.
- Try to keep the person you are moving, equipment, and supplies close to the body. Keep handholds between your waist and shoulders.
- Move the person toward you, not away from you.
- Use slides and lateral transfers instead of manual lifting.
- Use a wide, balanced stance with one foot slightly ahead of the other.
- Lower the person slowly by bending your legs, not your back. Return to an erect position as soon as possible.
- Use smooth movements and do not jerk. When lifting with others, coordinate lifts by counting down and synchronizing the lift.

Lateral Transfers

- Position surfaces (e.g., bed and gurney, bed and cardiac chair) as close as possible to each other. Surfaces should be approximately at waist height, with the receiving surface slightly lower to take advantage of gravity.
- Lower the rails on both surfaces (e.g., beds and gurneys).
- Use draw sheets or incontinence pads in combination with friction-reducing devices (e.g., slide boards, slippery sheets, plastic bags, low-friction mattress covers, etc.).
- Get a good handhold by rolling up draw sheets and incontinence pads or use other assist equipment such as slippery sheets with handles.
- Kneel on the bed or gurney to avoid extended reaches and bending of the back.
- Have team members on both sides of the bed or other surfaces. Count down and synchronize the lift. Use a smooth, coordinated push–pull motion. Do not reach across the person you are moving.

GUIDELINE 2: AMBULATING, REPOSITIONING, AND MANIPULATING

When using gait or transfer belts with handles:

- Keep the individual as close as possible.
- Avoid bending, reaching, or twisting your back when
  - Attaching or removing belts (e.g., raise or lower beds, bend at the knees)
  - Lowering the individual down
  - Assisting with ambulation

Pivot with your feet to turn.
Use a gentle rocking motion to take advantage of momentum.

Stand/pivot type transfers are used for transferring an individual from bed to chair, for example, or to help an individual get up from a sitting position:

- Use transfer disks or other assists when available. If using a gait or transfer belt with handles, follow the earlier guidelines.
- Keep feet at least a shoulder width apart.
- If the patient or resident is on a bed, lower the bed so the individual can place his or her feet on the floor to stand.
- Place the receiving surface (e.g., wheelchairs) on the individual's strong side (e.g., for stroke or hemiparalysis conditions) so the individual can help in the transfer.
- Get the person closer to the edge of bed or chair and ask him or her to lean forward when trying to stand (if medically appropriate).
- Block the individual's weak leg with your legs or knees (this may place your leg in an awkward, unstable position; an alternative is to use a transfer belt with handles and straddling your legs around the weak leg of the patient or resident).
- Bend your legs, not your back.
- Pivot with your feet to turn.
- Use a gentle, rocking motion to take advantage of the momentum.

Lifting or Moving Tasks with the Patient or Resident in Bed

Some common methods include scooting up or repositioning individuals using draw sheets and incontinence pads in combination with a logroll or other techniques:

- Adjust beds, gurneys, or other surfaces to waist height and as close to you as possible.
- Lower the rails on the bed, gurney, etc., and work on the side where the individual is closest.
- Place equipment or items close to you and at waist height.
- Get help and use teamwork.

GUIDELINE 3: TRANSPORTING PATIENTS, RESIDENTS, AND EQUIPMENT

It is often necessary to transport people in gurneys, wheelchairs, or beds or handle various types of carts, monitors, instrument sets, and other medical equipment:

- Decrease the load or weight of carts, instrument trays, etc.
- Store items and equipment between waist and shoulder height.
- Use sliding motions or lateral transfers instead of lifting.
- Push, don't pull. Keep loads close to your body. Use an upright neutral posture and push with your whole body, not just your arms.
- Move down the center of corridors to prevent collisions.
- Watch out for door handles and high thresholds that can cause abrupt stops.

GUIDELINE 4: PERFORMING ACTIVITIES OF DAILY LIVING

Cramped showers, bathrooms, or other facilities in combination with poor work practices may cause providers to assume awkward positions or postures or use forceful exertions when performing activities of daily living:

- Use upright neutral working postures and proper body mechanics. Bend your legs, not your back.
- Eliminate bending, twisting, and long reaches by
  - Using long-handled extension tools (e.g., handheld shower heads, wash and scrub brushes).
  - Wheeling people out of showers or bathrooms and turning them around to wash hard-to-reach places.
- Use shower-toilet chairs that are high enough to fit over toilets. This eliminates additional transfers to and from wheelchairs, toilets, etc.
- Use shower carts or gurneys, bath boards, pelvic lift devices, bathtub and shower lifts, and other helpful equipment.
- When providing in-bed medical care or other services, follow the guidelines listed previously.

GUIDELINE 5: TRANSFERRING FROM THE FLOOR

When it is medically appropriate, use a mechanical assist device to lift people from the floor. If assist devices are not readily available or appropriate, you may have to perform a manual lift. When placing slings, blankets, draw sheets, or cots under the person

- Position at least two providers on each side of the person. Get additional help for large patients or residents.
- Bend at your knees, not your back. Do not twist.
- Roll the person onto his or her side without reaching across the person.
- If using hoists, lower the hoist enough to attach slings without strain.
- If manually lifting, kneel on one knee, and grasp the blanket, draw sheet, or cot.

Count down and synchronize the lift. Perform a smooth lift with your legs as you stand up. Do not bend your back.

GUIDELINE 6: ASSISTING IN SURGERY

- Use retractor rings instead of prolonged manual holding of retractors.
- Position operating tables or other surfaces at waist height.
- Stand on lifts or stools to reduce reaching.
- Frequently shift position or stretch during long operations.
- Avoid prolonged or repeated bending of the neck or the waist.
- Stand with one foot on a lift and frequently alternate feet to reduce pressure on the back.
- Reduce the number of instrument sets (trays) on a case cart.
- Store instrument sets (trays) in racks between the waist and shoulders.
- Use stands or fixtures to hold extremities.
- Get help from coworkers as needed to
  - Position legs or extremities in stirrups
  - Move heavy carts, microscopes, monitors, alternate operating tables, equipment, or fixtures

Appendix Y: Patient Safety Plan Development Considerations

PURPOSE

The patient safety plan must direct actions to improve healthcare safety and reduce risk to patients through a culture that encourages

- Recognizing and reporting risks to patient safety and medical errors
- Reviewing reported risks to identify causal factors and process changes necessary to improve systems
- Determining and initiating the best solutions for eliminating and reducing identified risks, hazards, or behaviors
- Internal reporting of identified risks and details of all corrective and improvement actions
- A continuing focus on all procedures, processes, and systems
- Minimizing individual blame or retribution for involvement in a medical or care error
- Analyzing selected healthcare services prior to an adverse event occurrence to identify system or processes that require redesign
- Ongoing organizational learning about medical and healthcare errors
- Sharing that knowledge and information to impact behavioral changes within all levels of the organizational structure

APPROACH

The patient safety plan must provide a systematic, coordinated, and continuous approach to all improvement efforts. The plan must encourage establishment of mechanisms to promote effective responses to actual events. The plan should also encourage an ongoing proactive reduction in medical, medication, and care errors by integrating patient safety objectives into all new and existing processes. Maintaining and improving patient safety must be a coordinated and collaborative effort. Achieving optimal results depends on the existence of a total safety culture. Patient safety must be an integral part of all departments and disciplines within the organization. It is important to develop plans, processes, and mechanisms for all activities identified by interdisciplinary team.

ADVERSE EVENTS

Adverse events are untoward incidents, therapeutic misadventures, iatrogenic injuries, or other adverse occurrences directly associated with care or services provided. Adverse events may result from acts of commission or omission. Adverse events can include patient falls, medication errors, procedural errors or complications, suicides, and missing patients. An adverse event can also be categorized as either a sentinel event or near miss.

SENTINEL EVENT

A sentinel event is an unexpected occurrence involving death or serious physical or psychological injury or the risk thereof. Serious injury specifically includes loss of limb or function. The phrase *or the risk thereof* includes any process variation for which a recurrence would carry a significant chance of serious adverse outcome.

NEAR MISSES

A near miss is an event or situation that could have resulted in an accident, injury, or illness, but did not, either by chance or through timely intervention. Near misses are opportunities for learning and afford the chance to develop preventive strategies and actions. Near misses should receive the same level of scrutiny as adverse events that result in actual injury.

ROOT CAUSE ANALYSIS

A root cause analysis (RCA) process can identify causal factors that feed adverse or near miss events. Such an analysis focuses on improving systems and processes, not on individuals. A good analysis must go beneath the surface by asking probing questions regarding the *what* and *why*. This approach allows the discovery of immediate and contributing causal factors. The analysis permits the team to identify problems and develop changes for systems and processes. Improvements through redesign or development of new processes will help reduce the risk of event recurrence. An RCA looks at human and other factors most directly associated with the event, as well as all causal factors related to the event. Analysis of the contributing causes helps identify risks and their potential contributions to the event. A credible RCA must include participation by the leadership of the organization, be internally consistent, and include consideration of relevant literature. The root cause team must have members that understand the event being analyzed.

PATIENT SAFETY PROGRAM SCOPE

The patient safety program must include the development of a continuous assessment process to prevent error occurrence. Event information from data and incident occurrence reports should be reviewed by the multidisciplinary team to prioritize organizational efforts. Sources of data could include incident reports, medication errors, adverse drug reactions, transfusion reactions, sentinel events, and other adverse events. The patient safety program encompasses the patient population, visitors, volunteers, physicians, and staff and addresses improvement issues in every department. Senior leadership must be responsible for ensuring full implementation of the program, with an emphasis on the following functions:

- Patient rights and assessment
- Patient and continuum of care
- Patient/family education
- Leadership and improving organization performance
- Information and human resource management
- Environment of care management and infection control

METHODOLOGY

The multidisciplinary team should represent leadership from throughout the organization and provide oversight for the patient safety program. All patient care and nonpatient care departments must report safety events and potential occurrences. The report will contain aggregated information

related to the type of occurrence, severity of occurrence, number and type of occurrences per department, and impact on the patient. The team will

- Analyze this information to determine the need for further safety activities.
- Conduct a data review of all internal and external reports, including Joint Commission sentinel event reports, ORYX and Core Measure performance data, and any reporting information from state and federal sources, including current literature.
- Select at least one high-risk safety process for proactive risk assessment annually.

The proactive risk assessment requires the team to

- Assess the intended and actual implementation of the process to identify the steps in the process where there is, or may be, undesirable variation.
- Identify the possible effects of the undesirable variation on patients and how serious the possible effect on the patient could be.
- For the most critical effects, conduct an RCA to determine why the undesirable variation leading to that effect may occur.
- Redesign the process or underlying systems to minimize the risk of that undesirable variation or to protect patients from the effects of that undesirable variation.
- Test and implement the redesigned process.
- Identify and implement measures of the effectiveness of the redesigned process.
- Implement a strategy for maintaining the effectiveness of the redesigned process over time.
- Describe the mechanisms necessary to ensure that all components of the healthcare organization is integrated into and participates in the organization-wide program.

PATIENT CARE PROVIDER ACTIONS

In the event of a medical error

- Perform necessary healthcare interventions to protect and support the patient's clinical condition.
- Perform necessary healthcare interventions to contain the risk to others.
- Contact the patient's attending physician and other physicians, as appropriate, to report the error, carrying out any physician orders as necessary.
- Preserve any information related to the error including physical evidence; preservation of information includes documenting the facts regarding the error on an adverse drug event or occurrence report.
- Report the medical error to the staff member's immediate supervisor.
- Submit an occurrence or adverse drug event report per organizational policy.

REPORTING OF EVENTS

An effective patient safety program cannot exist without optimal reporting of medical or healthcare errors and occurrences. The organization should adopt a no punitive approach in its management of errors and occurrences. Personnel must be able to report suspected or identified medical or healthcare errors without the fear of reprisal in relationship to their employment. Organizations must support the concept that errors occur due to a breakdown in systems and processes. Improvement will be achieved by focusing on systems and processes rather than disciplining those involved in adverse events.

Focusing on remedial actions and individual development assists rather than punishes organizational members.

INFORMING PATIENT AND FAMILY MEMBERS

The patient safety program should include an annual survey of patients, their families, and staff about their perceptions of risks to patients. The survey should solicit opinions and suggestions for improvement. It is important to make sure that patients and, when appropriate, their families are informed about the outcomes of care; brief patients about unanticipated outcomes or when the outcomes differ significantly from the anticipated outcomes. When a healthcare error leads to injury, the patient and family should receive a truthful and compassionate explanation about the error, including remedies available to the patient. They should be informed that the factors involved in the injury are being investigated so steps can be taken to reduce the likelihood of similar injury to other patients. Staff should educate patients and their families about their role in helping to facilitate the safe delivery of care.

Appendix Z: Construction Infection Control Program Elements

DEFINITIONS OF CONSTRUCTION ACTIVITY

- Define the activity by the amount of dust generated, the duration of the work, and the amount that could enter HVAC systems.
- Recommend excluding routine maintenance activities not generating dust from the formal policy.
- Communicate with contractors for clarification and additional information.
- Consider the following classifications as only a guide.

Inspection and Noninvasive Work

Activities not generating dust, requiring the cutting of walls, or accessing ceilings for visual inspection could include but are not limited to

- Visually inspecting ceiling tiles (limit the number removed for visual inspection)
- Painting wall covering
- Conducting minimal (hand) sanding
- Carrying out electrical trim work
- Doing minor plumbing
- Conducting short-duration cable installation or removal
- Cutting walls or ceilings when dust migration can be controlled

Work Generating High Levels of Dust

This category includes demolition or removal of any fixed building components or assemblies. These activities include but are not limited to

- Mechanical sanding of walls
- Removing floor coverings
- Doing ceiling tile and casework
- Constructing new walls
- Conducting minor ductwork
- Accomplishing electrical work above ceilings
- Installing major amounts of cable
- Working on activities that cannot be completed within a single work shift
- Carrying out any major demolition and construction projects
- Performing any construction or renovation activities

High-Risk Areas

Patients in areas considered at high risk for experiencing adverse outcomes if exposed to construction-related dust include

- Transplant clinic and all operating rooms
- Delivery rooms and catheter labs
- Cancer clinics and infusion rooms
- Bone marrow transplant unit (adult and pediatric)
- Intensive care units and dialysis units
- Oncology clinics and transplant units
- Central supply and sterile processing areas
- Nursery and neonatal units
- Food preparation/service areas

INFECTION CONTROL DEPARTMENT RESPONSIBILITIES

- Coordinate with other departments on the extent of the work.
- Inspect or review infection controls planned for the project.
- Review and issue an infection control construction control permit prior to the beginning of work.
- Provide education, oversight, and direction to promote the safety of patients.
- Conduct follow-up activities during the project to ensure safety of patients.

PLANT OPERATIONS AND ENGINEERING RESPONSIBILITIES

- Evaluate the extent and risk of construction and renovation activities in patient care and other high-risk areas before, during, and after project completion.
- Coordinate with the infection control department to maintain patient safety during the project.
- Communicate with construction personnel on a daily basis on the status of controls.
- Complete and distribute the construction infection control permit for all renovation, repair, and construction activities to be performed in high-risk areas.
- Consult with infection control and the safety department before any high-risk activities begin.
- Require general contractors to supervise and control activities of subcontractors to promote patient safety.
- Inform contractors and subcontractors about specific infection control requirements.
- Provide oversight and direction for contracted work to ensure safety.
- Perform work in patient and high-risk areas in a manner that minimizes dust generation.
- Maintain equipment and replace high-efficiency particulate air (HEPA) and other filters as necessary to ensure facility safety.

SAFETY DEPARTMENT RESPONSIBILITIES

- Review the construction infection control permit prior to the initiation of work to be sure that all safety issues have been coordinated.
- Provide general oversight and direction to promote safety and ensure that infection controls remain in place.
- Make periodic visits to the worksite to assess safety practices.
- Conduct or schedule air and environmental monitoring, as necessary.
- Serve as a consultant to engineering, infection control, and contractors.
- Assist infection control personnel with the proactive risk assessment.
- Coordinate the facility reciprocal safety agreement with the general contractor.

CONTRACTOR RESPONSIBILITIES

- Coordinate the facility reciprocal safety agreement with the safety department.
- Work with the safety department, infection control, and facility engineering to verify the accuracy of the proactive risk assessment and agreement on the hazard level assessment.
- Complete and distribute the construction infection control permit.
- Conduct safety and infection control education for workers and subcontractors.
- Appoint someone with responsibility for ensuring safety work performance.
- Maintain all equipment used in the project correctly.
- Direct safety or infection control questions to the appropriate departments.
- Submit construction safety reports to the safety department as required.
- Replace HEPA and other filters as necessary.
- Make sure all subcontractors follow established procedures.
- Remove anyone from the site who fails to maintain safety in patient or high-risk areas.

DEPARTMENT OR UNIT MANAGER RESPONSIBILITIES

- Provide a safe environment for the patient and staff.
- Coordinate with safety, infection control, and plant engineering personnel and contractors to ensure isolation of construction activities from patient care activities.
- Report any problems to the safety department or plant engineering.
- Educate workers and care staff about the construction project.

CONSTRUCTION INFECTION CONTROL PERMIT

- Permits are issued when planned construction, renovation, or repair work may impact patient care or identified high-risk areas.
- No work can begin until the site supervisor has a fully completed and coordinated work permit issued by the infection control department.
- The responsible contractor or job supervisor must coordinate the job requirement as indicated in the permit.
- For work in patient care or high-risk areas, the project manager must complete, coordinate, and distribute a construction infection control matrix at least 72 h prior to beginning the job.
- Copies of the completed permit are sent to infection control, safety, and plant engineering personnel.
- The completed construction matrix form is sent to the safety department.

Noninvasive Activities

Work will not begin in an occupied patient room or in clinical areas unless the supervisor or contractor provides an active means to prevent airborne dust from dispersing into atmosphere. Also, it will be necessary to

- Contain dust by closing doors and applying masking tape to the doorframes
- Immediately replace any ceiling tile displaced for visual inspection
- Wipe work surfaces with disinfectant
- Clean up dust from project
- Remove debris in tightly covered containers

High-Risk Activities

Prior to beginning any construction, infection control, safety, and plant engineering personnel should request a meeting with the contractor's on-site management team. The contractor must:

- Display the infection control matrix entrances to work areas during the entire construction period.
- Isolate the HVAC system in areas where work is being done to prevent contamination of duct system.
- Block off all existing ventilation ducts within the construction area (duct capping must be dust tight and able to withstand airflow).
- Maintain negative air pressure within the worksite by utilizing HEPA-equipped air filtration units.
  - HEPA-equipped air filtration machines must provide air flow out of construction areas greater than four air changes per hour.
  - HEPA-equipped air filtration machines must run continuously.
- Complete all critical dust control barriers before construction begins.
- Construction activities causing disturbance of existing dust, or creating new dust, must be conducted in tight enclosures cutting off any flow of particles into patient areas.
- Contain dust by closing door and applying masking tape over doorframe.

When construction, demolition, or reconstruction cannot be contained within a single room:

- Use airtight plastic or drywall barriers that extend from floor to ceiling.
- Seal seams and joints with duct tape to prevent dust and debris from escaping.
- Seal all penetrations to provide an airtight barrier.
- Place barriers at penetrations of ceiling envelopes, chases, and ceiling spaces to stop movement of air and debris.

Construction, demolition, or reconstruction that cannot be contained within a single room must have the following additional barrier measures:

- Anteroom or double entrance openings that allow workers to remove protective clothing or vacuum off existing clothing
- Overlapping flap, minimum 2 ft wide, at polyethylene enclosures for personnel access
- HEPA-equipped air filtration machines

Any ceiling access panels opened for investigation beyond sealed areas must be replaced when they will be unattended. Also,

- Thoroughly clean existing surfaces that become exposed to dust.
- Allow the use of control cubes (heavy-duty, flexible, vinyl, portable, ceiling access modules) for limited ceiling access.
- Be sure construction workers understand the requirements and procedures for dust control.
- Require construction personnel to wear shoe covers in the work area.
- Require construction personnel to remove protective clothing such as coveralls and shoe covers or vacuum off existing clothing in the anteroom area prior to leaving the work area.
- Require the performance of housekeeping and dust control by the individual or group performing the construction.
- Immediately clean any dust tracked outside of the construction barrier.
- Vacuum using a HEPA-filtered vacuum or damp mop with hospital-approved disinfectant.

- Remove debris in tightly covered containers.
- Contain construction waste before transport.
- Keep adhesive mats or carpets located at barricade entrances and in the anteroom clean, and change them daily, or more frequently, as necessary to prevent the accumulation of dust.
- Stop all work on the project whenever a hazardous infection control situation exists.
- Have the contractor or plant engineering personnel take immediate action to correct any deficiencies.
- Do not remove barriers for contained work areas until the completed project is inspected by the safety department and thoroughly cleaned by environmental services.

Removal of construction barriers and ceiling protection may require temporary dust protection to be determined at final project review.

Appendix AA: TB Model Exposure Control Plan

(Practice Name) _____ maintains, reviews, and updates the exposure control plan (ECP) at least annually, and whenever necessary, to reflect new or modified tasks, procedures, and engineering controls that affect occupational exposure. The ECP is also updated to reflect new or revised employee positions with occupational exposure. This facility has had _____ cases of confirmed tuberculosis (TB) in the past 12 months. This facility is located in _____ County, which has reported _____ cases of TB in the last 12-month reporting period. The facility also considers the TB cases in surrounding counties that provide patients to this medical practice: _____.

These counties reported _____cases of TB in the past 12 months.

TB OVERVIEW

Transmission of TB is a recognized risk in healthcare facilities and medical practices and clinics. Transmission is most likely to occur by contact with patients who have unrecognized pulmonary or laryngeal TB and are not on effective anti-TB therapy. Increases in TB in many areas are related to the high risk of TB among immune-compromised persons, particularly those infected with the human immunodeficiency virus (HIV). Healthcare and medical facilities should be alert to the need for preventing TB transmission in settings in which persons with HIV infection receive care or work. TB is a bacterial disease caused by *Mycobacterium tuberculosis*. The bacteria are spread through the air by droplet nuclei when an infected person coughs, speaks, sneezes, sings, or during procedures that cause droplets to be aerosolized. Droplet nuclei are 1–5 μ is size. Air currents can keep the nuclei airborne for long periods of time. Droplet nuclei must be inhaled and reach the alveoli to cause infection.

TB EXPOSURE CONTROL PLAN

This Tuberculosis Exposure Control Plan applies to all areas of this practice where exposure to pulmonary or laryngeal TB may occur. It is intended to prevent transmission of pulmonary *Mycobacterium tuberculosis* (TB) from infected individuals to susceptible hosts. All employees must comply with this plan. TB precautions are not necessary if the patient is on anti-TB medications (and compliant) and has no symptoms such as coughing, night sweats, weight loss, and fever. Person(s) responsible for this plan are listed as follows:

Persons (s) responsible for implementation and evaluation of this plan and annual review of program with revisions as necessary: _____.

Person(s) responsible for employee TB skin testing, interpretation and follow-up procedures, and reporting skin tests results: _____.

Person(s) responsible for limiting employee exposures, ensuring proper education and training of staff, and monitoring staff compliance with this plan: _____.

Persons responsible for properly evaluating suspected and confirmed TB in patients: _____.

EMPLOYER PROVISIONS

The employer will provide proper personal protective equipment, skin testing, education, and training provided at no cost to employees. Employees are responsible for the information contained in this plan and are expected to wear proper respiratory protection when directed and trained by the employer. Prevention of TB exposure will be based on adherence to the recommendations by the Centers for Disease Control and Prevention (CDC) and the Occupational Safety and Health Administration (OSHA). The employer will ensure that employees use provided guidelines for patient assessment and evaluation of TB.

EMPLOYEE EXPOSURE DETERMINATION POTENTIAL

With respect to potential TB exposure, employees and students will be identified and placed into one of the two categories:

Category 1: Job classifications in which employees have occupational exposure to TB, regardless of frequency.

Category 2: Job classifications in which the employees do not have occupational exposure to TB.

Note: The list of job classifications will be located in _____

PATIENT ASSESSMENT FOR DETECTION OF TUBERCULOSIS

The first step in preventing exposure is to identify potentially infectious individuals. Triage of patients will include vigorous efforts to detect patients with active TB promptly and to minimize the time spent in contact with other patients, visitors, and employees and students.

Signs/symptoms

- Persistent cough (greater than 3-week duration)
- Coughing up blood
- Weight loss
- Loss of appetite
- Lethargy/weakness
- Night sweats
- Fever

Medical/social history

- Recent immigrant (especially high risk, e.g., Asia, Africa, or Latin America)
- Known immune-suppressed
- Known previous positive PPD and/or chest x-ray
- Resides in shelter, prison, or long-term care facility
- Known exposure to TB
- Known history of TB, did not complete therapy
- Alcohol or drug use

EXPOSURE INCIDENT REPORTING

All employees must report exposure incidents immediately to responsible person(s). _____ _____ is responsible for investigating, evaluating, and documenting the circumstances surrounding the exposure incident for instituting changes to prevent similar occurrences.

PROCEDURES TO ISOLATE AND MANAGE CARE

Establish procedures to isolate individuals with suspected or confirmed infectious TB. All individuals with suspected or confirmed infectious TB are placed in a room away from other individuals. High-hazard procedures (where TB may be aerosolized) require precautions to prevent/minimize occupational exposure to infectious TB. The following high-hazard procedures are performed at this facility: _____. The policy of this organization is to transfer TB-infected or TB-suspected patients to a treatment or isolation facility. While awaiting transfer, the individual is masked or segregated to protect employees who are without respiratory protection. The organization uses the following procedures and equipment for masking an individual with suspected/confirmed infectious TB and isolating the patient from others until the patient can be transported to an acceptable care or treatment facility _____.

TRANSPORTING OF PATIENTS WITH TUBERCULOSIS

The patient with suspected or confirmed infectious TB will wear a mask (surgical mask) if transported or sent to another department outside of the exam room (e.g., lab, hospital, rehab, and prison).

EMPLOYEE NOTIFICATION OF TB RISKS

The organization uses the local risk assessment to determine the potential for TB exposure. The organizations assess the medical procedures performed at the practice to ensure that all employees with job tasks that offer potential for occupational exposure are informed of the hazard and take proper precautions against exposure to TB.

WARNING SIGNS

Signs are posted at the entrance to rooms or areas used to isolate an individual with suspected or confirmed infectious TB. Signs are also required in areas where procedures or services are being performed on an individual with suspected/confirmed infectious TB. The sign must include a signal word (e.g., STOP, HALT, or NO ADMITTANCE) or biological hazard symbol and a descriptive message (e.g., Respiratory Isolation, No Admittance—Without Wearing a Type N-95 or More Protective Respirator, or See nurses' station before entering this room) [1910.145(f)(4)]—Specifications for Accident Prevention Signs and Tags.

PERSONS RESPONSIBLE FOR TB CONTROLS

Person(s) responsible for identifying and making available respiratory controls (masks for patients and respirators for exposed employees): _____

Person(s) responsible for administrative work practice controls (identification, triage, and isolation) to reduce atmospheric contamination: _____

ENGINEERING CONTROLS

Whenever possible, place a surgical or procedural mask on the patient. If the patient wears a mask, employees need not wear a mask. After placing the patient in an exam room that is away from other individuals, the door will remain closed at all times. Employees will wear respiratory protection (N-95 respirators) at all times while in the room if the patient cannot or will not wear a mask properly and at any time that there is potential for exposure.

WORK PRACTICES

Nonclinical support personnel will be excluded from any contact with known or suspected TB-infected patients. Prompt identification of patients with history or symptoms of TB will be done. Tissues and instructions for the patient to cough and sneeze into tissues and discard in waste container will be provided. The patient will be asked to wear a mask (regular surgical) until he/she is placed in a room with door closed. If the patient cannot wear a mask, employees/students who interview or examine a patient with confirmed or suspected TB will wear a mask (N-95) at all times while in contact with patient or in exam room with patient. Patients with active TB who must come into the clinic will have appointments scheduled to avoid exposing others. Designated times of the day for TB appointments will be observed to avoid interaction with immune-compromised individuals. OSHA and the CDC have defined the following as *high-hazard procedures* when performed on patients with known TB or those who are at high risk of having infectious TB. These procedures are likely to produce bursts of aerosolized infectious particles or to result in copious coughing or sputum production. Other high-risk situations include (1) aerosolized medication treatment (including pentamidine) and (2) diagnostic sputum induction.

RESPIRATORY CONTROLS

Respirators will be provided to exposed employees at no cost. Respirators must be at a minimum a National Institute for Occupational Safety and Health (NIOSH)-approved N-95. Employees will wear a respirator in the following circumstances: (1) when entering the room occupied by a known or suspected infectious TB patient or (2) while performing high-hazard procedures (if any). Employees will be instructed in the correct use and limitations of the N-95 mask in the prevention of exposure to TB. Employees and students are accountable to evaluate the mask for proper fit and condition at each usage. OSHA requirements state that a NIOSH-approved respirator (N-95 is NIOSH approved) is the minimum acceptable level of protection for staff exposed to TB. Respirators are issued and fit tested according to the provisions of OSHA Standard 29 CFR 1910.134. Responsible person(s) for respirator fit testing and program management: _____.

MEDICAL SCREENING OF EMPLOYEES

At the time of hire, employees including those with a history of taking the BCG vaccination will receive a two-step testing tuberculin skin test (PPD) to reduce the likelihood of interpreting a boosted reaction as representing a recent infection. Individuals who have a history of a positive PPD reaction, documentation of completion of preventive therapy, or documentation of adequate therapy for active TB disease will not receive a skin test. Routine chest x-ray is *not* recommended for those who have tested positive in the past or have received treatment for active TB. Chest x-rays should not be used to screen for TB. Chest x-rays may be used to detect active disease but may not detect latent infection that may be treated to prevent active disease. Employees will be tested annually thereafter. Employees/students with a positive history (+PPD or disease) will address the signs and symptoms portion of the PPD Skin Testing Form—Section III. Employees who have positive skin test results will be sent to the health department for further evaluation and treatment. There are no work restrictions for a positive skin test that is not accompanied by symptoms of the disease and/or a positive chest x-ray. Employees with active TB (chest x-ray and symptomatic) will be sent to _____ immediately for further evaluation and treatment. Work restriction is required. The healthcare provider must provide documentation that infection no longer exists before the employee can return to work. The cost of initial and annual testing and follow-up of positive PPDs is the responsibility of the employer.

EXPOSURE FOLLOW-UP PROCEDURES

Employees exposed to a confirmed or suspected source of TB will notify the employer, and the following testing will be done:

- Baseline skin test
- Monitoring of the individual for the development of symptoms of TB
- Follow-up skin test at 12 weeks

Note: If follow-up skin test converts to positive or if symptoms develop, the individual will be referred to _____for follow-up and treatment. The PPD Skin Test Form will be utilized to record results.

EDUCATION AND TRAINING

Contents for initial training will include the basic concepts of TB transmission, pathogenesis, and diagnosis, including the difference between latent TB infection and active disease. Training will also address the signs and symptoms of TB and the possibility of reinfection and/or reactivation in persons with a positive TB skin test. Training must address potential for exposure to persons with infectious TB, including prevalence of TB, and the situations with increased risk of exposure to TB. Employees must be taught about the principles and practices of infection control that reduce the risk of transmission of TB, including the infection control measures and written policies/procedures. Site-specific education will be provided in the areas of controls, purpose of skin testing, the significance of a positive skin testing results, and the importance of participating in the skin test program. Education includes basics of drug therapy for latent or active TB infection, indications, use, and effectiveness. Employees are educated on their responsibility to seek medical evaluation promptly if (1) symptoms develop that may be indicative of TB or (2) if skin test conversion occurs.

ANNUAL TB REQUIREMENTS

- Annual retraining to include new knowledge, incidence statistics, and a forum for questions
- TB skin testing

SKIN TEST ADMINISTRATION

Employees must read and sign appropriate consent forms. Employer will obtain medical history *prior* to testing. History will include signs and symptoms of TB and socioeconomic history. Consider the following:

- Hemoptysis, coughing >3 weeks, night sweats, unintentional weight loss, loss of appetite, malaise, weakness
- Close contact with anyone with active TB
- Nationality (foreign-born persons from areas where TB is endemic)
- Drug use
- Medical conditions that may cause immune-suppressed (AIDS, cancer, prolonged steroid use, etc.)
- Medically underserved (migrant farmworkers, homeless, etc.)
- Members of a high-risk racial group (e.g., Asians, Pacific Islanders, African Americans, Hispanics, and Native Americans)

Appendix BB: Glossary of Terms

A

Abatement—The process of minimizing public health dangers and nuisances, usually supported by regulation or legislation, that is, noise abatement and smoke abatement.
Absorbed dose—The amount of energy deposited by ionizing radiation in a unit mass of tissue.
Absorption–Transformation of radiant energy into a different form of energy by the interaction of matter, depending on the temperature and wavelength or the process by which a liquid penetrates the solid structure of absorbents, fibers, or particles or the process of an agent being taken in by a surface much like a sponge and water.
Access control—A method of restricting the movement of persons into or within a protected area by manual (guards), hardware (locks and keys), or software (electronic card or biometric readers).
Accessible—An ADA term about having the legally required features and/or qualities that ensure entrance, participation, and usability of places, programs, services, and activities by individuals with a wide variety of disabilities.
Accessible emission level—The magnitude of accessible laser or collateral radiation of a specific wavelength or emission duration at a particular point as measured by appropriate methods and devices of the radiation to which human access is possible in accordance with the definitions of the laser's hazard classification.
Accessible emission limit—The maximum accessible emission level permitted within a particular laser class.
Accident type—The description and classification of a mishap.
Acid—A compound either inorganic or organic that (1) reacts with a metal to evolve hydrogen, (2) reacts with a base to form a salt, (3) dissociates in water solution to yield hydrogen ions, (4) has a pH of less than seven, and (5) neutralizes bases or alkaline media by receiving a pair of electrons from the base so that a covalent bond is formed between the acid and the base.
Action level—The amount of a material in air at which certain OSHA regulations to protect employees take effect. Exposure at or above the action level is termed occupational exposure.
Action plan—Documented outline of specific projected activities to be accomplished within a specified period, to meet a defined need.
Active electrode—Electrosurgical accessory that directs current flow to the surgical site, also called a cautery tip.
Activity (radioactivity)—The rate of decay of radioactive material expressed as the number of atoms breaking down per second measured in units called Becquerel's or Curies.
Actual breakthrough time—The average time elapsed between initial contact of the chemical with the outside surface of the fabric and the detection time.
Actuator—A power mechanism used to effect the motion of a robot or a device that converts electrical, hydraulic, or pneumatic energy into robot motion.
Acute effect—An adverse effect on humans or animals, with symptoms developing rapidly and quickly becoming a crisis resulting from a short-term exposure.
Acute radiation exposure—An exposure to radiation that occurred in a matter of minutes rather than in longer or continuing exposure over a period of time.
Acute radiation syndrome—A serious illness caused by receiving a dose of more than 50 Rads of penetrating radiation to the body in a short time (usually minutes). The early symptoms include nausea, fatigue, vomiting, and diarrhea with loss of hair, and swelling of the mouth and throat, followed by general loss of energy.

Adaptation—A change in the structure of an organism that results in its adjustment to its surroundings.
Adequate—Denotes the quality or quantity of a system, process, procedure, or resource that will achieve the relevant incident response objective.
Adsorption—Attachment of the molecules of a gas or liquid to the surface of another substance, normally a solid, or the process by which a liquid adheres to the surface of a material but does not penetrate its fibers.
Advanced life support—Medical procedures performed by emergency medical technicians—paramedics that include the advanced diagnosis and protocol-driven treatment of a patient in the field.
Aerobic—Requiring the presence of air or oxygen to live, grow, and reproduce.
Aerosol—Liquid droplets or solid particles dispersed in air.
Agency—A division of government with a specific function offering a particular kind of assistance or in the emergency incident command system.
Aggressor—Any person seeking to compromise a function or structure.
Air blast—An airborne shock wave resulting from the detonation of explosives.
Air exchange rate—Speed at which outside air replaces air inside a building or the number of times the ventilation system replaces air within a room or built structure.
Airborne radioactive material—Any radioactive material dispersed in the air in the form of dust, fumes, mists, aerosols, vapors, or gases.
Alarm procedure—A means of alerting concerned parties to a disaster. Various optical and audible means of alarm are available, including flags, lights, sirens, radio, and telephone.
Alcohol-based hand sanitizers—A gel or rub that contains alcohol to reduce the number of viable microorganisms on the hands (60%–95% ethanol or isopropanol).
Alkali—A term normally used to refer to hydroxides and carbonates of the metals of group 1a of the periodic table or ammonium hydroxide.
All hazards—Emergency management term referring to a natural or man-made event that would require actions to protect life, property, environment, public health, safety, and/or minimize disruptions to government, social, or economic activities.
Allergen—A substance or particle that causes an allergic reaction.
Alloy—A mixture or solution of metals, either solid or liquid, which may or may not include a nonmetal.
Alpha particle—Positively charged particle emitted by certain radioactive materials. It is identical to the nucleus of the helium atom and is the least penetrating form of radiation.
Alternate site burn—A patient burn resulting from electricity exiting the body by unintended means.
Ambient air—Outside or surrounding air.
Americium (am)—A silvery metal that is a man-made element whose isotopes am-237 through am-246 are all radioactive; trace quantities of americium are widely used in smoke detectors and as neutron sources in neutron moisture gauges.
Analysis approach—Selecting one of two primary approaches for the FEMA, one is the hardware approach that lists individual hardware items and analyzes their possible failure modes and the second is the functional approach that recognizes that every item is designed to perform a number of outputs within a system.
Andon cord policy—Empowerment of healthcare personnel to act to ensure safety regardless of hierarchy and without risk or retaliation.
Anemometer—A rotating vane, swinging vane, or hot-wire device used to measure air velocity.
Anhydrous—A substance in which no water is present in the form of a hydrate or water of crystallization.
Anion—A negatively charged ion.
Annual summary—The occupational injury and illness totals for the year as reflected by OSHA Form 300 Log entries.

Annual survey—Survey conducted each year by the Bureau of Labor Statistics to produce national data on occupational injury and illness rates in various industries.
Anode—The positive electrode in an electrolytic cell.
Anosmia—Reduced sensitivity to odor detection.
Antidote—An agent that neutralizes or counteracts the effects of a poison.
Antimicrobial—Any agent that destroys microbial organisms.
Antiseptics—Substances applied to skin to reduce microbial flora such as alcohols, chlorine, iodine, etc.
Antiterrorism—Preventative in nature, it entails using passive and defensive measures such as education, foreign liaison training, surveillance, and countersurveillance, which is designed to deter terrorist activities.
Aperture—An opening through which radiation can pass.
Application program—The set of instructions that defines the specific intended tasks of robots and robot systems.
Approved—A method, procedure, equipment, or tool that has been determined to be satisfactory for a particular purpose.
Aqueous—A solution or suspension in which the solvent is water.
Area command—An organization established to oversee the management of multiple incidents that are each being handled by separate incident command systems or organizations; an area command is activated only if necessary, depending on the complexity of the incident and incident management span-of-control considerations.
Argon—A gas used as a laser medium that emits blue-green light.
Aromatic—Term applied to a group of hydrocarbons characterized by the presence of the benzene nucleus, a major series of unsaturated cyclic hydrocarbons whose carbon atoms are arranged in closed rings.
Asbestos—Fibrous magnesium silicate.
Asphyxiant—A chemical gas or vapor that can cause unconsciousness or death by suffocation.
Assessment—The evaluation and interpretation of measurements and other information to provide a basis for decision making.
Assigned protection factor—A rating assigned to a respirator style by OSHA or NIOSH; this rating indicates the level of protection most workers can expect from the properly worn, maintained, and fitted respirator used under actual workplace conditions.
Assignment—A task given to a resource to perform within a given operational period that is based on operational objectives defined in the incident action plan.
Atmosphere supplying respirator—Any respirator that provides clean air from an uncontaminated source to the face piece; examples include supplied-air (airline) respirators, self-contained breathing apparatus (SCBA), and combination supplied air/SCBA devices.
Atom—The smallest particle of an element that can enter into a chemical reaction.
Atomic mass number—The total number of protons and neutrons in the nucleus of an atom.
Atomic mass unit—One unit is equal to 1/12th of the mass of a carbon-12 atom.
Atomic weight—The mass of an atom, expressed in atomic mass units.
Atropine—An anticholinergic used as an antidote for nerve agents to counteract excessive amounts of acetylcholine.
Attended continuous operation—The time when robots are performing (production) tasks at a speed no greater than slow speed through attended program execution.
Attended program verification—The time when a person within the restricted envelope (space) verifies the robot's programmed tasks at programmed speed.
Attenuated vaccine—A vaccine that has been weakened but is still required to be controlled as infectious by some regulatory programs.
Attenuation—The decrease in energy (or power) as a beam passes through an absorbing or scattering medium.

Authority gradient—An unwillingness to be truthful to those in power or authority.
Autoclave—Device used to sterilize medical instruments and equipment by using steam under pressure.
Auto-ignition point—The lowest temperature at which a material will catch fire without the aid of a flame or spark.
Auto-ignition temperatures—Temperature at which a material will self-ignite and maintain combustion without a fire source.
Automatic contour—A feature of a bed where the thigh section of the sleep surface articulates upward as the head section travels upward thereby reducing the likelihood of patient/resident mattress from migrating toward the foot end of the bed.
Automatic conveyor and shuttle systems—Devices comprised of various types of conveying systems linked together with various shuttle mechanisms for the prime purpose of conveying materials or parts to prepositioned and predetermined locations automatically.
Automatic guided vehicle system—Advanced material-handling or conveying systems that involve a driverless vehicle that follows a guide-path.
Automatic mode—Robot state in which automatic operation can be initiated.
Automatic operation—Time during which robots are performing programmed tasks through unattended program execution.
Automatic sprinklers—System built in or added to a structure that automatically delivers water in case of fire.
Automatic storage and retrieval systems—Storage racks linked through automatically controlled conveyors and an automatic storage and retrieval machine or machines that ride on floor-mounted guide rails and power-driven wheels.
Awareness barrier—Physical and/or visual means that warn a person of an approaching or present hazard.
Awareness signal—A device that warns a person of an approaching or present hazard by means of audible sound or visible light.
Axis—The line about which a rotating body, such as a tool, turns.

B

Background radiation—The radiation in man's natural environment, including cosmic rays and radiation from naturally occurring radioactive elements.
Badging—Process of providing outside personnel with identification that gives them access to the designated facilities of the organization requesting assistance.
Ballistic protection—Techniques for the protection of personnel (and material) against projectiles of all kinds, such as protective blankets for vehicles or protective gear (jackets, helmets, trousers, etc).
Barricade—An intervening barrier (natural or artificial) of such type, size, and construction as to limit the effects of low-angle high-velocity fragments.
Barrier—A physical means of separating persons from the restricted envelope or space.
Base—Substance that (1) liberates hydroxyl ions when dissolved in water; (2) that liberates negative ions of various kinds in any solvent; (3) that receives a hydrogen ion from a strong acid to form a weaker acid; (4) that gives up two electrons an acid, forming a covalent bond with the acid.
Basic human needs—Physical, safety, social, self-esteem, and self-actualization.
Basic life support—Noninvasive first aid procedures and techniques utilized by most all trained medical personnel, including first responder, to stabilize critically sick and injured people.
Beam—A collection of rays that may be parallel, convergent, or divergent.
Beam diameter—The distance between diametrically opposed points in the cross section of a circular.
Becquerel—The amount of a radioactive material that will undergo one decay (disintegration) per second.

Bed alarms—Any alarm intended to notify caregivers of either an unwanted patient/resident egress or that the patient/resident is near the edge of the mattress.
Bed rail extender—Detachable device intended to bridge the space between the head and foot bed rail.
Bed rails—Adjustable metal or rigid plastic bars that attach to the bed. Synonymous terms are side rails, bed side rails, and safety rails.
Beta particle—A particle emitted from a nucleus during radioactive decay, which can be stopped by a sheet of metal or acrylic plastic depending on the emitted energy level of a particular isotope.
Bioassay—An assessment of radioactive materials that may be present inside a person's body through analysis of the person' blood, urine, feces, or sweat.
Biocide—A substance that can kill living organisms.
Biodegradable—A substance with the ability to decompose or break down into natural components.
Biological half-life—The time required for one half of the amount of a substance, such as a radionuclide, to be expelled from the body by natural metabolic processes, not counting radioactive decay, once it has been taken in through inhalation, ingestion, or absorption.
Biological threat—A threat that consists of biological material planned to be deployed to produce casualties in personnel or animals or damage plants.
Bioremediation—The management of microorganisms.
Bipolar—Forceps-shaped active electrode; current flows through the tissue from one tip to the other.
Black list—A counterintelligence agency listing of actual or potential hostile collaborators, sympathizers, or other persons viewed as threatening to friendly military forces.
Blameless reporting—Accountable with emphasis on learning not blame.
Blast—The brief and rapid movement of air, vapor, or fluid away from a center of outward pressure, as in an explosion or in the combustion of rocket fuel; the pressure accompanying this movement.
Blast containment—Containing an explosive force so the blast wave and fragmentation materials are contained within a border made by barriers, walls, revetments, or other materials or objects.
Blast effect—Destruction of or damage to personnel, vehicles, or structures from an explosive force by a weapon designed to explode on contact with or above the ground.
Blast mitigation—Various physical measures that can be used to lessen the damage of a blast wave on critical assets. These measures include, but are not limited to, blast walls, blast barriers, standoff distance, and structural hardening.
Blast wave—A sharply defined wave of increased pressure rapidly propagated through a surrounding medium from a center of detonation or similar disturbance. A sharp jump in pressure is known as a shock wave, and a slow rise is known as a compression wave.
Blister agent—A chemical warfare agent that produces local irritation and damage to the skin and mucous membranes, pain and injury to the eyes, reddening and blistering of the skin, and when inhaled, damage to the respiratory tract.
Block diagrams—Diagrams that illustrate the operation, interrelationships, and interdependencies of the functions of a system that are required to show the sequence and the series dependence or independence of functions and operations; block diagrams may be constructed in conjunction with, or after defining, the system and shall present the system breakdown of its major functions.
Blood agent—A chemical warfare agent that is inhaled and absorbed into the blood. The blood (cyanogens) carries the agent to all body tissues where it interferes with the tissue oxygenation process.
Bloodborne pathogens—Pathogenic microorganisms that are present in human blood and can cause disease in humans; these pathogens include, but are not limited to, hepatitis b virus and human immunodeficiency virus.
Bloodborne pathogens engineering controls—Sharps disposal containers, self-sheathing needles, safer medical devices, such as sharps with engineered sharps injury protections and needleless systems that isolate or remove the bloodborne pathogens hazard from the workplace.

Bloodborne pathogens exposure incident—Means a specific eye, mouth, other mucous membrane, no intact skin, or parenteral contact with blood or other potentially infectious materials that result from the performance of an employee's duties.
Boiling point—The temperature at which a liquid changes to a vapor as expressed in degrees F at sea-level pressure.
Bollard—Any object used to confine traffic within or from a given area. They are vertical members made of wood, steel, or concrete that are permanently placed.
Bolt ring—Closing device used to secure a cover to the body of an open head drum; this ring requires a bolt and nut to secure the closure.
Bonding—The interconnection of two objects such as a tank or cylinder with clamps and wire as a safety practice to equalize the electrical potential between the objects and help prevent static sparks that could ignite flammable materials, dispensing/receiving a flammable liquid that requires dissipating the static charge by bonding between containers.
Boundaries of excediency—These are margins of safety when errors become known and signals the need to reassess, slow down, or ask for help.
Branch—Organizational level having functional or geographic responsibility for major aspects of incident operations, organizationally situated between the section chief and the division or group in the operations section.
Breakthrough time—The time from initial chemical contact to detection.
Buffer—An acid–base balancing or control reaction in which the pH of a solution is protected from major change when acids or bases are added to it.
Building-related illness—Diagnosable illnesses with identifiable symptoms that can be attributed to building contaminants.
Bung—A threaded closure located in the head or body of a drum.
Bunker—A fortified structure, but primarily a buried or semiburied structure, offering a high degree of protection to personnel, defended gun positions, or a defensive position, from enemy attack.
Bureaucratic organization—Line organization with an established hierarchy.
Burn back—The distance a flame will travel from the ignition source back to the aerosol container.

C

Cache—A predetermined complement of tools, equipment, and/or supplies stored in a designated location, available for incident use.
Canister or cartridge—A container with a filter, sorbent, or catalyst, or a combination of these items, that removes specific contaminants from the air passed through the container.
Carbon dioxide—A heavy, colorless, nonflammable, relatively nontoxic gas produced by the combustion and decomposition of organic substances and as a by-product of many chemical processes.
Carbon monoxide—A colorless, odorless, toxic gas generated by the combustion of common fuels in the presence of insufficient air or where combustion is incomplete.
Carbonate—A compound formed by the reaction of carbonic acid with either a metal or an organic compound.
Carcinogen—Any substance that has been found to induce the formation of cancerous tissue in experimental animals.
Carpal tunnel syndrome—A common affliction caused by the compression of the median nerve in the carpal tunnel, often associated with tingling, pain, or numbness in the thumb and first three fingers.
CAS—Chemical abstracts service.
CAS number—A number assigned to identify a chemical substance. Chemical abstracts service indexes information that appears in chemical abstracts, published by the American chemical society.

Catalyst—An element or compound that accelerates the rate of a chemical reaction but is neither changed nor consumed by it.
Catastrophic incident—Any natural or man-made incident, including terrorism that results in extraordinary levels of mass casualties, damage, or disruption severely affecting the population, infrastructure, environment, economy, national morale, and/or government functions.
Catastrophic loss—A loss of huge and extraordinary proportion.
Cathode—The negative electrode of an electrolytic cell.
Causation—Factors that come together and result in adverse events.
Caustic material—That which is able to burn, corrode, dissolve, or eat away another substance.
Caustic substances—Strong alkalis their solutions being corrosive to the skin and other tissues.
CBRN—Chemical, biological, radiological, or nuclear agent or substance.
Ceiling concentration—Maximum concentration of a toxic substance allowed at any time or during a specific sampling period.
Ceiling limit—Normally expressed as threshold limit value (TLV) and permissible exposure limit (PEL), ceiling limit is the maximum allowable concentration to which an employee may be exposed in a given time period.
Ceiling maximum—Allowable exposure limit not to be exceeded for an airborne substance.
Ceiling value—Concentration that should not be exceeded during the working exposure, and exposure should at no time exceed the ceiling value.
Cell—The smallest unit within a guerrilla or terrorist group. A cell generally consists of two to five people dedicated to a terrorist cause. The formation of cells is born of the concept that an apparent *leaderless resistance* makes it hard for counterterrorists to penetrate.
CFC—Chlorofluorocarbons, being phased out worldwide because of their detrimental effect on the ozone layer.
CFM—Cubic feet per minute, a unit measuring air flow when evacuating ventilation systems.
Chain of command—A series of command, control, executive, or management positions in hierarchical order of authority.
Chain reaction—A process that initiates its own repetition; in a fission chain reaction, a fissile nucleus absorbs a neutron and fissions spontaneously releasing additional neutrons.
Characteristic waste—Hazardous waste that exhibits one of four characteristics: ignitability, reactivity, toxicity, or corrosivity.
Chemical agent—Any chemical substance that is intended for use in military operations to kill, seriously injure, or incapacitate humans because of its physiological effects.
Chemical contamination—The presence of a chemical agent on a person, object, or area.
Chemical disinfection—Use of formulated chemical solutions to treat and decontaminate infectious waste.
Chemical family—A group of compounds with related chemical and physical properties.
Chemical hygiene plan—A written plan that addresses job procedures, work equipment, protective clothing, and training necessary to protect employees from chemical and toxic hazards, required by OSHA under its laboratory standard.
Chemical name—Scientific designation of a chemical substance.
Chemical Transportation Emergency Center—An organization that provides immediate information for members on what to do in case of spills, leaks, fires, or exposures.
Chemical warfare agent—A chemical substance, which, because of its physiological, psychological, or pharmacological effects, is intended for use in military operations to kill, seriously injure, or incapacitate humans (or animals) through its toxicological effects.
Chemotherapy—Development and use of chemical compounds that are specific for the treatment of diseases.
Chief—The incident command system title for individuals responsible for management of functional sections: operations, planning, logistics, finance/administration, and intelligence/investigations, if established as a separate section.

Chlorinated solvent—Organic solvent that contains chlorine atoms.
Choking agents—Agents that exert their effects solely on the lungs and result in the irritation of the alveoli of the lungs.
Chronic effect—Adverse effect on animals or humans in which symptoms develop slowly over a long period of time or recurs frequently.
Chronic exposure—Exposure to a substance over a long period of time, possibly resulting in adverse health effects.
Citizen Corps—A community-level program, administered by the Department of Homeland Security, that brings government and private-sector groups together and coordinates the emergency preparedness and response activities of community members. Through its network of community, state, and tribal councils, Citizen Corps increases community preparedness and response capabilities through public education, outreach, training, and volunteer service.
Civil support—DOD support to US civil authorities for domestic emergencies and for designated law enforcement and other activities.
Class A fire—That which involves wood, paper, cloth, trash, or other ordinary materials.
Class B fire—That which involves grease, paint, or other flammable liquids.
Class C fire—That which involves live electrical or energized equipment.
Class D fire—That which involves flammable metals.
Class K fire—That which involves kitchen oils used for frying.
Clean air act—Public Law Pl 91-604, the EPA sets national ambient air quality standards and enforcement/discharge permits are carried out by the states under implementation plans.
Clear zone—An area that is clear of visual obstructions and landscape materials that could conceal a threat or perpetrator.
Clinical laboratory—Workplace where diagnostic or other screening procedures are performed on blood or other potentially infectious materials.
Clinicians—Physicians, nurses, nurse practitioners, physicians' assistants, and others.
Cobalt (co)—Gray, hard, magnetic, and somewhat malleable metal, cobalt is relatively rare and generally obtained as a by-product of other metals, such as copper; most common radioisotope is cobalt-60 used in radiography and medical applications.
Cold zone—The support zone is the area outside the warm zone where there is no contamination present.
Collateral damage—Unintended damages, beyond the destruction of the enemy forces or installations specifically targeted, to surrounding human and nonhuman resources, either military or nonmilitary, caused by the spillover of weapons effect, as opposed to the damage caused by aiming errors.
Collective dose—The estimated dose for an area or region multiplied by the estimated population in that area or region.
Colorimetry—An analytical method by which the amount of a compound in solution can be determined by measuring the strength of its color by either visual or photometric methods.
Combustible—Term used to classify certain liquids that will burn on the basis of flash point; NFPA and DOT classify combustible liquids as having a flash point of 100°F (38°C) or higher.
Combustible liquids—OSHA defines combustible liquids as any liquid having a flash point at or above 100°F (38°C) but below 200°F (93.3°C).
Command—The act of directing, ordering, or controlling by virtue of explicit statutory, regulatory, or delegated authority.
Command staff—An incident command component that consists of the following functions: public information officer, safety officer, liaison officer, and other positions as required, which report directly to the incident commander.
Committed dose—A dose that accounts for continuing exposures expected to be received over a long period of time from radioactive materials that were deposited inside the body.

Common operating picture—A continuously updated overview of an incident compiled throughout an incident's life cycle from data shared between integrated systems for communication, information management, and intelligence and information sharing. The common operating picture allows incident managers at all levels to make effective, consistent, and timely decisions. The common operating picture also helps ensure consistency at all levels of incident management across jurisdictions, as well as between various governmental jurisdictions and private sector and nongovernmental entities that are engaged.
Common operating picture—An overview of an incident by all relevant parties that provides incident information enabling the incident commander/unified command and any supporting agencies and organizations to make effective, consistent, and timely decisions.
Communications/Dispatch Center—An agency or interagency dispatch center, 911 call centers, emergency control or command dispatch centers, or any naming convention given to the facility and staff that handles emergency calls from the public and communication with emergency management/response personnel.
Complexity—The characteristic of healthcare that requires vigilance.
Compliance safety and health officer—An OSHA representative whose primary job is to conduct workplace inspections.
Comprehensive Preparedness Guide 101—Producing Emergency Plans: A Guide for All-Hazard Emergency Operations Planning for State, Territorial, Local, and Tribal Governments—Guide that describes the intersection of the federal and state, tribal and local plans and planning.
Concentration—The ratio of the amount of a specific substance in a given volume or mass of solution to the mass or volume of solvent.
Concept Plan (CONPLAN)—A plan that describes the concept of operations for integrating and synchronizing federal capabilities to accomplish critical tasks and describes how federal capabilities will be integrated into and support regional, state, and local plans to meet the objectives described in the strategic plan.
Conductivity—The property of a circuit that permits the flow of an electrical current.
Confirmation bias—People when uncertain will tend to agree with authority.
Consensus standards—A variety of standards developed according to a consensus of agreement among several organizations, stakeholders, or individuals.
Consequence management—Measures taken to protect public health and safety, restore essential government services, and provide emergency relief to governments, businesses, and individuals affected by the consequences of a chemical, biological, nuclear, and/or high-yield explosive situation.
Contaminated—The presence or the reasonably anticipated presence of blood or other potentially infectious materials on an item or surface.
Contaminated laundry—Means laundry that has been soiled with blood or other potentially infectious materials or may contain sharps.
Contaminated sharps—Any contaminated object that can penetrate the skin including, but not limited to, needles, scalpels, broken glass, broken capillary tubes, and exposed ends of dental wires.
Contamination (radioactive)—The deposit of unwanted radioactive material on the surfaces of structures, areas, objects, or people where it may be external or internal.
Contingency plan—An emergency plan developed in expectation of a disaster. Contingency plans are often based on risk assessments, the availability of human and material resources, community preparedness, and local and international response capabilities.
Control bed rail—A bed rail that incorporates bed function controls for patient/staff activation.
Control device—Any control hardware providing a means for human intervention in the control of a robot or robot system, such as an emergency-stop button, a start button, or a selector switch.
Controlling—Measuring performance of work by monitoring outcomes.

Controls program—The inherent set of control instructions that defines the capabilities, actions, and responses of the robot system not intended to be modified by the user or operator.
Coordinate—To systematically advance an analysis and exchange of information among principals who have or may have a need to know certain information to carry out specific incident management responsibilities.
Coordinated straight-line motion—Control wherein the axes of the robot arrive at their respective end points simultaneously, giving a smooth appearance to the motion.
Corrective actions—Implementation of procedures that are based on lessons learned from actual incidents or during realistic exercises.
Corrosive—Substance that causes visible destruction or permanent change in human skin tissue at the site of contact.
Cost benefit analysis—Evaluation of a situation that focuses on the comparing expenditures with potential benefits but not necessarily a dollar for dollar comparison.
Counter-Terrorism Security Group—An interagency body convened on a regular basis to develop terrorism prevention policy and to coordinate threat response and law enforcement investigations associated with terrorism. This group evaluates various policy issues of interagency importance regarding counterterrorism and makes recommendations to senior levels of the policymaking structure for decision.
Credentialing—Authentication and verification of the certification and identity of designated incident managers and emergency responders.
Crisis management—Measures to identify, acquire, and plan to use the resources available to anticipate, prevent, and resolve a threat or act.
Criteria standard—A standard against which performance can be measured.
Critical infrastructure—Systems, assets, and networks, whether physical or virtual, so vital to the United States that the incapacity or destruction of such systems and assets would have a debilitating impact on security, national economic security, national public health or safety, or any combination.
Critical mass—The minimum amount of fissile material that can achieve a self-sustaining nuclear chain reaction.
Criticality—A relative measure of the consequences of a failure mode and its frequency of occurrence.
Criticality (nuclear)—A fission process where the neutron production rate equals the neutron loss rate to absorption or leakage.
Criticality analysis—A procedure by which each potential failure mode is ranked according to the combined influence of severity and probability of occurrence.
Cubic feet per minute—Measure of the volume of a substance flowing through air within a specified time period and used to measure air exchanged in ventilation systems.
Culture of trust—A culture where workers have a voice and choice in organizational matters.
Cumulative dose—The total dose resulting from repeated or continuous exposures of the same portion of the body, or of the whole body, to ionizing radiation.
Curie (ci)—Traditional measure of radioactivity based on the observed decay rate of 1 g of radium.
Cutaneous radiation syndrome—Effects can be reddening and swelling of the exposed area creating blisters, ulcers on the skin, hair loss, and severe pain.

D

Damage assessment—The process used to appraise or determine the number of injuries and deaths, damage to public and private property, and the status of key facilities and services such as hospitals and other healthcare facilities, fire and police stations, communication networks, water and sanitation systems, utilities, and transportation networks resulting from a man-made or natural disaster.
Damper—Control that varies airflow through an air inlet, outlet, or duct.

De Quervain's disease—The tendon sheath of both the long and short abductor muscles of the thumb narrows.
Dead zone—Zone that lies outside the sensing capability of sensors within a protected area; a dead zone may result from defective or improperly adjusted sensors or from interference, such as blocking objects or structures.
Decay (radioactive)—Disintegration of the nucleus of an unstable atom by the release of radiation.
Decay products—Isotopes or elements formed and the particles and high-energy electromagnetic radiation emitted by the nuclei of radionuclide during radioactive decay.
Decibel—A unit to express the relative intensity of a sound on a scale from 0 to 130 (average pain level); sound doubles every 10 dB.
Decomposition—Breakdown of a chemical or substance into different parts or simpler compounds that can occur due to heat, chemical reaction, or decay.
Decontamination—The process of neutralizing or removing contaminants that have accumulated on personnel, clothing, and equipment.
Defatting—Removal of natural oils from the skin by the use of a fat-dissolving solvent.
Defense layer —Building design or exterior perimeter barriers intended to delay attempted forced entry.
Demand respirator—An atmosphere supplying respirator that admits breathing air to the face piece only when a negative pressure is created inside the face piece by inhalation.
Denaturant—A substance added to ethyl alcohol to prevent it from being used for internal consumption.
Denier—A term used in the textile industry to designate the weight per unit length of a filament.
Density—The ratio of weight (mass) to volume of any substance, usually expressed as grams per cubic centimeter.
Density mass—Substance of mass per unit volume usually compared to water, which has a density of 1.
Department of Homeland Security—A new cabinet level department charged with strengthening the security and protecting the assets of the United States and its territories. The primary mission of this agency, which consolidates a large number of other governmental entities under the leadership of one director, includes (1) preventing terrorist attacks within the United States, (2) reducing America's vulnerability to terrorism, and (3) minimizing the damage and recovery from attacks that do occur.
Department Operating Center—An emergency operations center specific to a single department or agency.
Deposition density—The activity of a radionuclide per unit area of ground.
Dermatitis—Inflammation of the skin caused by defatting of the dermis.
Desiccant chemical—A substance that absorbs moisture.
Desorption —The reverse process of absorption. The agent will be *removed* from the surface (off-gassing or outgassing).
Detection mechanism—The means or methods by which a failure can be discovered by an operator under normal system operation or can be discovered by the maintenance crew by some diagnostic action.
Deterministic effects—Effects that can be related directly to the radiation dose received with severity increasing as the dose increases.
Detonation—A release of energy caused by the extremely rapid chemical reaction of a substance in which the reaction front advances into the unreacted substance at equal to or greater than sonic velocity. An explosive reaction that consists of the propagation of a shock wave through the explosive accompanied by a chemical reaction that furnishes energy to sustain the shock propagation in a stable manner, with gaseous formation and pressure expansion following shortly thereafter.
Deuterium—A nonradioactive isotope of the hydrogen atom that contains a neutron in its nucleus in addition to the one proton normally seen in hydrogen.

Device—Any control hardware such as an emergency-stop button, selector switch, control pendant, relay, solenoid valve, or sensor.
DFM—This abbreviation refers to a respirator filter cartridge suitable for use against dusts, fumes, or mist and is used in the new NIOSH regulation on respirator certification.
DHS—DHS is responsible for homeland security coordination with other executive branch agencies, state and local governments, and the private sector.
Dielectric material—An electrical insulator or in which an electric field can be sustained with a minimum dissipation of power.
Directing—Providing the necessary guidance to others during job accomplishment.
Dirty bomb—A device designed to spread radioactive material by conventional explosives when the bomb detonates.
Disaster—Any natural catastrophe including any hurricane, tornado, storm, high water, wind-driven water, tidal wave, tsunami, earthquake, volcanic eruption, landslide, mudslide, snowstorm, and drought or, regardless of cause, any fire, flood, or explosion.
Disaster Recovery Center (DRC)—A facility established in a centralized location within or near the disaster area at which disaster victims (individuals, families, or businesses) apply for disaster aid.
Disinfectant—An agent with the ability to kill at least 95% of targeted microorganisms.
Division—The partition of an incident into geographical areas of operation. Divisions are established when the number of resources exceeds the manageable span of control of the operations chief. A division is located within the incident command system organization between the branch and resources in the operations section.
Doff—To take off or remove (e.g., PPE).
Domestic terrorism —The unlawful use, or threatened use, of force or violence by a group or individual based and operating entirely within the United States or Puerto Rico without foreign direction committed against persons or property to intimidate or coerce a government, the civilian population, or any segment thereof in furtherance of political or social objectives.
Don—To put on, in order to wear (e.g., PPE).
Dose (radiation)—Radiation absorbed by person's body.
Dose coefficient—The factor used to convert radionuclide intake to dose.
Dose equivalent—A quantity used in radiation protection to place all radiation on a common scale for calculating tissue damage.
Dose quantity—Radiation absorbed per unit of mass by the body or by any portion of the body.
Dose rate—The radiation dose delivered per unit of time.
Dose reconstruction—A scientific study that estimates doses to people from releases of radioactivity or other pollutants.
Dose response—Relationship between the amount of a toxic or hazardous substance and the extent of illness or injury produced in humans.
Dosimeter—Small portable instrument (such as a film badge, thermo luminescent dosimeter, or pocket dosimeter) for measuring and recording the total accumulated dose of ionizing radiation a person receives.
Dosimetry—Assessment (by measurement or calculation) of radiation dose.
Drive powers—The energy source or sources for the robot actuators.
Drop test—A test required by DOT regulations for the determination of the quality of a container or finished product.
Dry bulb temperature—Temperature of air measured with a dry bulb thermometer in a psychomotor to measure relative humidity.
Dry pipe—Piping under pressure, and when head opens, air is released and water flows into the system.
Dusts—Solid particles generated by handling, crushing, grinding, rapid impact, detonation, and decrepitating of organic or inorganic materials such as rock, ore, metal, coal, wood, and grain.

E

Ecoterrorism—Sabotage intended to hinder activities that are considered damaging to the environment.
Effective dose—A dosimetry quantity useful for comparing the overall health effects of irradiation of the whole body; effective dose is used to compare the overall health detriments of different radio nuclides in a given mix.
Effective half-life—The time required for the amount of a radionuclide deposited in a living organism to be diminished by 50% as a result of the combined action of radioactive decay and biologic elimination.
Effective standoff distance—A standoff distance at which the required level of protection can be shown to be achieved through analysis or can be achieved through building hardening or other mitigating construction or retrofit.
Elastomer—A term used to describe any high polymer having the essential properties of vulcanized natural rubber.
Electrochemistry—Chemistry concerned with the relationship between electrical forces and chemical reactions.
Electrode—A material used in an electrolytic cell to enable the current to enter or leave the solution.
Electrolysis—Decomposition of a chemical compound by means of an electric current.
Electron—A particle of negative electricity, electrons surround the nucleus of an atom because of the attraction between their negative charge and the positive charge of the nucleus.
Electron volt—Unit of energy equivalent to the amount of energy gained by an electron when it passes from a point of low potential to a point 1 V higher in potential.
Electrosurgery—Radiofrequency energy to produce cutting and coagulation in body tissues.
Electrosurgical unit—A device that produces radiofrequency energy for electrosurgery procedures.
Element—All isotopes of an atom that contain the same number of protons or in a nuclear, the fuel element is a metal rod containing the fissile material.
Embedded laser—A laser with an assigned class number higher than the inherent capability of the laser system in which it is incorporated.
Emergency—Any incident, whether natural or man-made, that requires responsive action to protect life or property. Under the Robert T. Stafford Disaster Relief and Emergency Assistance Act, an emergency means any occasion or instance for which, in the determination of the president, federal assistance is needed to supplement state and local efforts and capabilities to save lives and to protect property and public health and safety, or to lessen or avert the threat of a catastrophe in any part of the United States.
Emergency management —The efforts of the state and the political subdivisions to develop, plan, analyze, conduct, provide, implement, and maintain programs for disaster mitigation, preparedness, response, and recovery.
Emergency management assistance compact—A congressionally ratified organization that provides form and structure to interstate mutual aid during emergency event response.
Emergency management committee—A preparedness entity established by an organization that has the responsibility for emergency management program oversight within the organization.
Emergency management program—A program that implements the organization's mission, vision, management framework, and strategic goals and objectives related to emergencies and disasters.
Emergency manager—The person who has the day-to-day responsibility for emergency management programs and activities. The role is one of coordinating all aspects of a jurisdiction's mitigation, preparedness, response, and recovery capabilities.
Emergency medical services (EMS)—Services, including personnel, facilities, and equipment required to ensure proper medical care for the sick and injured from the time of injury to the time of final disposition, including medical disposition within a hospital, temporary medical

facility, or special care facility, release from site, or declared dead. Further, emergency medical services specifically include those services immediately required to ensure proper medical care and specialized treatment for patients in a hospital and coordination of related hospital services.

Emergency Operations Center (EOC)—The physical location at which the coordination of information and resources to support incident management (on-scene operations) activities normally takes place. An EOC may be a temporary facility or may be located in a more central or permanently established facility, perhaps at a higher level of organization within a jurisdiction. EOCs may be organized by major functional disciplines (e.g., fire, law enforcement, and medical services), by jurisdiction (e.g., federal, state, regional, tribal, city, and county), or some combination thereof.

Emergency operations plan—An ongoing plan maintained by various jurisdictional levels for responding to a wide variety of potential hazards, disasters, or emergency events.

Emergency Public Information—Information that is disseminated primarily in anticipation of an emergency or during an emergency that provides guidance or requires actions. In addition to providing situational information to the public, it also frequently provides directive actions required to be taken by the general public.

Emergency Response Guide—A document that provides guidance on emergency response in a transportation incident involving a particular chemical.

Emergency response team (ERT)—An interagency team, consisting of the lead representative from each federal department or agency assigned primary responsibility for an emergency response function and key members of the federal coordinating officer's (FCO) staff, formed to assist the FCO in carrying out his/her coordination responsibilities. The emergency response team may be expanded by the FCO to include designated representatives of other federal departments and agencies as needed. The ERT usually consists of regional-level staff.

Emergency situation—Any occurrence including equipment failure, rupture of containers, or failure of control equipment that results in an uncontrolled substantial release of a contaminant.

Emergency stop—The operation of a circuit using hardware-based components that overrides all other robotic controls.

Emergency support function—Refers to a group of capabilities of federal departments and agencies to provide the support, resources, program implementation, and services that are most likely to be needed to save lives, protect property, restore essential services and critical infrastructure, and help victims return to normal following a national incident.

Employee exposure—An exposure to a concentration of an airborne contaminant that would occur if the employee were not using respiratory protection.

Emulsion—A permanent suspension or dispersion, usually of oil particles in water.

Emulsion—Stable mixture of two or more liquids held in suspension by small percentages of substances called emulsifiers.

Enabling device—A manually operated device that permits motion when continuously activated; releasing the device stops robot motion and motion of associated equipment that may present a hazard.

Enclave—A secured area within another secured area.

Enclosed laser device—Any laser or laser system located within an enclosure that does not permit hazardous optical radiation emission from the enclosure.

End-effector—An accessory device or tool specifically designed for attachment to the robot wrist or tool mounting plate to enable the robot to perform its intended task.

End-of-service-life indicator—A system that warns the respirator user of the approach of the end of adequate respiratory protection.

Endothermic—A term used to characterize a chemical reaction that requires absorption of heat from an external source.

Energy sources—Any electrical, mechanical, hydraulic, pneumatic, chemical, thermal, or other sources.

Engineering controls—The preferred method of controlling employee exposures in the workplace.

Enriched uranium—Any uranium in which the proportion of the isotope uranium-235 has been increased by removing uranium-238 mechanically.
Entrapment—An event in which a patient is caught, trapped, or entangled in the spaces in or about the bed rail, mattress, or hospital bed frame.
Envelope—Space or maximum the volume of space encompassing the maximum designed movements of all robot parts including the end-effector, work piece, and attachments.
Enzyme complex—Protein produced by living cells that starts up biochemical reactions.
Epidemiology—Sum of factors that influence the incidence/distribution of disease.
Ergonomics—A multidisciplinary activity that deals with interactions between workers and their total working environment plus stresses related to such environmental elements as atmosphere, heat, light, and sound, as well as tools and equipment in the workplace.
Error-tolerant system—A system with corrective actions to recover from errors.
Escape-only respirator—A respirator intended to be used only for emergency exit.
Etiologic agent—Viable microorganism or its toxin that can cause human disease.
Evacuation—Organized, phased, and supervised withdrawal, dispersal, or removal of humans from dangerous or potentially dangerous areas.
Evacuation—Organized, phased, and supervised withdrawal, dispersal, or removal of civilians from dangerous or potentially dangerous areas, and their reception and care in safe areas.
Evaluating—Assessing the effectiveness for the purpose of improving.
Evaporation rate—The rate at which a material is converted to a vapor at a given temperature and pressure when compared to the evaporation rate of a given substance.
Excimer—A gas mixture used as the active medium in a family of lasers emitting ultraviolet light.
Exhaust ventilation—The removal of air from any space, usually by mechanical means.
Exothermic—A term used to characterize a chemical reaction that gives off heat as it proceeds.
Experience rating—Process of basing insurance or worker's compensation premiums on the insured record of losses.
Explosimeter —A device that detects and measures the presence of gas or vapor in an explosive atmosphere.
Explosion class 1—Flammable gas/vapor.
Explosion class 2—Combustible dust.
Explosion class 3—Ignitable fibers.
Explosion-proof can—An electrical apparatus designed so that the explosion of flammable gas or vapor inside an enclosure will not ignite flammable gas or vapor outside.
Explosive—Any chemical compound or chemical mixture that, under the influence of heat, pressure, friction, or shock, undergoes a sudden chemical change (decomposition) with the liberation of energy in the form of heat and light and accompanied by a large volume of gas.
Explosive limit—The amount of vapor in the air that forms an explosive mixture.
Exposure (radiation)—A measure of ionization in air caused by x-rays or gamma rays only; the unit of exposure most often used is the Roentgen.
Exposure level—The level or concentration of a physical or chemical hazard to which an individual is exposed.
Exposure limit—The concentration of a substance under which it is believed that nearly all workers may be repeatedly exposed day after day without adverse effects.
Exposure pathway—A route by which a radionuclide or other toxic material can enter the body.
Exposure rate—A measure of the ionization produced in air by x-rays or gamma rays per unit of time.

F

Face velocity—The average air velocity into the exhaust system measured at the opening into the hood or booth.

Fahrenheit—The temperature scale commonly used in the United States with the freezing point of water 32°F and the boiling point 212°F at sea level.
Fail-safe interlock—An interlock where the failure of a single mechanical or electrical component of the interlock will cause the system to go into, or remain in, a safe mode.
Failure cause—The physical or chemical process, design defects, part misapplication, quality defects, or other processes that are the basic reason for failure or which initiate the physical process by which deterioration proceeds to failure.
Failure definition—This is a general statement of what constitutes a failure of the item in terms of performance parameters and allowable limits for each specified output.
Failure effect—Consequence(s) a failure mode has on the operation, function, or status of an item; failure effects are usually classified according to how the entire system is impacted.
Failure mode and effects analysis (FMEA)—Process by which each potential failure mode in a system is analyzed to determine the results, or effects thereof, on the system and to classify each potential failure mode according to its severity.
Failure mode—The way, by which failure is observed, describes the way the failure occurs and its impact on equipment operation.
Fallout (nuclear)—Minute particles of radioactive debris that descend slowly from the atmosphere after a nuclear explosion.
Federal Emergency Management Agency (FEMA)—An independent agency reporting to the president and tasked with responding to, planning for, recovering from, and mitigating against disaster. The terrorist attacks of September 11 focused the agency on issues of national preparedness and homeland security, and tested the agency in unprecedented ways. FEMA's Office of National Preparedness has the responsibility for helping to ensure that the nation's first responders were trained and equipped to deal with weapons of mass destruction.
Federal-to-federal support—Support that may occur when a federal department or agency responding to an incident under its own jurisdictional authorities requests Department of Homeland Security coordination to obtain additional federal assistance. As part of federal-to-federal support, federal departments and agencies execute interagency or intra-agency reimbursable agreements, in accordance with the Economy Act or other applicable authorities.
FEMA—Federal Emergency Management Agency.
Field assessment team—A small team of preidentified technical experts who conduct an assessment of response needs (not a PDA) immediately following a disaster. The experts are drawn from FEMA, other agencies and organizations—such as the US Public Health Service, US Army Corps of Engineers, US Environmental Protection Agency, and the American Red Cross—and the affected state(s). All *fast* operations are joint federal/state efforts.
Film badges—A package of photographic film worn like a badge by persons working with or around radioactive material to measure exposure to ionizing radiation; the absorbed dose can be calculated from the degree of film darkening caused by the irradiation.
Filter—An air-purifying component used in respirators to remove solid or liquid aerosols from the inspired air.
Filtering face piece (dust mask)—A negative pressure particulate respirator with a filter as an integral part of the face piece or with the entire face piece composed of the filtering medium.
Finance/administration section—The ICS functional area that addresses the financial, administrative, and legal/regulatory issues for the incident management system.
Fireman pole—A pole secured (floor and ceiling mooring) next to the bed that acts as a support for the patient to get into and out of the bed.
First aid (OSHA)—Any one-time treatment and subsequent observation of minor scratches, cuts, burns, and splinters that normally does not require medical care.
First receiver—Employees at a hospital engaged in decontamination and treatment of victims who have been contaminated by a hazardous substance(s) during an emergency incident. The incident occurs at a site other than the hospital. These employees are a subset of first responders.

First report—A state-mandated worker compensation form used to report work-related injuries and illnesses.
First responder—Personnel who have responsibility to initially respond to emergencies such as firefighter, police officers, highway patrol officers, lifeguards, forestry personnel, ambulance attendants, and other public service personnel; the first personnel trained to arrive on the scene of a hazardous or emergency situation.
First responder—Personnel who have responsibility to initially respond to emergencies. Some examples are firefighters, HAZMAT team members, law enforcement officers, lifeguards, forestry personnel, ambulance attendants, and other public service personnel. In the case of hazardous materials incidents, these personnel typically respond at the site where the incident occurred.
First responder awareness level—Individuals who might reasonably be anticipated to witness or discover a hazardous substance release and who have been trained to initiate an emergency response sequence by notifying the proper authorities of the release. They would take no further action beyond notifying the authorities.
First responder operations level—Individuals who respond to releases or potential releases of hazardous substances as part of the initial response to the site for the purpose of protecting nearby persons, property, or the environment from the effects of the release; OSHA mandates that these individuals must receive at least 8 h of training or have sufficient experience to objectively demonstrate competency in specific critical areas.
Fission—Splitting of a nucleus into at least two other nuclei that releases a large amount of energy.
Fit factor—A quantitative estimate of the fit of a particular respirator to a specific individual and typically estimates the ratio of the concentration of a substance in ambient air to its concentration inside the respirator when worn.
Fit test—The use of a protocol to qualitatively or quantitatively evaluate the fit of a respirator on an individual; fit testing can be qualitative or quantitative.
Flame arrestors—Mesh or perforated metal insert within a flammable storage that can protects its contents from external flame or ignition.
Flame extension—The distance a flame will travel from an aerosol container when exposed to an ignition source.
Flame retardant—Substances applied to or incorporated in a combustible material to reduce/eliminate its tendency to ignite when exposed to a low-energy flame.
Flammable liquid—A liquid with a flash point below 100°F (37.8°C).
Flash back—A phenomenon characterized by vapor ignition and flame traveling back to the vapor source.
Flash point—The temperature at which an organic liquid evolves a high enough concentration vapor at or near its surface to form an ignitable mixture with air.
Flocculation—The process to make solids in water increase in size by biological or chemical means so they may be separated from water.
Fluorocarbon—Any of a broad group of organic compounds analogous to hydrocarbons in which most of the hydrogen atoms of a hydrocarbon have been replaced by fluorine.
Flux—Any material or substance that will reduce the melting or softening temperature of another material when added to it.
Force Protection—Security program developed to protect service members, civilian employees, family members, facilities and equipment, in all locations and situations, through the planned and integrated application of combating terrorism, physical security, operations security, personal protective services supported by intelligence, counterintelligence, and other security programs.
Fractionated exposure—An exposure to radiation that occurs in several small acute exposures, rather than continuously as in a chronic exposure.
Frequency—Electrical term indicating the number of wave cycles in a second, measured in units called hertz.

Fumes—Particulate matter consisting of solid particles generated by condensation from the gaseous state, generally after violation from melted substances and often accompanied by a chemical reaction, such as oxidation.
Function—One of the five major activities in the incident command system—command, operations, planning, logistics, and finance/administration. The term *function* is also used when describing the activity involved (e.g., the planning function). A sixth function, intelligence/investigations, may be established, if required, to meet incident management needs.
Functional approach—The functional approach is normally used when hardware items cannot be uniquely identified or when system complexity requires analysis from the top down.
Functional area—A major grouping of the similar tasks that agencies perform in carrying out incident management activities.
Functional block diagrams—Diagrams that illustrate the operation and interrelationships between functional entities of a system as defined in engineering data and schematics.
Fungi—Organisms that lack chlorophyll and must receive food from decaying matter.
Fusion—A reaction in which at least one heavier, more stable nucleus is produced from two lighter, less stable nuclei.

G

Galvanizing—Application of a protective layer of zinc to a metal, chiefly steel, to prevent or inhibit corrosion.
Gamma rays—High-energy electromagnetic radiation emitted by certain radionuclides when their nuclei transition from a higher to a lower energy state, very similar to x-rays.
Gas—A state of matter in which a material has very low density and viscosity; gases expand and contract greatly in response to changes in temperature and pressure.
Gas discharge laser—A laser containing a gaseous lasing medium in a glass tube in which a constant flow of gas replenishes the molecules depleted by the electricity or chemicals used for excitation.
Gas neutralizer —A product used in riot control operations to neutralize the effect of tear gases. It is usually packaged as an aerosol spray and issued to police personnel.
Gas/vapor sterilization waste treatment—A technique that uses gases or vaporized chemicals such as ethylene oxide and formaldehyde as sterilizing agents.
Gauge—Thickness of the steel used to manufacture a drum, lower the gauge, the thicker the material.
Geiger counter—A radiation detection and measuring instrument consisting of a gas-filled tube containing electrodes, between which there is an electrical voltage but no current flow; Geiger counters are the most commonly used portable radiation detection instruments.
General staff—A group of incident management personnel organized according to function and reporting to the incident commander. The general staff normally consists of the operations section chief, planning section chief, logistics section chief, and finance/administration section chief. An intelligence/investigations chief may be established, if required, to meet incident management needs.
Generator—EPA term for any person, organization, or agency whose act or process produces medical waste or causes waste to become subject to regulation.
Genetic effects—Hereditary effects (mutations) that can be passed on through reproduction because of changes in sperm or ova.
Glacial—A term applied to a number of acids, which, in a highly pure state, have a freezing point slightly below room temperature.
Golden hour —A principle that states that unstable victims must be stabilized within one hour following injury to reduce the risk of death.
Gram—A standard unit of mass (weight) equivalent to 1/453.49 lb.

Gravimetric—A term used by analytical chemists to denote methods of quantitative analysis that depend upon the weight of the components in the sample.
Gray (gy)—A unit of measurement for the amount of energy absorbed in a material.
Ground zero—The central point of a nuclear detonation (or other large blast). Refers to the point on the ground below or above a nuclear detonation if the device is triggered in the air or underground.

H

Half-life—The time any substance takes to decay by half of its original amount. See also biological half-life, decay constant, effective half-life, radioactive half-life.
Hand antisepsis—Refers to either antiseptic hand wash or antiseptic hand rub.
Hand hygiene—A general term that applies to either hand washing, antiseptic hand wash, antiseptic hand rub, or surgical hand antisepsis.
Handgrips—Devices attached to either side of the bed to provide the patient/resident the ability to reposition themselves while in bed as well as an aid to enter and leave the bed.
Hard target—A building, piece of critical infrastructure (i.e., dam, power plant, utility company, etc.), or other commercial or noncommercial entity that has rigid security measures in place to include barriers, cameras, guards, etc.
Hardware approach—The hardware approach is normally used when hardware items can be uniquely identified from schematics, drawings, and other engineering and design data. This approach is recommended for use in a part level-up approach often referred to as the bottom-up approach.
Hazard—A potential or actual force, physical condition, or agent with the ability to cause human injury, illness, and/or death, and significant damage to property, the environment, critical infrastructure, agriculture and business operations, and other types of harm or loss.
Hazard—Something that is potentially dangerous or harmful, often the root cause of an unwanted outcome.
Hazard classes (DOT)—The nine descriptive terms established by the United Nations committee of experts to categorize hazardous chemical, physical, and biological materials. Categories are flammable liquids, explosives, gaseous oxidizers, radioactive materials, corrosives, flammable solids, poisons, infectious substances, and dangerous substances.
Hazard control—A means of reducing the risk due to exposure to a hazard. Such means may include ergonomic designing of work stations and equipment; arranging, safety-guarding, and interlocking of equipment; barricading of pedestrian and vehicular traffic routes; controlling exposure to toxic materials; and wearing protective gear.
Hazard control management—The practice of identifying, evaluating, and controlling hazards to prevent accidents.
Hazard identification—A process to identify hazards and associated risk to persons, property, and structures and to improve protection from natural and human-caused hazards.
Hazard identification and risk assessment (HIRA)—A process to identify hazards and associated risk to persons, property, and structures and to improve protection from natural and human-caused hazards. HIRA serves as a foundation for planning, resource management, capability development, public education, and training and exercises.
Hazard operability study—A structured means of evaluating a complex process to find problems associated with operability or safety of the process.
Hazard rating (NFPA)—Classification system that uses a four-color diamond to communicate health, flammability, reactivity, and specific hazard information for a chemical substance, a numbering system that rates hazards from 0 (lowest) to 4 (highest).
Hazard vulnerability analysis (healthcare)—The identification of potential emergencies and direct and indirect effects these emergencies may have on the healthcare organization's operations and the demand for its services.

Hazard vulnerability analysis (HVA)—A systematic approach to identifying all potential hazards that may affect an organization, assessing the probability of occurrence and the consequences for each hazard; the organization creates a prioritized comparison of the hazard vulnerabilities.
Hazard Vulnerability Analysis (HVA)—The identification of potential emergencies and direct and indirect effects these emergencies may have on the healthcare organization's operations and the demand for its services.
Hazardous chemical—Any chemical that poses a physical or health hazard.
Hazardous material (DOT)—A substance or material that has been determined by DOT to pose an unreasonable risk to health, safety, and property when transported in commerce (49 CFR 171.8).
Hazardous motion—Any motion of machinery or equipment that could cause personal physical harm.
Hazardous substance—Any substance to which exposure may result in adverse effects on the health or safety of employees. This includes substances defined under Section 101(14) of CERCLA; biological or disease-causing agents that may reasonably be anticipated to cause death, disease, or other health problems; any substance listed by the US Department of Transportation as hazardous material under 49 CFR 172.101 and appendices; and substances classified as hazardous waste.
Hazardous waste (EPA)—Any solid or combination of solid wastes, which because of its physical, chemical, or infectious characteristics may pose a hazard when not managed properly.
Hazcom—The OSHA Hazard Communication Standard (29 CFR 1910.1200).
Hazmat—Hazardous material.
HazWoper—The OSHA standard on hazardous waste operations and emergency response (29 CFR 1910.120) paragraph (q) of the standard covers employers whose employees are engaged in emergency response to hazardous substance releases.
Health hazard—A chemical for which there is statistically significant evidence that acute or chronic health effects may occur in exposed individuals.
Health physics—A scientific field that focuses on protection of humans and the environment from radiation. Health physics uses physics, biology, chemistry, statistics, and electronic instrumentation to help protect individuals from any damaging effects of radiation.
Healthcare coalition—A group of individual healthcare organizations in a specified geographic area that agree to work together to enhance their response to emergencies or disasters; the healthcare coalition, being composed of relatively independent organizations that voluntarily coordinate their response, does not conduct command or control; operates consistent with multiagency coordination (MAC) system principles to support and facilitate the response of its participating organizations.
Hearing conservation—Preventing or minimizing noise-induced deafness through the use of hearing protection devices, engineering methods, annual audiometric tests, and employee training.
Helium neon laser—A laser in which the active medium is a mixture of helium and neon; its wavelength is usually in the visible range.
High-efficiency particulate air filter—Any filter with at least 99.97% efficiency in the filtration of airborne particles 0.3 μm in diameter or greater.
High-impact mat—A mat placed next to the bed that absorbs the shock if the patient falls from the bed.
High-level radioactive waste—The radioactive material resulting from spent nuclear fuel reprocessing; this can include liquid waste directly produced in reprocessing or any solid material derived from the liquid wastes having a sufficient concentration of fission products.
High-reliability organizations—Complexity carried out with precision.
Homeland Security—A concerted national effort to prevent terrorist attacks within the United States, reduce America's vulnerability to terrorism, and minimize the damage and recover from attacks that do occur—Homeland Security includes federal, state, and local governments, the private sector, and individual citizens.

Homeland Security Council (HSC)—Entity that advises the president on national strategic and policy during large-scale incidents. Together with the National Security Council, HSC ensures coordination for all homeland and national security–related activities among executive departments and agencies and promotes effective development and implementation of related policy.

Hospital decontamination zone—This zone includes any areas where the type and the quantity of hazardous substance are unknown and where contaminated victims, contaminated equipment, or contaminated waste may be present. It can be anticipated that employees in this zone might have exposure to contaminated victims, their belongings, equipment, or waste. This zone includes, but is not limited to, places where initial triage and/or medical stabilization of possibly contaminated victims occur, predecontamination waiting (staging) areas for victims, the actual decontamination area, and the postdecontamination victim's inspection area. This area will typically end at the emergency department door. In other documents, this zone is sometimes called the warm zone, contamination reduction zone, yellow zone, or limited access zone.

Hospital incident command system (HICS)—An example of an optional NIMS-based ICS tailored specifically for use by hospitals and designed to function in conjunction with other common command systems used by emergency response organizations (e.g., Fire Service Incident Command System).

Hospital incident command system—A generic crisis management plan expressly for comprehensive medical facilities that is modeled closely after the fire service incident command system.

Hospital postdecontamination zone—The hospital postdecontamination zone is an area considered uncontaminated. At a hospital receiving contaminated victims, the hospital postdecontamination zone includes the emergency department (unless contaminated). This zone is sometimes called the *cold zone* or *clean area*.

Hot spot—Any place where the level of radioactive contamination is considerably greater than the area around it.

Hot zone—The hot zone is an area immediately surrounding an incident, which extends far enough to prevent adverse effects from the device/agent to personnel outside the zone. The hot zone can also be referred to as the exclusion zone (EZ), real zone, or restricted zone and is the primary area of contamination. The hot zone is the area that the incident commander judges to be the most affected by the incident. This includes any area to which the contaminant has spread or is likely to spread. Access is permitted to only personnel who are properly trained and protected. The incident commander sets the parameters of this zone after giving consideration to the type of agent, the volume released, the means of dissemination, the prevailing meteorological conditions, and the potential effects of local topography. ICS priorities within the hot zone may include conducting rescue and search, performing mitigation, and identifying WMD or other physical obstacles to the entry point. The hot zone is also the location where contamination reduction begins.

HSPD-5—Homeland Security Presidential Directive 5, *Management of Domestic Incidents*. The directive assigned DHS to develop a National Response Plan to integrate all federal government domestic prevention, preparedness, response, and recovery plans into a single all-discipline, all-hazards plan. As a result of HSPD-5, hospitals are required to be national incident management system compliant and to be able to develop an all-hazards approach to emergency management.

HSPD-6—Homeland Security Directive, 6, *Integration and Use of Screening Information*. To protect against terrorism, it is the policy of the United States to (1) develop, integrate, and maintain thorough, accurate, and current information about individuals known or appropriately suspected to be or have been engaged in conduct constituting, in preparation for, in aid of, or related to terrorism (Terrorist Information); and (2) use that information as appropriate and to the full extent permitted by law to support (a) federal, state, local, territorial, tribal, foreign-government, and private-sector screening processes; and (b) diplomatic, military, intelligence, law enforcement, immigration, visa, and protective processes.

HSPD-7—Homeland Security Presidential Directive 7, *Critical Infrastructure, Identification, Prioritization, and Protection*. HSPD-7 identifies and prioritizes critical infrastructure and key

resources in the United States that need to be protected from terrorist attacks. *Public health and health care* is listed as one of the infrastructure sectors by DHS, and HSPD-7 assigns DHHS to protect this sector by mitigating risk and providing recovery assistance if a disaster occurs.
HSPD-8—Homeland security presidential directive addresses national preparedness and calls for a national preparedness goal that establishes measurable priorities and targets and an approach to developing needed capabilities; it clearly states that hospital emergency medical facilities are considered emergency response providers as defined by the Department of Homeland Security Act.
HSPD-9—Homeland Security Presidential Directive, *Defense of United States Agriculture and Food*. This directive establishes a national policy to defend the agriculture and food system against terrorist attacks, major disasters, and other emergencies.
HSPD-10—Homeland Security Directive 10, *Bio-Defense for the 21st Century.* HSPD-10 was issued in response to the fears of bioterrorism following the anthrax attacks of 2001, the threat of pandemic influenza, and the outbreak of severe acute respiratory syndrome. HSPD-10 serves as the basis for the country's biodefense program. This directive calls upon hospitals not only to plan for more traditional hazards, such as explosive or incendiary threats, but also to be ready to respond to bioterrorism attacks.
HSPD-12—Homeland Security Presidential Directive-12, *Common Identification Standard for Federal Employees and Contractors.* This directive mandates the promulgation of a new standard for secure, reliable identification issued to federal workers and contractors. In response to HSPD-12, the National Institute of Standards and Technology (NIST) released a new standard, FIPS 201, to provide implementation instructions for the directive. FIPS 201 consists of personal identity verification (PIV) components that (1) define the minimum requirements for a system for meeting security goals that includes proving identity and (2) provide the technical specifications to meet security goals and achieve interoperability of smart cards that are to be used to meet key requirements of HSPD-12.
HSPD-20—Homeland Security Presidential Directive 20, *National Continuity Policy.*
HSPD-21—Homeland Security Presidential Directive 21, *National Strategy for Public Health and Medical Preparedness.* This directive calls for a system that integrates all of the important functions of public health and medical preparedness and response vertically (through all levels of government) and horizontally (across all sectors in communities) to achieve improved capability. Community based planning is critical to effective response, and HSPD-21 defines community resilience as one of the four most critical components of public health and medical preparedness. What still needs to be addressed, however, is the involvement of public health and public safety institutions in the response. A collaborative effort between public and private medical and health organizations is critical for effective community resilience.
Humidity (relative)—The ratio of the amount of water vapor present in air at a given temperature to the maximum that can be held by air at that temperature.
Hydrocarbon—Any compound composed of carbon and hydrogen.
Hydrophilic—A term that refers to substances that tend to absorb and retain water.
Hydrophobic—A term that describes substances that repel water.
Hygroscopic—A term used to describe solid or liquid materials that pick up and retain water vapor from the air.
Hypersensitivity diseases—Diseases characterized by allergic responses to animal antigens, often associated with indoor air quality conditions such as asthma and rhinitis.

I

IDLH—Or *immediately dangerous to life or health* means an atmospheric concentration of any toxic, corrosive, or asphyxiate substance that poses an immediate threat to life or would interfere with an individual's ability to escape from a dangerous atmosphere.
Ignitable a solid, liquid, or compressed gas—Must have a flash point less than 140F.

Ignition temperature—Lowest temperature at which a substance can catch fire and continue to burn.
Illumination—The amount of light a surface receives per unit area, expressed in lumens per square foot or foot candles.
Immediate dangerous to life or health—An atmospheric concentration of any toxic, corrosive, or asphyxiate substance that poses an immediate threat to life or would interfere with an individual's ability to escape from a dangerous atmosphere.
Immiscible—A term used to describe substances of the same phase that cannot be uniformly mixed or blended.
Impact area—An area having designated boundaries within the limits of which all ordnance will detonate or impact.
Incapacitating agent—An agent that produces physiological or mental effects, or both, that may persist for hours or days after exposure, rendering an individual incapable of performing his or her assigned duties.
Incident—An actual or impending unplanned event with hazard impact, either human caused or by natural phenomena, that requires action by emergency personnel to prevent or minimize loss of life or damage to property and/or natural resources.
Incident action plan (IAP)—An oral or written plan containing general objectives reflecting the overall strategy for managing an incident. It may include the identification of operational resources and assignments. It may also include attachments that provide direction and important information for the management of the incident during one or more operational periods.
Incident command system (ICS)—A standardized on-scene emergency management construct specifically designed to provide for the adoption of an integrated organizational structure that reflects the complexity and demands of single or multiple incidents, without being hindered by jurisdictional boundaries. ICS is a management system designed to enable effective incident management by integrating a combination of facilities, equipment, personnel, procedures, and communications operating within a common organizational structure, designed to aid in the management of resources during incidents. It is used for all kinds of emergencies and is applicable to small as well as large and complex incidents. ICS is used by various jurisdictions and functional agencies, both public and private, to organize field-level incident management operations.
Incident command—The entity responsible for overall management of an incident. It consists of the incident commander, either single or unified command, and any assigned supporting staff.
Incident commander (IC)—The individual who holds overall responsibility for incident response and management.
Incident commander—The individual responsible for all incident activities, including the development of strategies and tactics and the ordering and the release of resources.
Incident commander—The individual responsible for all incident activities, including the development of strategies and tactics and the ordering and the release of resources. The incident commander has overall authority and responsibility for conducting incident operations and is responsible for the management of all incident operations at the incident site.
Incident management—Refers to how incidents are managed across all homeland security activities, including prevention, protection, and response and recovery.
Incident management team—The incident commander and appropriate command and general staff personnel assigned to an incident.
Incident objectives—Statements of guidance and direction needed to select appropriate strategy(s) and the tactical direction of resources. Incident objectives are based on realistic expectations of what can be accomplished when all allocated resources have been effectively deployed. Incident objectives must be achievable and measurable, yet flexible enough to allow strategic and tactical alternatives.
Incompatible—The term used to indicate that one material cannot be mixed with another without the possibility of a dangerous reaction.

Indicator—A measurement used to evaluate program effectiveness within an organization.
Indoor air quality—The study, evaluation, and control of indoor air quality related to temperature, humidity, and building contaminants.
Industrial equipment—Physical apparatus used to perform industrial tasks, such as welders, conveyors, machine tools, fork trucks, turn tables, positioning tables, or robots.
Industrial robot—A reprogrammable multifunctional manipulator designed to move material, parts, tools, or specialized devices through variable programmed motions for the performance of a variety of tasks.
Industrial robot system—A system that includes industrial robots, the end-effectors, and the devices and sensors required for the robots to be taught or programmed, or for the robots to perform the intended automatic operations, as well as the communication interfaces required for interlocking, sequencing, or monitoring the robots.
Inert—Having little or no chemical affinity or activity.
Infectious waste—Waste containing pathogens that can cause an infectious disease in humans.
Infrared radiation—Invisible electromagnetic radiation with wavelengths that lie within the range of 0.70–1000 imp.
Ingestion—Taking a substance into the body through the mouth.
Inhalation—Breathing of an airborne substance into the body, maybe in the form of a gas, vapor, fume, mist, or dust.
Inhibitor—A substance that is added to another substance to prevent or slow down an unwanted reaction or change.
Innocuous—Harmless.
Inorganic—This term refers to a major and the oldest branch of chemistry. It is concerned with substances that do not contain carbon.
Intelligence—The process by which analysis is applied to information and data to inform policy making, decision making, operations, and tactical decisions. Intelligence serves many purposes among which are the identification and elimination of threat sources, the investigations and resolution of threats, the identification and treatment of a security risk, and the elimination of a threat source.
Interior structural firefighting—The physical activity of fire suppression, rescue, or both, inside of buildings or enclosed structures that are involved in a fire situation beyond the incipient stage.
Interior zone—A protective zone established inside a perimeter zone. Also called a secondary zone.
Interlock—An arrangement whereby the operation of one control or mechanism brings about or prevents the operation of another.
Internal exposure—Exposure to radioactive material taken into the body.
Interoperability—The ability of emergency management/response personnel to interact and work well together; in the context of technology, interoperability also refers to having an emergency communications system that is the same or is linked to the same system that a jurisdiction uses for nonemergency procedures and that effectively interfaces with national standards as they are developed.
Intrabeam viewing—The viewing condition whereby the eye is exposed to all or part of a direct laser beam or a specular reflection.
Iodine—A nonmetallic solid element; there are both radioactive and nonradioactive isotopes of iodine.
Ion—An atom, group, or molecule that has either lost one or more electrons or gained one or more electrons.
Ionization—The process of adding one or more electrons to, or removing one or more electrons from, atoms or molecules, thereby creating ions; high temperatures, electrical discharges, or nuclear radiation can cause ionization.
Ionizing radiation—Any radiation capable of displacing electrons from atoms, thereby producing ions, and high doses of ionizing radiation may produce severe skin or tissue damage.

Irradiation—Exposure to radiation.
Irradiation sterilization—The use of ionizing radiation for the treatment of infectious waste.
Isolation zone—An area adjacent to a physical barrier, clear of all objects that could conceal or shield an individual.
Isomer—One of two or more compounds having the same molecular weight and formula, but often having quite different properties and somewhat different structure.
Isotonic—Having the same osmotic pressure as the fluid phase of a cell or tissue.
Isotope—A nuclide of an element having the same number of protons but a different number of neutrons, any of two or more forms of an element in which the weights differ by one or more mass units due to a variation in the number of neutrons in the nuclei.

J

Jersey barrier—A protective concrete barrier initially and still used as a highway divider and now functions as an expedient method for traffic speed control at entrance gates and to keep vehicles away from buildings.
Job hazard analysis—The breaking down of methods, tasks, or procedures into components to determine hazards.
Joint field office—The primary federal incident management field structure for support; the JFO uses an incident command system structure but does not manage on-scene operations.
Joint information center—A center established to coordinate the public information activities for a large incident.
Joint information system (JIS)—Mechanism that integrates incident information and public affairs into a cohesive organization designed to provide consistent, coordinated, accurate, accessible, timely, and complete information during crisis or incident operations. The mission of the JIS is to provide a structure and system for developing and delivering coordinated interagency messages; developing, recommending, and executing public information plans and strategies on behalf of the incident commander; advising the incident commander concerning public affairs issues that could affect a response effort; and controlling rumors and inaccurate information that could undermine public confidence in the emergency response effort.
Joint motion—A method for coordinating the movement of the joints such that all joints arrive at the desired location simultaneously.
Joint operations center (JOC)—An interagency command post established by the Federal Bureau of Investigation to manage terrorist threats or incidents and investigative and intelligence activities. The JOC coordinates the necessary local, state, and federal assets required to support the investigation, and to prepare for, respond to, and resolve the threat or incident.
Joint task force (JTF)—Based on the complexity and type of incident, and the anticipated level of Department of Defense (DOD) resource involvement, DOD may elect to designate a JTF to command federal (Title 10) military activities in support of the incident objectives. If a JTF is established, consistent with operational requirements, its command and control element will be colocated with the senior on-scene leadership at the joint field office (JFO) to ensure coordination and unity of effort.
Joule—Unit of energy used to describe a single pulsed output of a laser; it is equal to 1 watt-second or 0.239 calories.
Jurisdiction—A political subdivision with the responsibility for ensuring public safety, health, and welfare within its legal authorities and geographic boundaries.

K

Ketone—A class of unsaturated and reactive compounds whose formula is characterized by a carbonyl group to which two organic groups are attached.

Kevlar—A synthetic yellow-brown fiber of very high tensile strength, woven into bulletproof vests, molded into solid sheets of lightweight armor (from aircraft to helmets). Kevlar is the brand name from DuPont used in bulletproof jackets.
Kilogram—About 2.2 lb.
Kiloton—The energy of an explosion that is equivalent to an explosion of 1000 tons of TNT.
Kinetic energy—The energy that a particle or an object possesses due to its motion or vibration.

L

Lab pack—Generally refers to any small container of hazardous waste in an overpacked drum. Not restricted to laboratory wastes.
Lacquer—A type of organic coating in which rapid drying is effected by evaporation of solvents.
Laser—A term for light amplification by stimulated emission of radiation; laser is a cavity with mirrors at the ends, filled with material such as crystal, glass, liquid, gas, or dye. It produces an intense beam of light with the unique properties of coherency, collimation, and monochromaticity.
Laser medium—Material used to emit the laser light and for which the laser is named.
Laser safety officer—Person with authority to monitor and enforce measures to control laser hazards and effect the knowledgeable evaluation and control of laser hazards.
Laser system—An assembly of electrical, mechanical, and optical components of a laser; under federal standard, it also includes the power supply.
Latent period—Time between exposure to a toxic material and the appearance of a resultant health effect.
Layered security—A physical security approach that requires a criminal to penetrate or overcome a series of security layers before reaching the target. The layers might be perimeter barriers; building or area protection with locks, CCTV, and guards; and point and trap protection using safes, vaults, and sensors.
Leading—A person who creates an atmosphere and purpose that encourage people to succeed and achieve.
Leak test—A test performed to detect leakage of a radiation source.
Lens—A curved piece of optically transparent material that, depending on its shape, is used to either converge or diverge light.
LEPC—Local Emergency Planning Committee.
Level of analysis—The level of analysis applies to the system hardware or functional level at which failures are postulated.
Liaison officer—A member of the command staff responsible for coordinating with representatives from cooperating and assisting agencies or organizations.
Light-emitting diode—A semiconductor diode that converts electric energy efficiently into spontaneous and noncoherent electromagnetic radiation at visible and near-infrared wavelengths.
Limited area—A restricted area within close proximity of a security interest. Uncontrolled movement may permit access to the item. Escorts and other internal restrictions may prevent access to the item.
Limiting aperture—Maximum circular area over which radiance and radiant exposure can be averaged when determining safety hazards.
Limiting device—A device that restricts the maximum envelope (space) by stopping or causing to stop all robot motion and is independent of the control program and the application programs.
Line organization—An organization with a chain of command hierarchy.
Liquefied petroleum—A gas usually comprised of propane and some butane created as a by-product of petroleum refining.
Liquid crystal display—A constantly operating display that consists of segments of a liquid crystal whose reflectivity varies according to the voltage applied to the.

Local exhaust ventilation—A ventilation system that captures/removes contaminants at the point produced before they escape into the work area.
Long-term recovery—A process of recovery that may continue for a number of months or years, depending on the severity and extent of the damage sustained.
Loose-fitting face piece—A respiratory inlet covering that is designed to form a partial seal with the face.
Loss ratio—A fraction calculated by dividing losses of an organization and the amount of insurance premiums paid.
Lost workdays—The number of workdays an employee is away from work beyond the day of injury or onset of illness.
Lower explosive limit—The lowest concentration of a substance that will produce a fire or flash when an ignition source is present, expressed as a percent of vapor or gas in the air by volume.
Low-level waste—Radioactively contaminated industrial or research waste such as paper, rags, plastic bags, medical waste, and water-treatment residues.
Lumbar—The section of the lower vertebral column immediately above the sacrum, located in the small of the back and consists of five large lumbar vertebrae.

M

Major disaster—Under the Robert T. Stafford Disaster Relief and Emergency Assistance Act, any natural catastrophe (including any hurricane, tornado, storm, high water, wind-driven water, tidal wave, tsunami, earthquake, volcanic eruption, landslide, mudslide, snowstorm, or drought) or, regardless of cause, any fire, flood, or explosion in any part of the United States that, in the determination of the president, causes damage of sufficient severity and magnitude to warrant major disaster assistance under the Stafford Act to supplement the efforts and available resources of states, local governments, and disaster relief organizations in alleviating the damage, loss, hardship, or suffering caused thereby.
Management by exception—A manager makes a decision make reviewing key information but not all available information on a subject.
Management by objective—A management theory where a manager and subordinates agree on a predetermined course of action or objective.
Management by objectives—ICS concept that related to a proactive management activity that involves a four-step process to achieve the incident goal.
Mass—The amount of material substance present in a body, irrespective of gravity.
Mass casualty—A combination of patient numbers and patient care requirements that challenge or exceed a community's ability to provide adequate patient care using day-to-day operations.
Mass casualty incident—An incident that generates a sufficiently large number of casualties whereby the available healthcare resources, or their management systems, are severely challenged or unable to meet the healthcare needs of the affected population.
Mass effect incident—An incident that primarily affects the ability of an organization to continue its normal operations.
Mass spectroscopy—Process that identifies compounds by breaking them up into all combinations of ions and measuring mass-to-charge ratios at detector.
Material safety data sheet—A document that contains descriptive information on hazardous chemicals under OSHA hazard communication standard; data sheets also provide precautionary information, safe handling procedures, and emergency first aid procedures.
Maximum permissible exposure—The level of laser radiation to which a person may be exposed without hazardous effect or adverse biological changes in the eye or skin.
Measure—Term used in the quality field for the collection of quantifiable data and information about performance, production, and goal accomplishment.
Measures of effectiveness—Defined criteria for determining whether satisfactory progress is being accomplished toward achieving the incident objective.

Medical surge—The ability to provide adequate medical evaluation and care in events that severely challenge or exceed the normal medical infrastructure of an affected community.
Medical waste—Any solid waste generated in the diagnosis, treatment, or immunization of humans or animals.
Megaton (mt)—The energy of an explosion that is equivalent to an explosion of 1 million tons of TNT. One megaton is equal to a quintillion (1018) calories. See also kiloton.
Memorandum of agreement—A conditional agreement between two or more parties; one party's action depends on the other party's action.
Memorandum of understanding—A formal agreement documenting the commitment of two or more parties to an agreed undertaking.
Method of dissemination—The way a chemical agent or compound is finally released into the atmosphere.
Microbe—Minute organism including bacteria, protozoa, and fungi, which is capable of causing disease.
Micron—A unit of length in the metric system equivalent to one-millionth of a meter.
Milligrams per cubic meter—Unit used to measure air concentration of dust, gas, mist, and fume.
Mindfulness—A culture that encourages alertness/vigilance to prevent error, mitigate harm, prevent injury, and limit damage to property or the environment.
Mitigation—Activities designed to reduce or eliminate risks to persons or property or to lessen the actual or potential effects or consequences of a hazard.
Mobile robots—Freely moving automatic programmable industrial robots.
Mobilization—The process and procedures used by all organizations—federal, state, tribal, and local—for activating, assembling, and transporting all resources that have been requested to respond to or support an incident.
Molecular weight—The total obtained by adding together the weights of all the atoms present in a molecule.
Molecule—A combination of two or more atoms that are chemically bonded. A molecule is the smallest unit of a compound that can exist by itself and retain all of its chemical properties.
Multiagency coordination (MAC) group—Typically, administrators/executives, or their appointed representatives, who are authorized to commit agency resources and funds are brought together and form MAC groups. MAC groups may also be known as multiagency committees, emergency management committees, or as otherwise defined by the system. A MAC group can provide coordinated decision-making and resource allocation among cooperating agencies and may establish the priorities among incidents, harmonize agency policies, and provide strategic guidance and direction to support incident management activities.
Multiagency coordination system(s) (MACS)—Multiagency coordination systems provide the architecture to support coordination for incident prioritization, critical resource allocation, communications systems integration, and information coordination. The elements of multiagency coordination systems include facilities, equipment, personnel, procedures, and communications. Two of the most commonly used elements are emergency operations centers and MAC groups. These systems assist agencies and organizations responding to an incident.
Multijurisdictional incident—An incident requiring action from multiple agencies that each have jurisdiction to manage certain aspects of the incident. In the incident command system, these incidents will be managed under unified command.
Munroe effect—The focusing of the force produced by an explosion resulting in an increased pressure wave.
Mutagen—A substance or agent capable of changing the genetic material of a living cell.
Muting—The deactivation of a presence-sensing safeguarding device during a portion of the robot cycle.

Mutual aid agreement—Written instrument between agencies and/or jurisdictions in which they agree to assist one another upon request, by furnishing personnel, equipment, supplies, and/or expertise in a specified manner.
Mutual aid and assistance agreement—Written or oral agreement between and among agencies/organizations and/or jurisdictions that provides a mechanism to quickly obtain emergency assistance in the form of personnel, equipment, materials, and other associated services. The primary objective is to facilitate rapid short-term deployment of emergency support prior to, during, and/or after an incident.

N

Naphtha—Any of several liquid mixtures of hydrocarbons of specific boiling and distillation ranges derived from either petroleum or coal tar.
Narcosis—Stupor or unconsciousness caused by exposure to a chemical.
National Disaster Medical System (NDMS)—A federally coordinated system that augments the nation's medical response capability. The overall purpose of the NDMS is to establish a single, integrated national medical response capability for assisting state and local authorities in dealing with the medical impacts of major peacetime disasters. NDMS, under Emergency Support Function #8—Public Health and Medical Services, supports federal agencies in the management and coordination of the federal medical response to major emergencies and federally declared disasters.
National incident management system (NIMS)—The system established by the US Department of Homeland Security as a standardized management approach to incident response that all responders would use to coordinate and conduct response actions.
National Joint Terrorism Task Force (NJTTF)—Entity responsible for enhancing communications, coordination, and cooperation among federal, state, tribal, and local agencies representing the intelligence, law enforcement, defense, diplomatic, public safety, and homeland security communities by providing a point of fusion for terrorism intelligence and by supporting joint terrorism task forces throughout the United States.
National Military Command Center (NMCC)—Facility that serves as the nation's focal point for continuous monitoring and coordination of worldwide military operations. It directly supports combatant commanders, the chairman of the joint chiefs of staff, the secretary of defense, and the president in the command of US Armed Forces in peacetime contingencies and war. Structured to support the president and secretary of defense effectively and efficiently, the NMCC participates in a wide variety of activities, ranging from missile warning and attack assessment to management of peacetime contingencies such as Defense Support of Civil Authorities activities. In conjunction with monitoring the current worldwide situation, the center alerts the joint staff and other national agencies to developing crises and will initially coordinate any military response required.
National Operations Center (NOC)—Serves as the primary national hub for situational awareness and operations coordination across the federal government for incident management. The NOC provides the secretary of Homeland Security and other principals with information necessary to make critical national-level incident management decisions.
National Preparedness Guidelines—Guidance that establishes a vision for national preparedness and provides a systematic approach for prioritizing preparedness efforts across the nation. These guidelines focus policy, planning, and investments at all levels of government and the private sector. The guidelines replace the interim national preparedness goal and integrate recent lessons learned.
National Response Coordination Center (NRCC)—As a component of the National Operations Center, the NRCC serves as the Department of Homeland Security/Federal Emergency Management Agency primary operations center responsible for national incident response and recovery as well

as national resource coordination. As a 24/7 operations center, the NRCC monitors potential or developing incidents and supports the efforts of regional and field components.

National response framework (NRF)—Guides how the nation conducts all-hazards response. The framework documents the key response principles, roles, and structures that organize national response. It describes how communities, states, the federal government, and private sector and nongovernmental partners apply these principles for a coordinated, effective national response. And it describes special circumstances where the federal government exercises a larger role. It allows first responders, decision makers, and supporting entities to provide a unified national response.

National Security Council (NSC)—Advises the president on national strategic and policy during large-scale incidents. Together with the Homeland Security Council, NSC ensures coordination for all homeland and national security–related activities among executive departments and agencies and promotes effective development and implementation of related policy.

Natural gas—A combustible gas composed largely of methane and other hydrocarbons obtained from natural earth fissures.

Necrosis—Death of plant or animal cells.

Needleless systems—Devices do not use needles for the collection of bodily fluids or withdrawal of body fluids after initial venous or arterial access is established.

Negative pressure—A condition caused when less air is supplied to a space than is exhausted from the space. The air pressure in the space is less than that in the surrounding areas.

Negligence—Failure to do what reasonable and prudent persons would do under similar or existing circumstances.

Nerve agents—Agents that effect the transmission of nerve impulses by reacting with the enzyme cholinesterase, permitting an accumulation of acetylcholine and continuous muscle stimulation. The muscles tire due to overstimulation and begin to contract.

Neutralization—The reaction between equivalent amounts of an acid and a base to form a salt.

Neutron—A small atomic particle possessing no electrical charge typically found within an atom's nucleus; they are neutral in their charge.

NFPA—National Fire Protection Association.

Night vision—Night observation device (NOD); night sight; night viewing weapon sight; night vision equipment (NVE); night viewing aid (NVA); night viewing goggles (NVG)—a variety of devices, using (passive) image intensifiers (intensification of residual light) and/or thermal (infrared) imagers to improve observation, target acquisition, or aiming in low light conditions; they can be coupled with (active) laser aiming lights (laser illuminators or designators, target markers, and spot projectors); they take the form of handheld or helmet-mounted binocular and monocular goggles, pocket scopes, rifle-mounted weapon sights, or armored vehicle periscopes.

Nitrogen oxide—Compound produced by combustion.

NMR—Nuclear magnetic resonance.

Nomenclature—Names of chemical substances and the system used for assigning them.

Nonexclusive zone—An area around an asset that has controlled entry but shared or less restrictive access than an exclusive zone.

Nonionizing radiation—Radiation that has lower energy levels and longer wavelengths than ionizing radiation; examples include radio waves, microwaves, visible light, and infrared.

Nonlethal weapon—Weapons used by friendly forces designed to incapacitate the target or otherwise neutralize hostile forces rather than to kill or seriously injure. Examples include gas, such as tear gas, and stun grenades.

Nonpersistent agent—An agent that remains in the target area(s) for a relatively short period of time. The hazard, predominantly vapor, will exist for minutes or, in exceptional cases, hours after dissemination of the agent. As a general rule, a nonpersistent agent duration will be less than 12 h.

Nonstochastic effects—Effects that can be related directly to the radiation dose received.

Nucleus—Central part of an atom that contains protons and neutrons.

Nuclide—A general term applicable to all atomic forms of an element.
Numerically controlled machine tools—Tools operated by a series of coded instructions comprised of numbers, letters of the alphabet, and other symbols.

O

Occupational illness—Illness caused by environmental exposure during employment.
Occurrence—Incident classified as major or minor, which results from apparent or foreseen causal factors.
Odor threshold—Minimum concentration of a substance at which most people can detect and identify its characteristic odor.
Operating envelope—The portion of the restricted envelope (space) that is actually used by the robot while performing its programmed motions.
Operations level—See First responder operations level.
Operations plan (OPLAN)—A plan developed by and for each federal department or agency describing detailed resource, personnel, and asset allocations necessary to support the concept of operations detailed in the concept plan.
Operator—The person designated to start, monitor, and stop the intended productive operation of a robot or robot system.
Optical cavity (resonator)—Space between the laser mirrors where lasing action occurs.
Optical density—Logarithmic expression of the attenuation afforded by a filter.
Optical fiber—A filament of quartz or other optical material capable of transmitting light along its length by multiple internal reflections and emitting it at the end.
Order of magnitude—A term used in science to indicate a range of values representing numbers, dimensions, or distances, which start at any given value and ends at 10 times that value.
Ordnance—Weapons, ammunition, or other consumable armament.
Organic—Any compound containing the element carbon, describes substances derived from living organisms.
Organizing—Arranging work or tasks to be performed in the most efficient manner.
Outcomes—Results reached due to performance or nonperformance of a task, job, or process.
Output power—Energy per second measured in watts emitted from the laser in the form of coherent light.
Overt culture—The formal, expected, published, visible, or anticipated culture of an organization.
Overt threat—A terrorist act that is done out in the open without regard to possible discovery.
Oxidant—An oxygen-containing substance that reacts chemically to produce a new substance.
Oxidation—Reaction in which electrons are transferred from one atom to another either in the uncombined state or within a molecule.
Oxidizers—Materials that may cause the ignition of a combustible material without the aid of an external ignition source.
Oxygen-deficient atmosphere—An atmosphere with oxygen content below 19.5% by volume.
Ozone—Reactive oxidant that contains three atoms of oxygen.

P

Parenteral—Means piercing mucous membranes or the skin barrier through such events as needlesticks, human bites, cuts, and abrasions.

PART II—GLOSSARY FOR NATIONAL RESPONSE FRAMEWORK

Particulates—Fine solid or liquid particles found in air and other emissions.
Parts per million—A unit for measuring the concentration of a gas or vapor in contaminated air, used to indicate the concentration of a particular substance in a liquid or solid.

Pasteurization—Heat treatment of liquid or semiliquid food products for the purpose of killing or inactivating disease-causing bacteria.
Pathways—The routes by which people are exposed to radiation or other contaminants. The three basic pathways are inhalation, ingestion, and direct external exposure.
Patient assessment—An assessment that provides ongoing information necessary to develop a care plan, to provide the appropriate care and services for each patient.
Patient safety science—Helps create systems that do no harm.
PEL—Permissible exposure limit; OSHA limit for employee exposure to chemicals (29 CFR 1910.1000) based on a TWA of hours for a 40 h workweek.
Pendant—Any portable control device, including teach pendants, that permits an operator to control the robot from within the restricted envelope space of a robot.
Pendant control—A means used by either the patient or the operator to control the drives that activate various bed functions and are attached to the bed by a cord.
Penetrating radiation—Any radiation that can penetrate the skin and reach internal organs and tissues.
Perimeter—The edge or boundary of property or location.
Periodic law—States that the arrangement of electrons in the atoms of any given chemical element, and the properties determined by this arrangement, is closely related to the atomic number of that element.
Periodic table—A systematic classification of the chemical elements based on the periodic law.
Permeation rate—An invisible process by which a hazardous chemical moves through a protective material.
Persistent activity—Activity defined as the prolonged or extended antimicrobial activity that prevents or inhibits the proliferation or survival of microorganisms after the application of the product.
Persistent agent—An agent that remains in the target area for longer periods of time. Hazards from both vapor and liquid may exist for hours, days, or, in exceptional cases, weeks or months after dissemination of the agent. As a general rule, persistent agent duration will be greater than 12 h.
Personal protection—Equipment designed to protect individuals against injury from firearms, nuclear or conventional explosives, chemical, and/or biological agents.
Personal protective equipment (PPE)—Examples include protective suits, gloves, foot covering, respiratory protection, hoods, safety glasses, goggles, and face shields.
pH—A scale indicating the acidity or alkalinity of aqueous solutions.
Physical hazard of a chemical—A chemical validated as being or having one of the following characteristics: combustible liquid, compressed gas, explosive, flammable, organic peroxide, oxidizing qualities, pyrophoric, unstable, or water reactive.
Planning—Actions taken to predetermine the best course of action.
Planning section—Functional area is responsible for the collection, evaluation, and dissemination of operational information related to the incident and for the preparation and documentation of the incident action plan and its support.
Plume—Smoke from the use of electrosurgery, lasers, and aerosols.
Poison—Solid or liquid substance that is known to be a toxic to humans.
Polychlorinated biphenyls—A pathogenic and teratogenic industrial compound used as a heat transfer agent; they accumulate in human or animal tissue.
Polymerization—A chemical reaction in which one or more small molecules combine to form larger molecules.
Polyvinyl chloride—A member of the family of vinyl resins.
Positive-pressure—A respirator in which the pressure inside the respiratory inlet covering exceeds the ambient air pressure outside the respirator.
Powered air-purifying respirator—An air-purifying respirator that uses a blower to force the ambient air through air-purifying elements to the inlet covering.

Preaction—The main water control valve is opened by an actuating device.
Preemptive attack—An attack initiated on the basis of incontrovertible evidence that an enemy attack is imminent.
Prefilter—A filter used in conjunction with a cartridge on an air-purifying respirator.
Preparedness—The range of deliberate critical tasks and activities necessary to build, sustain, and improve the capability to protect against, respond to, and recover from hazard impacts.
Presence-sensing safeguarding device—A device designed, constructed, and installed to create a sensing field or area to detect an intrusion into the field or area by personnel, robots, or other objects.
Pressure demand respirator—A positive pressure atmosphere-supplying respirator that admits breathing air to the face piece when the positive pressure is reduced inside the face piece by inhalation.
Prevention—Actions to avoid an incident or to intervene to stop an incident from occurring. Prevention involves actions to protect lives and property. It involves applying intelligence and other information to a range of activities that may include such countermeasures as deterrence operations; heightened inspections; improved surveillance and security operations; investigations to determine the full nature and source of the threat; public health and agricultural surveillance and testing processes; immunizations, isolation, or quarantine; and, as appropriate, specific law enforcement operations aimed at deterring, preempting, interdicting, or disrupting illegal activity and apprehending potential perpetrators and bringing them to justice.
Priority I—Patients with correctable life-threatening illnesses or injuries such as respiratory arrest or obstruction, open chest or abdomen wounds, femur fractures, or critical or complicated burns.
Priority II—Patients with serious but nonlife-threatening illnesses or injuries such as moderate blood loss, open or multiple fractures (open increases priority), or eye injuries.
Priority III—Patients with minor injuries such as soft tissue injuries, simple fractures, or minor-to-moderate burns.
Priority zero (or IV)—Patients who are dead or fatally injured. Fatal injuries include exposed brain matter, decapitation, and incineration.
Process—Method of interrelating steps, events, and mechanisms to accomplish an action or goal.
Process flow diagram—Sequence of events diagram.
Processes—Systems of operations that incorporate standardized procedures, methodologies, and functions necessary to effectively and efficiently accomplish objectives.
Protocol—A set of established guidelines for actions that may be designated by individuals, teams, functions, or capabilities under various specified conditions.
Proton—Basic unit of mass that is a constituent of the nucleus of all elements, the number present being the atomic number of a given element.
Public information—Processes, procedures, and systems for communicating timely, accurate, accessible information on an incident's cause, size, and current situation; resources committed; and other matters of general interest to the public, responders, and additional stakeholders (both directly affected and indirectly affected).
Public information officer (PIO)—A member of the command staff responsible for interfacing with the public and media and/or with other agencies with incident-related information requirements.
Pulse duration—The *on* time of a pulsed laser; it may be measured in terms of milliseconds, microseconds, or nanoseconds.
Pyrolysis—A chemical change brought about by heat alone.
Pyrophoric—A chemical that will ignite spontaneously in air at a temperature of 130F or below.

Q

Qualitative analysis—Examination of a sample of a material to determine the kinds of substances present and to identify each constituent.
Qualitative fit test—A pass/fail fit test to assess the adequacy of respiratory fit that relies on the individual's response to the test agent.

Quantitative fit test—An assessment of the adequacy of respirator fit by numerically measuring the amount of leakage into the respirator.
Quarantine—Restriction of the activities of well persons or animals who have been exposed to a case of communicable disease during its period of communicability (i.e., contacts) to prevent disease transmission during the incubation period if infection should occur. Absolute or complete quarantine is the limitation of freedom of movement of those exposed to a communicable disease for a period of time not longer than the longest usual incubation period of that disease. Modified quarantine is a selective partial limitation of freedom of movement of contacts, commonly on the basis of known or presumed differences in susceptibility and related to the danger of disease transmission.
Quaternary ammonium compounds—Chemical substances used to disinfect or sanitize by rupturing the cell walls of microorganisms.

R

Rad (radiation absorbed dose)—A basic unit of absorbed radiation dose.
Radiation warning symbol—A symbol prescribed by OSHA; it is a magenta on a yellow background, displayed where certain quantities of radioactive materials are present or where certain doses of radiation could be received.
Radio assay—A test to determine the amounts of radioactive materials through the detection of ionizing radiation.
Radioactivity—The spontaneous decay or disintegration of an unstable atomic nucleus, usually accompanied by the emission of ionizing radiation.
Radiography—Medical use of radiant energy (such as x-rays and gamma rays) to image body systems.
Radioisotope—Isotopes of an element that have an unstable nucleus, commonly used in science, industry, and medicine.
Reactivity—Susceptibility of a substance to undergo chemical reaction and change that could result in an explosion or fire.
Reagent—Any chemical compound used in laboratory analyses to detect and identify specific constituents of the material being examined.
Reciprocal accountability—Between line staff and leadership.
Recommend exposure limit—A NIOSH chemical exposure limit recommendation.
Recovery—The phase of comprehensive emergency management that encompasses activities and programs implemented during and after response that are designed to return the entity to its usual state or to a *new normal*.
Red team—A technique for assessing vulnerability that involves viewing a potential target from the perspective of an attacker to identify its hidden vulnerabilities and to anticipate possible modes of attack.
Reflection—Return of radiant energy (incident light) by a surface, with no change in wavelength.
Refraction—Change of direction of propagation of any wave, such as an electromagnetic wave, when it passes from one medium to another in which the wave velocity is different.
Regional Response Coordination Centers—Located in each Federal Emergency Management Agency (FEMA) region, these multiagency coordination centers are staffed by Emergency Support Functions in anticipation of a serious incident in the region or immediately following an incident. Operating under the direction of the FEMA regional administrator, the centers coordinate federal regional response efforts and maintain connectivity with state emergency operations centers, State fusion centers, federal executive boards, and other federal and state operations and coordination centers that have the potential to contribute to the development of situational awareness.
Relative humidity—The ratio of the quantity of water vapor present in air to the quantity that would saturate the air at any specific temperature.

Relative risk—The ratio between the risks for disease in an irradiated population to the risk in an unexposed population.
Release zone—An area in and immediately surrounding a hazardous substance release. It is assumed to pose an immediate health risk to all persons, including first responders. For the purposes of this document, the release zone is always *remote* from the hospital. This zone is also referred to as the *exclusion zone*, the *red zone*, and the *restricted zone* in other documents.
Reliability block diagrams—Diagrams that define the series dependence, or independence, of all functions of a system or functional group for each life cycle event.
Relief valve—A valve designed to release excess pressure within a system without damaging the system.
Rem—Roentgen equivalent man, the unit of dose of any ionizing radiation that produces the same biological effect on human tissue as one roentgen of x-rays.
Resiliency—The ability of an individual or organization to quickly recover from change or misfortune.
Resin—Naturally occurring water-insoluble mixtures of carboxylic acids, essential oils, and other substances formed in numerous varieties of trees and shrubs.
Resonator—Mirrors (or reflectors) making up the laser cavity including the laser rod or tube. The mirrors reflect light back and forth to build up amplification.
Resource Conservation and Recovery Act—Legislation used by the EPA to regulate waste materials including hazardous wastes from generation through final disposal.
Resource management—A system for identifying available resources at all jurisdictional levels to enable timely and unimpeded access to resources needed to prepare for, respond to, or recover from an incident. Resource management includes mutual aid and assistance agreements; the use of special federal, state, tribal, and local teams; and resource mobilization protocols.
Resources—Personnel and major items of equipment, supplies, and facilities available or potentially available for assignment to incident operations and for which status is maintained. Under the national incident management system, resources are described by kind and type and may be used in operational support or supervisory capacities at an incident or at an emergency operations center.
Respiratory inlet covering—The portion of a respirator that forms the protective barrier between the user's respiratory tract and an air-purifying device or breathing air source.
Response force—The people who respond to an act of aggression. Depending on the nature of the threat, the response force could consist of guards, special reaction teams, military or civilian police, an explosives ordnance disposal team, or a fire department.
Response—Activities that address the direct effects of an incident; response includes immediate actions to save lives, protect property, and meet basic human needs.
Restricted area—Any area with access controls that is subject to these special restrictions or controls for security reasons.
Reversible—A chemical reaction that can proceed first to the right and then to the left when the conditions change.
Reynaud's syndrome—A condition where the blood vessels in the hand constrict from cold temperature, vibration, emotion, or unknown causes.
Right to know—Phrase that relates to an employee's right to know about the nature and hazards of agents used in the workplace, and/or to the right of communities.
Risk—The probability of injury, illness, disease, loss, or death under specific circumstances.
Risk assessment—An evaluation of the risk to human health or the environment by hazards; risk assessments can look at either existing hazards or potential hazards.
Risk migration—Risk mitigated in one part of a system can move to another part.
Roentgen equivalent man—A unit of equivalent dose that relates the absorbed dose in human tissue to the effective biological damage of the radiation.
Roentgen—A unit of exposure to x-rays or gamma rays.

S

Safe haven—Secure areas within the interior of the facility. A safe haven should be designed such that it requires more time to penetrate by terrorist than it takes for the response force to reach the protected area to rescue the occupants.
Safeguard—A barrier guard, device, or safety procedure designed for the protection of personnel.
Safety—Human actions to control, reduce, or prevent accidental loss.
Safety belt—A belt worn to prevent falls when working in high places; a belt used to secure passengers in vehicles or airplanes.
Safety can—An approved container of not more than 5 gal capacity with a spring-closing lid and a spout cover designed to safely relieve internal pressure when exposed to fire.
Safety hat—A hard hat worn to protect a worker from head injuries, flying particles, and electric shock.
Safety procedure—An instruction designed for the protection of personnel.
Salt—One of the products resulting from a reaction between an acid and a base.
Sanitize—To destroy common microorganisms on a surface to a safe level.
Scanning laser—A laser having a time-varying direction, origin, or pattern of propagation with respect to a stationary frame of reference.
Section—The organizational level having responsibility for a major functional area of incident management (e.g., operations, planning, logistics, finance/administration, and intelligence/investigations [if established]).
Self-contained breathing apparatus (SCBA)—A respirator that provides fresh air to the face piece from a compressed air tank (usually worn on the worker's back).
Semiconductor laser—Type of laser that produces its output from semiconductor materials.
Sense making—A process that transforms raw experience into intelligible views by making sense of new or changing circumstances.
Sensitivity—The ability of an analytical method to detect small concentrations of radioactive material.
Sensitizer—A substance that may cause no reaction in a person during initial exposure, but will cause an allergic response upon further exposure.
Sensor—A device that responds to physical stimuli such as heat, light, sound, pressure, magnetism, or motion.
Serious injury—An injury classification that includes disabling work injuries and injuries such as eye injuries, fractures, hospitalization for observation, loss of consciousness, and any other injury that requires medical treatment by a physician.
Service—To adjust, repair, maintain, and make fit for use.
Service life—The period of time that a respirator, filter or sorbent, or other respiratory equipment provides adequate protection to the wearer.
Service robots—Machines that extend human capabilities.
Severity classification—A classification assigned to provide a qualitative measure of the worst potential consequences resulting from design error or item failure.
Severity—Consequences of a failure as a result of a particular failure mode.
Sharp end—Point of vulnerability in care delivery where failure is visible, where expertise is applied, and adverse events are experienced.
Sharps—Objects that can penetrate the skin, such as needles, scalpels, and lancets.
Shielding—Material between a radiation source and a potentially exposed person that reduces exposure.
Shock wave—A transient pressure pulse that propagates at supersonic velocity.
Short-term exposures limit—An OSHA measurement of the maximum concentration for a continuous 15 min exposure period.
Short-term recovery—A process of recovery that is immediate and overlaps emergency response actions.

Shrapnel—High-speed metal fragments from a shell or bomb explosion. Shrapnel can be quite lethal to personnel; it can also cause considerable damage to aircraft. Fragments from exploding munitions can acquire velocities comparable to those of rifle bullets and cause great impact effects. Objects are attached to the outside or included inside a device to increase the blast damage and/or injure/kill personnel. The device/container walls themselves can also function in this manner.
Sick building syndrome—A situation where building occupants experience acute health or discomfort that appear to be linked to time spent in the building, but no specific illness or cause can be determined.
Sievert—A unit used to derive a quantity called dose equivalent as it relates to the absorbed dose in human tissue to the effective biological damage of the radiation.
Single failure point—A failure of an item that would result in failure of the system and is not compensated by redundancy or alternative operational procedure.
Situation report—Document that contains confirmed or verified information and explicit details (who, what, where, and how) relating to an incident.
Situational awareness—The ability to identify, process, and comprehend the critical elements of information about an incident.
Sludge—A solid material that collects as the result of air or water treatment processes.
Solubility—The percentage of a material (by weight) that will dissolve in water at a specified temperature.
Solvent—A substance that dissolves or disperses another substance.
Somatic effects—The effects of radiation that is limited to the exposed person.
Source—Means either laser or laser-illuminated reflecting surface.
Span of control—The number of resources for which a supervisor is responsible, usually expressed as the ratio of supervisors to individuals. (Under the national incident management system, an appropriate span of control is between 1:3 and 1:7, with optimal being 1:5.)
Special needs population—Populations whose members may have additional needs before, during, and after an incident in functional areas, including but not limited to maintaining independence, communication, transportation, supervision, and medical care. Individuals in need of additional response assistance may include those who have disabilities; who live in institutionalized settings; who are elderly; who are children; who are from diverse cultures; who have limited English proficiency or are non-English speaking; or who are transportation disadvantaged.
Specific gravity—The weight of a material compared to the weight of an equal volume of water.
Spectrum—A range of frequencies within which radiation has some specified characteristic, such as audio-frequency spectrum, ultraviolet spectrum, and radio spectrum.
Stafford Act—The Robert T. Stafford Disaster Relief and Emergency Assistance Act, P.L. 93–288, as amended. This act describes the programs and processes by which the federal government provides disaster and emergency assistance to state and local governments, tribal nations, eligible private nonprofit organizations, and individuals affected by a declared major disaster or emergency. The Stafford Act covers all hazards, including natural disasters and terrorist events.
Staging area—Any location in which personnel, supplies, and equipment can be temporarily housed or parked while awaiting operational assignment.
Standard industrial classification—A classification developed by the office of management and budget used to assign each establishment an industry code, which is determined by the product manufactured or service provided.
Standard operating procedure (SOP)—Complete reference document or an operations manual that provides the purpose, authorities, duration, and details for the preferred method of performing a single function or a number of interrelated functions in a uniform manner.
Standard procedure—A written instruction that establishes what action is required, who is to act, and when the action is to take place.
Standoff zone—The area between the protected structure and the perimeter barrier protecting the asset against potential threats.

Staphylococcus—Any of various spherical parasitic bacteria that occur in grapelike clusters and cause infections.
Static pressure—The potential pressure exerted in all directions by a fluid at rest.
Status report—Relays information specifically related to the status of resources (e.g., the availability or assignment of resources).
Steam sterilization—Treatment method for infectious waste using saturated steam within a pressurized vessel such as an autoclave.
Sterilize—Means the use of a physical or chemical procedure to destroy all microbial life including highly resistant spores.
Stochastic effect—Effect that occurs on a random basis independent of the size of dose of radiation.
Stoichiometry—Study of the mathematics of the material and energy balances (equilibrium) of chemical reactions.
Strategic—Elements of incident management are characterized by continuous, long-term, high-level planning by senior-level organizations.
Strategic Guidance Statement and Strategic Plan—Documents that together define the broad national strategic objectives; delineate authorities, roles, and responsibilities; determine required capabilities; and develop performance and effectiveness measures essential to prevent, protect against, respond to, and recover from domestic incidents.
Strategic Information and Operations Center (SIOC)—The focal point and operational control center for all federal intelligence, law enforcement, and investigative law enforcement activities related to domestic terrorist incidents or credible threats, including leading attribution investigations. The SIOC serves as an information clearinghouse to help collect, process, vet, and disseminate information relevant to law enforcement and criminal investigation efforts in a timely manner.
Strategy—The general plan or direction selected to accomplish objectives.
Streptococcus—Any of various rounded disease-causing bacteria that occur in pairs or chains.
Strontium (sr)—A silvery soft metal that rapidly turns yellow in air. Sr-90 is one of the radioactive fission materials created within a nuclear reactor during its operation. Stronium-90 emits beta particles during radioactive decay.
Substandard—A condition that deviates from what is acceptable, normal, or correct and is a potential hazard.
Supplied-air respirator (SAR)—A respirator that provides breathing air through an airline hose from an uncontaminated compressed air source to the face piece. The face piece can be a hood, helmet, or tight-fitting face piece.
Surge capability—The ability to manage patients requiring unusual or very specialized medical evaluation and care.
Surge capacity—The ability to evaluate and care for a markedly increased volume of patients—one that challenges or exceeds normal operating capacity.
Survey—Comprehensive study or assessment of a facility, workplace, or activity for insurance or loss control purposes.
System—A clearly described functional structure, including defined processes, that coordinates otherwise diverse parts to achieve a common goal.
Systematic—Striving toward goal accomplishment in a planned manner using predetermined steps or procedures.

T

Tactical—ICS elements characterized by the execution of specific actions or plans in response to an actual incident.
Tactics—Deployment and directing of resources on an incident to accomplish the objectives designated by strategy.

Teach mode—The control state that allows the generation and storage of positional data points effected by moving the robot arm through a path of intended motions.
Teamwork—Based on trust, communication, and innovation.
Tear gas—A chemical agent typically in liquid form and released as an aerosol liquid or gas. Upon contact with the target persons, it produces disorientation, nausea, a copious flow of tears and irritation of the eyes, and other disabling effects of temporary duration. When discharged, the gas has a blue-white smoky appearance and a strong, sweet odor. The effects last from 5 to 30 min depending upon the concentration and exposure.
Tendinitis—A condition where the muscle–tendon junction becomes inflamed.
Tenosynovitis—A condition that results in the inflammation of the tendons and their sheaths.
Teratogen—A substance or agent that when a pregnant female is exposed to can cause malformations in the fetus.
Terrorism—Any premeditated, unlawful act dangerous to human life or public welfare that is intended to intimidate or coerce civilian populations or governments.
Thermoluminescent dosimeter—A badge that contains a thermoluminescent chip worn by persons working with or around radioactive materials. This directive establishes a comprehensive national policy on the continuity of federal government structures and operations, and also creates the position of a single national continuity coordinator responsible for coordinating the development and implementation of federal continuity policies. This policy establishes *National Essential Functions* and prescribes continuity requirements for all executive departments and agencies, in order to ensure a comprehensive and integrated national continuity program that will enhance the credibility of our national security posture and enable a more rapid and effective response to and recovery from a national emergency.
Tiger team—A team of experts who assess the security measures by conducting unannounced penetration attempts such as trying to circumvent access controls or bypassing other security protection.
TLV—An ACGIH-published threshold limit value of an airborne concentration of a hazardous/toxic substance to which workers may be repeatedly exposed day after day without adverse effect.
Toxic substance—Any substance that can cause acute or chronic injury or illness to the human body.
Toxicity—Potential of a substance to have a harmful effect and a description of the effect and the conditions or concentration under which the effect takes place.
Transparency—Openness about error and learning from error.
Triage—The process of screening and classifying sick, wounded, or injured persons to determine priority needs in order to ensure the efficient use of resources.
Trigger finger—A condition caused by any finger being frequently flexed against some type of resistance.
Two-person rule—A security strategy that requires two people to be present in or gain access to a secured area to prevent unobserved access by any individual.

U

Ultraviolet radiation—Electromagnetic radiation with wavelengths between soft x-rays and visible violet light.
Undetectable failure—A postulated failure mode in the FMEA for which there is no failure detection method by which the operator is made aware of the failure.
Unified command—Agencies working together through their designated incident commanders or managers at a single location to establish a common set of objectives and strategies and a single incident action plan.
Uniform fire code—Regulations consistent with nationally recognized good practice for safeguarding life and property from the hazards of fire and explosion that arise from the storage, handling, and use of hazardous substances, materials, and devices.

Unity of command—Principle of management stating that each individual involved in incident operations will be assigned to only one supervisor.
Universal precautions—An OSHA term for the method of infection control in which all human blood and certain other materials are treated as infectious for bloodborne pathogens.
Unstable—A chemical that when in the pure state will vigorously polymerize, decompose, condense, or become self-reactive under conditions of shock, pressure, or temperature.
Upper explosive limit—Highest concentration of a substance that will burn or explode when an ignition source is present, expressed in percentage of vapor or gas in the air by volume.
Uranium—A naturally occurring radioactive element in a hard, silvery-white, shiny metallic ore that contains a minute amount of uranium-234.
User seal check—An action conducted by the respirator user to determine if a respirator is properly seated to the face.

V

Vapor—The gaseous form of a substance that is normally in the solid or liquid state at room temperature and pressure.
Vapor density—The weight of a vapor or gas compared to the weight of an equal.
Vapor pressure—The pressure exerted by a saturated vapor above its own liquid in a closed container.
Vector—Organism that carries disease, such as insects or rodents.
Vesicant agent—An agent that acts on the eyes and lungs and blisters the skin.
Viscosity—The property of a liquid that causes it to resist flow or movement in response to external force applied to it.
Visible radiation (light)—Electromagnetic radiation that can be detected by the human eye.
Volatile—The tendency or ability of a liquid to vaporize.
Volatile organic compounds—Compounds that evaporate from many housekeeping, maintenance, and building products made from organic chemicals.
Vomiting agent—Compounds that cause irritation of the upper respiratory tract and involuntary vomiting.

W

Water-reactive chemical—That reacts with water to release a gas that either is flammable or presents a health hazard.
Wavelength—The distance in the line of advance of a wave from any point to a like point on the next wave. Usually measured in angstroms, micrometers, macrometers, or nanometers.
Weapons of mass destruction (WMD)—Weapons that are capable of a high order of destruction and/or of being used in such a manner as to destroy large numbers of people. WMD can be high explosives or nuclear, biological, chemical, and radiological weapons, but exclude the means of transporting or propelling the weapon where such means is a separable and divisible part of the weapon.
Whole body count—The measure and analysis of the radiation being emitted from a person's entire body, detected by a counter external to the body.
Whole-body exposure—An exposure of the body to radiation, in which the entire body, rather than an isolated part, is irradiated by an external source.
Wood alcohol—Methyl alcohol.
Work practice controls—Any controls that reduce the likelihood of exposure by altering the manner in which a task is performed.

X

Xenobiotic—A man-made substance, such as plastic, found in the environment.
X-ray—Electromagnetic radiation caused by deflection of electrons from their original paths or inner orbital electrons that change their orbital levels around the atomic nucleus.

Z

Zone—A section of an alarmed, protected, or patrolled area. A zone often means a space having one or more sensors.

Appendix CC: AHRQ Patient Safety Tools and Resources

The Agency for Healthcare Research and Quality (AHRQ) offers the following tools for healthcare organizations, providers, policymakers, and patients to improve patient safety in healthcare settings.

The Hospital Survey on Patient Safety Culture examines patient safety culture from a hospital staff perspective and allows hospitals to assess their safety culture and track changes over time. Hospitals that administer the patient safety culture survey can voluntarily submit their data to the Comparative Database, a resource for hospitals wishing to compare their survey results to similar types of hospitals (AHRQ Publication No. 04-0041).

Hospital Survey on Patient Safety Culture: *Comparative Database Reports* give benchmark data collected voluntarily from more than 1000 US hospitals. Survey results from these hospitals are averaged over the entire sample by topical composite or individual survey item. Two appendices report the average responses, which are broken down by hospital or respondent characteristics.

The *Medical Office Survey on Patient Safety Culture* measures issues relevant to patient safety in the ambulatory medical office setting. Pilot tested in approximately 100 medical offices, the survey lets providers, and staff members to assess their safety culture, identify areas where improvement is needed, track changes in patient safety, and evaluate the effect of interventions. Researchers can also use the survey to assess patient safety culture improvement initiatives (AHRQ Publication No. 08(09)-0059).

The *Medical Office Survey on Patient Safety Culture*: *2012 Comparative Database Report* presents data from 23,679 staff within 934 US medical offices that completed the Medical Office Survey on Patient Safety Culture, so offices can compare their patient safety culture to other medical offices. The full report contains detailed comparative data for various medical office characteristics (number of providers, specialty, ownership, and region) and staff positions (AHRQ Publication No. 12-0052).

The *Nursing Home Survey on Patient Safety Culture* uses provider and staff perspectives to assess their nursing home's safety culture, identify areas where improvement is needed, track changes in patient safety, and evaluate the impact of interventions. The survey also lets researchers assess safety culture improvement initiatives in nursing homes (AHRQ Publication No. 08(09)-0060).

The *Nursing Home Survey on Patient Safety Culture*: *2011 User Comparative Database Report* is based on data from 226 nursing homes in the United States and provides initial results that nursing homes can use to compare their patient safety culture to other US nursing homes. The report consists of a narrative description of the findings and four appendices presenting data by nursing home characteristics and respondent characteristics (AHRQ Publication No. 11-0030).

Pharmacy Survey on Patient Safety Culture focuses on patient safety culture. AHRQ sponsored the survey, which was designed specifically for community pharmacy staff, and asked for their opinions about the culture of patient safety in their pharmacy (AHRQ Publication No. 12(13)-0085).

Patient Safety Organizations (PSOs) were created by the Patient Safety and Quality Improvement Act to improve the quality and safety of healthcare by encouraging clinicians and healthcare organizations to voluntarily report patient safety events without fear of legal discovery. PSOs offer a secure environment to identify and reduce the risks associated with patient care. As independent external experts, PSOs collect, analyze, and aggregate patient safety data locally, regionally, and nationally to develop insights into the underlying causes of patient safety events (web: http://www.pso.ahrq.gov).

Patient safety, quality and risk managers, clinicians, and others use *Common Formats* to collect patient safety event information in a standard way, using common language, definitions, technical requirements for electronic implementation, and reporting specifications. Common Formats optimize the opportunity for the public and private sectors to learn more about trends in patient safety with the purpose of improving healthcare quality. AHRQ has developed Common Formats for hospitals and nursing homes (including skilled nursing facilities) to collect data for all types of adverse events, near misses, and unsafe conditions (web: http://www.pso.ahrq.gov).

Measures of healthcare quality that make use of readily available hospital administrative data, the *Quality Indicators*™, can be used to highlight potential quality concerns, identify areas that need further study and investigation, and track changes over time. AHRQ distributes the Quality Indicators through free software programs that can help hospitals identify the quality of care events that might need further study. The current AHRQ Quality Indicators modules represent various aspects of quality:

- *Patient Safety Indicators* reflect quality of care inside hospitals, as well as geographic areas, to focus on potentially avoidable complications and iatrogenic events.
- *Prevention Quality Indicators* identify hospital admissions in geographic areas that, evidence suggests, may have been avoided through access to high-quality outpatient care.
- *Inpatient Quality Indicators* reflect quality of care inside hospitals, as well as across geographic areas, including inpatient mortality for medical conditions and surgical procedures.
- *Pediatric Quality Indicators* use indicators from the other three modules with adaptations for use among children and neonates to reflect quality of care inside hospitals, as well as geographic areas, and identify potentially avoidable hospitalizations.

A *Toolkit for Hospitals*: *Improving Performance on the AHRQ Quality Indicators*™ helps hospitals understand AHRQ's Quality Indicators that use hospital administrative data to assess the quality of care provided, identify areas of concern in need of further investigation, and monitor progress over time. The toolkit is a general guide to using improvement methods and focuses on the 17 Patient Safety Indicators and the 28 Inpatient Quality Indicators to improve quality and patient safety.

The *Hospital Consumer Assessment of Healthcare Providers and Systems* is a survey instrument for measuring patients' perspectives on hospital care. The 27-question survey contains patient perspectives on care and patient rating items that encompass key topics, including communication with doctors and nurses, responsiveness of hospital staff, pain management, communication about medicines, discharge information, and cleanliness and quietness of the hospital environment. The survey also includes screener questions and demographic items that are used for adjusting the mix of patients across hospitals and for analytical purposes (web: http://www.hcahpsonline.org).

The *Comprehensive Unit-Based Safety Program (CUSP) Toolkit* includes training tools to make care safer by improving the foundation of how physicians, nurses, and other clinical team members work together. It builds the capacity to address safety issues by combining clinical best practices and the science of safety. Created for clinicians by clinicians, the CUSP toolkit is modular and modifiable to meet individual unit needs and was proven effective through a national project that reduced central line–associated bloodstream infections by 41%. Each module includes teaching tools and resources to support change at the unit level, presented through facilitator notes that take you step by step through the module, presentation slides, tools, and videos.

The *Reengineered Discharge Toolkit* is designed to assist hospitals, including those that serve diverse populations, in implementing RED. A variety of forces are pushing hospitals to improve their discharge processes to reduce preventable readmissions. Researchers at the Boston University Medical Center developed and tested a Re-Engineered Discharge (RED) process, which was effective at reducing readmissions and posthospital emergency department visits (AHRQ Publication No. 12(13)-0084).

Preventing Falls in Hospitals: *A Toolkit for Improving Quality of Care* focuses on overcoming the challenges associated with developing, implementing, and sustaining a fall prevention program. The toolkit features an implementation guide for the team that is putting the new prevention strategies into practice and also has links to tools and resources.

The *Falls Management Program*: *A Quality Improvement Initiative for Nursing Facilities* presents an interdisciplinary quality improvement initiative designed to assist nursing facilities in providing individualized person-centered care and improving their fall care processes and outcomes through educational and quality improvement tools.

Making Health Care Safer II: *An Updated Critical Analysis of the Evidence for Patient Safety Practices* is the result of a panel of patient safety experts who assessed the evidence behind 41 patient safety strategies and identified 10 strategies that health systems should adopt now. The strategies can help prevent harmful events such as med errors, bedsores, and healthcare-associated infections. *Making Health Care Safer II* updates Evidence-based Practice Center report (#43), which was published in 2001 and provided the first systematic assessment of patient safety practices.

The *Emergency Severity Index (ESI)*: *A Triage Tool for Emergency Department Care, Version 4* is a five-level emergency department triage algorithm that provides clinically relevant stratification of patients into five groups from 1 (most urgent) to 5 (least urgent) on the basis of acuity and resource needs. The ESI helps hospital emergency departments to rapidly identify patients in need of immediate attention, better identify patients who could safely and more efficiently be seen in a fast-track or urgent care center rather than the main emergency department, and more accurately determine thresholds for diversion of ambulance patients from the emergency department. The 2012 edition of the Implementation Manual includes a pediatrics section and many other updates (AHRQ Publication No. 12-0014).

Improving Patient Flow and Reducing Emergency Department Crowding: *A Guide for Hospitals* presents step-by-step instructions for planning and implementing patient flow improvement strategies to alleviate crowded emergency departments. It addresses creating a patient flow team, measuring performance, identifying strategies, preparing to launch, facilitating change, and sharing results (AHRQ Publication No. 11(12)-0094).

Medications at Transitions and Clinical Handoffs (MATCH) Toolkit for Medication Reconciliation, based on the MATCH website, incorporates the experiences and lessons learned by healthcare facilities that have implemented MATCH strategies to improve their medication reconciliation processes for patients as they move through healthcare settings (AHRQ Publication No. 11(12)-0059).

The *Guide to Patient and Family Engagement in Hospital Quality and Safety* will help hospitals work as partners with patients and families to improve quality and safety. It contains four strategies to help hospitals partner with patients and families, and it has an implementation handbook and tools for patients, families, and clinicians for each strategy. The four strategies are helping hospitals recruit and work with patient and family advisors, communicating with patients and families throughout their hospital stay to improve quality, implementing nursing bedside change of shift report, and engaging patients and families in discharge planning (AHRQ 13-0033).

The *Toolkit for Reduction of Clostridium difficile through Antimicrobial Stewardship* assists hospital staff and leadership in developing an effective antimicrobial stewardship program (ASP) with the potential to reduce *Clostridium difficile* infection (*C. difficile*), a serious public health problem that has recently increased in both incidence and severity. An ASP is a systematic approach to developing coordinated interventions to reduce overuse and inappropriate selection of antibiotics, and to achieve optimal outcomes for patients in cost-efficient ways. ASPs targeted to *C. difficile* reduction show promise because increased rates of *C. difficile* are associated with inappropriate antibiotic use.

The *Preventing Pressure Ulcers in Hospitals Toolkit* assists hospital staff in implementing effective pressure ulcer prevention practices through an interdisciplinary approach to care. The toolkit draws on literature on best practices in pressure ulcer prevention and includes both validated and newly developed tools.

Preventing Hospital-Acquired Venous Thromboembolism: *A Guide for Effective Quality Improvement* is based on quality improvement initiatives undertaken at the University of California, San Diego Medical Center, and Emory University Hospitals in Atlanta. This guide assists quality improvement practitioners in leading an effort to improve the prevention of one of the most serious problems facing hospitalized patients: Hospital-acquired venous thromboembolism (AHRQ Publication No. 08-0075).

Developing a Community-Based Patient Safety Advisory Council provides approaches for hospitals and other healthcare organizations to use to develop a community-based advisory council that can drive change for patient safety through education, collaboration, and consumer engagement (AHRQ Publication No. 08-0048).

Mistake-Proofing the Design of Health Care Processes is illustrated with numerous examples and explains how to apply the industrial engineering concept of mistake-proofing to processes in hospitals, clinics, and physicians' offices (AHRQ Publication No. 07-0020).

Team Strategies and Tools to Enhance Performance and Patient Safety (TeamSTEPPS®) is a set of tools to help train clinicians in teamwork and communication skills to reduce risks to patient safety (AHRQ Publication No. 06-0020-0).

TeamSTEPPS Rapid Response Systems Guide, which includes PowerPoint presentations, teaching modules, and video vignettes for training hospital staff who work with Rapid Response Systems, in which hospitals use groups of clinicians to bring critical care expertise to patients requiring immediate treatment (AHRQ Publication No. 08(09)-0074-CD).

TeamSTEPPS® Enhancing Safety for Patients with Limited English Proficiency Module, which helps healthcare organizations develop and deploy a customized plan to train staff in teamwork skills and lead a medical teamwork improvement initiative for working with applied to patients who have difficulty communicating in English. Comprehensive curricula and instructional guides include short case studies and videos illustrating teamwork opportunities and successes (AHRQ Publication No. 12(13)-0068-DVD).

Research suggests that adverse events affect patients with limited English proficiency more frequently, are often caused by communication problems, and are more likely to result in serious harm compared to those that affect English-speaking patients. *Improving Patient Safety Systems for Patients with Limited English Proficiency*: *A Guide for Hospitals* focuses on how hospitals can better identify, report, monitor, and prevent medical errors in patients with limited English proficiency (AHRQ Publication No. 12-0041).

TeamSTEPPS Long-Term Care Version adapts the core concepts of the TeamSTEPPS program to reflect the environment of nursing homes and other long-term care settings such as assisted living and continuing care retirement communities. The examples, discussions, and exercises are tailored to address and improve teamwork in the long-term care environment (AHRQ Publication No. 12(13)-0004-DVD).

Improving Patient Safety in Long-Term Care Facilities is intended for use in training frontline personnel in nursing home and other long-term care facilities. The educational materials are presented in three modules: Module One addresses detecting changes in a resident's condition, Module Two addresses communicating changes in a resident's condition, and Module Three addresses falls prevention and management. The Instructor Guide comprises all three modules, including suggested slides and pre- and posttests to gauge the student's knowledge level before and after training. Separate student workbooks are available for each module (AHRQ Publication No. 12-0001-1).

Transforming Hospitals: *Designing for Safety and Quality* presents information about three model hospitals that incorporated evidence-based design elements into their construction and renovation projects. This DVD shows hospital leaders how evidence-based design can improve the quality and safety of hospital services. It is an especially useful tool for hospitals that are planning capital construction projects or renovations (AHRQ Publication No. 07-0076-DVD).

Patient Safety and Quality: *An Evidence-Based Handbook for Nurses* is a three-volume handbook in which nurses will find peer-reviewed discussions and reviews of issues and literature regarding patient safety and quality healthcare. Each of the 51 chapters and 3 leadership vignettes presents an examination of the state of the science behind quality and safety concepts and challenges nurses to use evidence to change practices and engage in developing the evidence base to address critical knowledge gaps (AHRQ Publication No. 08-0043-CD).

Advances in Patient Safety: *New Directions and Alternative Approaches* is a four-volume set of 115 articles, which describe patient safety findings, investigative approaches, process analyses, lessons learned, and practical tools to prevent patients from being harmed. It includes articles by AHRQ-funded patient safety researchers on topics such as reporting systems, risk assessment, safety culture, medical simulation, health information technology, and medication safety (AHRQ Publication No. 08-0034).

Advances in Patient Safety: *From Research to Implementation* is a four-volume set of 140 articles, which describe accomplishments between 1999 and 2004 by federally funded programs in understanding medical errors and implementing programs to improve patient safety. Included are articles with a research and methodological focus, articles that address implementation issues, and tools to improve patient safety (AHRQ Publication No. 05-0021-CD).

Tools for Patients and Families

20 Tips to Help Prevent Medical Errors tells patients what they can do to get safer care and addresses medicines, hospital stays, surgery, medical tests, and more (AHRQ Publication No. 11-0089).

Appendix DD: Agency Listings

ALPHABETICAL LISTING

Agency for Health Care Policy and Research
2101 East Jefferson Street, Suite 600, Rockville, MD 20852

Agency for Healthcare Research and Quality and Center for Quality Improvement and Patient Safety
6011 Executive Blvd., Suite 200, Rockville, MD 20852
(301) 594-1783; www.ahrq.gov

Agency for Toxic Substances and Disease Registry and National Center for Environmental Health
(404) 498-0110, fax: 404-498-0093, toll-free: (888) 422-8737

American Board of Medical Specialties
1007 Church Street, Suite 404, Evanston, IL 60201-5913
(866) ASK-ABMS, (847) 491-909; www.abms.org

American Chemical Society (ACS)
1155 Sixteenth St. NW, Washington, D.C. 20036
(202) 872-4600; (800) 227-5558

American Conference of Governmental Industrial Hygienists (ACGIH)
1330 Kemper Meadow Drive, Cincinnati, OH 45240
(513) 742-2020

American Health Care Association
1201 L Street, NW, Washington, D.C. 20005
(202) 842-4444

American Health Information Management Association
919 North Michigan Avenue, Suite 1400, Chicago, IL 60611
(312) 787-2672, www.ahima.org

American Hospital Association
One North Franklin Street, Chicago, IL 60606
(312) 422-3000, fax: (312) 422-4796
325 Seventh Street, NW, Washington, D.C. 20004
(202) 638-1100, fax: (202) 626-2345,
toll-free: (800) 424-4301

American Industrial Hygiene Association (AIHA)
2700 Prosperity Avenue, Suite 250, Fairfax, VA 22031
(703) 849-8888; fax: (703) 207-3561

American Medical Association
515 N. State Street, Chicago, IL 60610
(312) 464-5000, toll-free: (800) 621-8335; www.ama-assn.org

American National Standards Institute
11 W 42nd Street, New York, NY 10036
(212) 642-4900

American Nurses Association
600 Maryland Avenue SW, Suite 100 West, Washington, D.C. 20024
(202) 651-7000, (202) 651-7001, fax: (800) 274-4ANA (4262)

American Organization of Nurse Executives (AONE)
Liberty Place, 325 Seventh Street, NW
Washington, D.C. 20004
(202) 626-2240, fax: (202) 638-5499

American Society for Healthcare Engineering (ASHE)
One North Franklin Street, Chicago, IL 60606
(312) 422-3800, fax: (312) 422-4571, e-mail: ashe@aha.org

American Society for Healthcare Environmental Services (ASHES)
One North Franklin Street, Chicago, IL 60606
(312) 422-3860, fax: (312) 422-4578

American Society for Healthcare Risk Management (ASHRM)
One North Franklin Street, Chicago, IL 60606
(312) 422-3980, fax: (312) 422-4580, e-mail: ashrm@aha.org

American Society for Testing and Materials (ASTM)
100 Barr Harbor Drive, West Conshohocken, PA 19428
(610) 832-9500

American Society of Heating, Refrigerating, and Air Conditioning Engineering (ASHRAE)
1791 Tullie Circle, N.E, Atlanta, GA 30329
(404) 636-8400, fax: (404) 321-5478
Toll-free for customer service:
(800) 527-4723 (U.S. and Canada only)

American Society of Safety Engineers (ASSE)
1800 E. Oakton Street, Des Plaines, IL 60018
(847) 699-2929

Association for Professionals in Infection Control and Epidemiology (APIC)
1275 K Street, NW, Suite 1000, Washington, D.C. 20005-4006
(202) 789-1890, fax: (202) 789-1899, e-mail: APICinfo@apic.org

Association of American Medical Colleges
2450 N Street, NW, Washington, D.C. 20037-1126
(202) 828-0400, fax (202) 828-1125; www.aamc.org

Association of Healthcare Resources and Materials Management
One North Franklin Street, Chicago, IL 60606
(312) 422-3840, fax: (312) 422-4573, e-mail: ahrmm@aha.org

Centers for Disease Control (CDC)
1600 Clifton Road NE, Atlanta, GA 30333
(404) 639-3535

Centers for Medicare and Medicaid Services (CMS)
www.hcfa.gov

Chemical Manufacturers Association (CMA)
1300 Wilson Blvd, Arlington, VA 22209
(703) 741-5000

CHEM-TEL (24-Hour Emergency Information Services)
(800) 255-3924

CHEMTREC
(800) 262-8200 (nonemergency chemical information)

Compressed Gas Association (CGA)
1725 Jefferson Davis Hwy, Suite 1004, Arlington, VA 22202-4102
(703) 412-0900

Consumer Product Safety Commission Hotline
(800) 638-2772 or (800) 638-CPSC

Department of Defense (DOD)
Armed Forces Institute of Pathology, Patient Safety Center
1335 East West Highway, Suite 6-100, Silver Spring, MD 20910-9813
(800) 863-3263, (301) 295-7242; www.defenselink.mil, www.afip.org/PSC

Department of Energy (DOE)
1000 Independence Avenue SW, Washington, D.C. 20585
(202) 586-5000

Department of Health and Human Services (HHS)
200 Independence Avenue, SW, Washington, D.C. 20201
(202) 619 0257; www.os.dhhs.gov/

Department of Transportation (DOT)
400 7th Street SW, Washington, D.C. 20590
(202) 366-4488

Emergency Care Research Institute (ECRI)
5200 Butler Pike, Plymouth Meeting, PA 19462-1298
(610) 825-6000; www.ecri.org, www.mdsr.ecri.org (medical device safety reports)

Environmental Protection Agency (EPA)
401 M Street SW, Washington, D.C. 20460
(202) 260-2090; EPA hotline: (800) 621-8431; RCRA, Superfund, Hazardous Waste hotline, Office of Solid Waste and Emergency Response: (800) 424-9346; Emergency Planning Community Right-to-Know hotline (CERCLA, SARA, Title III): (800) 535-0202; Toxic Substances Control Act hotline: (202) 554-1404

Factory Mutual (FM)
1151 Boston-Providence Turnpike, Norwood, MA 02062
(617) 762-4300

FEMA
500 C Street, SW, Washington, D.C. 20472
(202) 566-1600

Food and Drug Administration
5600 Fishers Lane, Rockville, MD 20857-0001
(301) 443-1544; Center for Drug Evaluation and Research: 888-INFO-FDA (1-888-463-6332); www.fda.gov/cder/drug/MedErrors/default.htm (medication errors);
www.accessdata.fda.gov/scripts/cdrh/cfdocs/psn/index.cfm (patient safety news)

Health Care Financing Administration
7500 Security Boulevard, Baltimore, MD 21244
(410) 786-300; www.hcfa.gov

Health Care without Harm
1755 S Street, NW, Suite 6B, Washington, D.C. 20009
Fax: (202) 234-9121

Health Physics Society
1313 Dolley Madison Boulevard, Suite 402, McLean, VA 22101
(703) 790-1745, fax: (703) 790-2672, e-mail: hps@BurkInc.com

Health Resources and Services Administration
5600 Fishers Lane, Parklawn Building, Room 14-45, Rockville, MD 20857
(301) 443-3376

Hospitals for a Healthy Environment
P.O. Box 53315, Washington, D.C. 20009
(800) 727-4179, fax: (866) 379-9705

Human Factors and Ergonomics Society
P.O. Box 1369, Santa Monica, CA 90406
(310) 394-1811, fax: (310) 394-2410; www.hfes.org

Institute for Healthcare Improvement
375 Longwood Ave., 4th Floor, Boston, MA. 02215
(617) 754-4800; www.ihi.org

Institute for Safe Medication Practices (ISMP)
www.ismp.org

Institute of Medicine
2101 Constitution Avenue NW, Washington, D.C. 20418
www.iom.edu; www.iom.edu/IOM/IOMHome.nsf/Pages/Quality+Initiative (patient safety)

International Association for Healthcare Security and Safety (IAHSS)
www.iahss.org

Joint Commission on Accreditation of Health Care Organizations (JCAHO)
1 Renaissance Boulevard, Oakbrook Terrace, IL 60181
(708) 916-5600; www.jcaho.org

Leapfrog Group
1801 K Street NW, Suite 701-L, Washington, D.C. 20006
(202) 292-6713; www.leapfroggroup.org/safety.htm

National Association for Healthcare Quality (NAHQ)
4700 W. Lake Avenue, Glenview, IL 60025
(847) 375-4720, info@nahq.org

National Coalition on Health Care
1200 G Street NW, Suite 750, Washington, D.C. 20005
(202) 638-7151; www.nchc.org

National Council on Radiation Protection and Measurements
7910 Woodmont Avenue, Suite 400, Bethesda, MD 20814-3095
(301) 657-2652, fax: (301) 907-8768; www.ncrp.com

National Fire Protection Association
1 Batterymarch Park, P.O. Box 9101, Quincy, MA 02269
(617) 770-3000

National Institute for Occupational Safety and Health (NIOSH)
4676 Columbia Parkway, Cincinnati, OH 45226
(513) 533-8236, toll-free: (800) 356-4674

National Institutes of Health
9000 Rockville Pike, Bethesda, MD 20892
(301) 496-4000; TTY: (301) 402-9612; www.nih.gov/health

National Library of Medicine
8600 Rockville Pike, Bethesda, MD 20894
(301) 496-6308; www.nlm.nih.gov/

National Oceanic and Atmospheric Administration (NOAA)
14th Street and Constitution Avenue NW, Room 6217, Washington, D.C. 20230
(202) 482-6090, fax: (202) 482-3154

National Patient Safety Foundation
8405 Greensboro Drive, Suite 800, McLean, VA 22102-5120
(703) 506-3280; www.npsf.org

National Quality Forum
601 Thirteenth Street NW, Suite 500 North, Washington, D.C. 20005
(202) 783-1300; www.qualityforum.org

Nuclear Regulatory Commission (NRC)
(301) 492-7000 (regulatory questions), (301) 492-7333 (publications)

National Response Center/Coast Guard Command
(800) 424-8802 (report spills, chemical releases, radiological incidents)

National Safety Council (NSC)
1121 Spring Lake Drive; Itasca, IL 60143-3201
(800) 621-7615; http://nsc.org

National Sanitation Foundation International
P.O. Box 130140, 789 N. Dixboro Road, Ann Arbor, MI 48113-0140
(734) 769-8010, fax: (734) 769-0109, toll-free: (800) NSF-MARK; www.nsf.org

Occupational Safety and Health Administration (OSHA)
200 Constitution Ave. NW, Room 3647, Washington, D.C. 20210
(202) 219-8148, hotline: (800) 321-6742 (24-hour access line to report unsafe work practices)

Patient Safety Institute
555 Republic Drive, Suite 200, Plano, TX 75074
(972) 444-9800; www.ptsafety.org

Public Law Update Service
(202) 523-6641 (information on recent bills signed or vetoed by the president)

Safety Equipment Institute
1901 N. Moore Street, Suite 808, Arlington, VA 22209
(703) 525-3354

Superintendent of Documents
U.S. Government Printing Office, Washington, D.C. 20402-9329
(202) 512-2457

Underwriters Laboratories
333 Pfingsten Road, Northbrook, IL 60062
(847) 272-8800

U.S. Fire Administration
16825 S. Seton Ave., Emmitsburg, MD 21727
(301) 447-1000, fax: (301) 447-1346, (301) 447-1441 (admissions)

Veteran's Administration (VA)
National Center for Patient Safety, 24 Frank Lloyd Wright Drive, Lobby M, P.O. Box 486, Ann Arbor, MI 48106-0486
(734) 930-5890; www.patientsafety.gov

WEBSITE QUICK REFERENCE

Agency for Health Care Policy and Research
http://www.ahcpr.gov

Air Force Safety Center
http://www-afsc.saia.af.mil

American Association of Homes and Services for the Aging (AAHSA)
http://www.aahsa.org

American Association of Integrated Healthcare Delivery Systems (AAIHDS)
http://www.aaihds.org

American Association of Poison Control Centers (AAPCC)
http://www.aapcc.org

American Board of Industrial Hygiene
http://www.abih.org

American Chemical Society
http://www.acs.org

American College of Health Care Administrators (ACHCA) (long-term care)
http://www.achca.org

American College of Healthcare Executives (ACHE)
http://www.ache.org

American Conference of Governmental Industrial Hygienists
http://www.acgih.org

American Health Care Association (AHCA) (nursing homes/long-term care)
http://www.ahca.org

American Industrial Hygiene Association
http://www.aiha.org

American Institute of Architects (AIA)/Academy of Architecture for Health (AAH)
(800) 242-3837; http://www.aia.org/pia/gateway/PIA_Home_Pages/aah_default

American Medical Association (AMA)
http://www.ama-assn.org

American National Standards Institute
http://www.ansi.org

American Nurses Association (ANA)
http://www.ana.org

American Osteopathic Association (AOA)
http://www.am-osteo-assn.org

American Osteopathic Healthcare Association (AOHA)
http://www.aoha.org

American Public Health Association (APHA)
http://www.apha.org

American Society for Healthcare Environmental Services
http://www.ashes.org

American Society for Healthcare Risk Management
http://www.ashrm.org

American Society for Industrial Security
http://www.asisonline.org

American Society of Health System Pharmacists (ASHP)
http://www.ashp.com

American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE)
http://www.ashrae.org

American Society of Safety Engineers (ASSE)
http://www.asse.org

American Society of Safety Engineers/Healthcare Division (ASSE)
http://www.gegoux.com/asse.html

American Subacute Care Association (ASCA)
http://members.aol.com/ascamail/index.htm

Army MEDCOM Quality Management Office
http://www.cs.amedd.army.mil/qmo/

Army MEDCOM Safety
http://www.cs.amedd.army.mil/medcomsafety

Army Medical Department
http://www.armymedicine.army.mil/armymed/default2.htm

Army Safety Program
http://safety.army.mil/

ASHP Compounding Resource Center (offers advice on compliance with USP Chapter 797)
http://www.ashp.org/SterileCPD/

Association for Health Services Research (AHSR)
http://www.ahsr.org

Association for Professionals in Infection Control and Epidemiology (APIC)
http://www.apic.org

Association of American Medical Colleges (AAMC)
http://www.aamc.org

Bureau of Labor Statistics (includes price indexes)
http://stats.bls.gov

Bureau of the Census
http://www.census.gov

California Medical Services Authority, Disaster Medical Services Division
http://www.emsa.cahwnet.gov/dms2/dms2.asp

Canadian Centre for Occupational Health and Safety (CCOHS), The
http://www.ccohs.org

Canadian College of Health Service Executives (CCHSE)
http://highlander.cbnet.ns.ca/cbnet/healthca/cchse/index.html

Case Management Society of America (CMSA)
http://www.cmsaonline.com

Catholic Health Association of the United States
http://www.chausa.org

Center for Health Design
http://www.healthdesign.org

Centers for Disease Control and Prevention (CDC)
1600 Clifton Road, N.E., Atlanta, GA 30333
(404) 639-3534, (800) 311-3435; http://www.cdc.gov

Clinical Laboratory Management Association (CLMA)
http://www.clma.org

Coalition for Healthier Cities and Communities
http://www.healthycities.org

College of Healthcare Information Management Executives (CHIME)
http://www.chime-net.org

Commission on Accreditation of Rehabilitation Facilities (CARF)
http://www.carf.org

Compressed Gas Association (CGA)
http://www.cganet.com/

Consumer Product Safety Commission
http://www.cpsc.gov

Defense Environmental Network and Information Exchange
http://www.denix.osd.mil/

Department of Health and Human Services
http://www.os.dhhs.gov

Department of Homeland Security's Federal Emergency Management Agency National Incident Management System (NIMS)
http://www.fema.gov/nims

Department of Transportation Office of Hazardous Materials Safety
http://hazmat.dot.gov/

Department of Veterans Affairs
http://www.va.gov

Disaster Resource Guide
http://www.disaster-resource.com

ECRI (formerly the Emergency Care Research Institute)
http://www.ecri.org

Environmental Protection Agency (EPA)
http://www.epa.gov/

FDA Patient Safety News
http://www.accessdata.fda.gov/scripts/cdrh/cfdocs/psn/index.cfm

Federal Emergency Management Agency (FEMA)
http://www.fema.gov/

FedStats
http://www.fedstats.gov

Fire Prevention, Medical Equipment and Utilities, American College of Clinical Engineering
http://www.accenet.org

Food and Drug Administration (FDA)
http://www.fda.gov/

Government Printing Office
http://www.access.gpo.gov

H2E
http://www.h2e-online.org/index.asp

Hazard, Education, and Safety Performance Institute, a Division of TLC Services, Inc.
http://certsafenow.com

HAZMAT for Healthcare
http://www.hazmatforhealthcare.org/about_the_task_force.htm

HC Information Resources Inc.
http://hcinfo.com

Health Care Resource Management Society (HCRMS)
http://www.hcrms.com

Health Resources and Services Administration
http://www.hrsa.dhhs.gov

Healthcare Circuit News
http://www.healthcareengineering.net/

Healthcare Financial Management Association (HFMA)
http://www.hfma.org

Healthcare Information and Management Systems Society (HIMSS)
http://www.himss.org

Healthcare Safety Institute
http://www.hcsinstitute.com

Howard Hughes Medical Institute
http://www.hhmi.org

Industrial Hygiene and Safety Resource
http://www.safetyonline.com/content/homepage/

Industrial Hygiene Resource Pages
http://freeweb.pdq.net/ennis/ih/

International Association for Healthcare Security and Safety (IAHHS)
http://www.iahss.org

International Executive Housekeepers Association (IEHA)
http://www.ieha.org

Joint Commission on Accreditation of Healthcare Organizations (JCAHO)
http://www.jcaho.org

Medical Group Management Association (MGMA)
http://www.mgma.com

National Association for Healthcare Quality (NAHQ)
http://www.nahq.org

National Association for Home Care (NAHC)
http://www.nahc.org

National Center for Health Statistics
http://www.cdc.gov/nchswww/nchshome.htm

National Center for Missing and Exploited Children
http://www.missingkids.org

National Commission on Correctional Health Care (NCCHC)
http://www.corrections.com/ncchc/index.html

National Committee for Quality Assurance (NCQA)
http://www.ncqa.org

National Council for Community Behavioral Healthcare (NCCBH)
http://www.nccbh.org

National Fire Protection Association (NFPA)
http://www.nfpa.org

National Health Information Center
http://www.nhic-nt.health.org

National Hospice Organization (NHO)
http://www.nho.org

National Institute for Occupational Safety and Health (NIOSH)
http://www.cdc.gov/niosh/homepage.html

National Institutes of Health
http://www.nih.gov

National League for Nursing (NLN)
http://www.nln.org

National Library of Medicine
http://www.nlm.nih.gov

National Medical Association (NMA)
http://www.nma.org

National Rural Health Association (NRHA)
http://www.nrharural.org

National Safety Council
http://www.nsc.org

National Safety Management Society
http://www.safetyhealthmanager.org

National Society for Healthcare Food Service Management (NSHFSM)
http://www.nshfsm.org

Naval Safety Center
http://www.safetycenter.navy.mil

Occupational Hazards (resource for safety, health, and industrial hygiene)
http://www.occupationalhazards.com/

Occupational Safety and Health Administration (OSHA)
http://www.osha.gov/

Public Health Foundation
http://www.phf.org

Safety Info.com
http://www.safetyinfo.com/

Substance Abuse and Mental Health Services Administration (SAMHSA)
http://www.samhsa.gov

University of Virginia Health Care Worker Safety Center
http://www.med.virginia.edu/medcntr/centers/epinet/home.html

U.S. Environmental Protection Agency
http://www.epa.gov

U.S. House of Representatives
http://www.house.gov

U.S. Senate
http://www.senate.gov

Vermont Safety Information Service
http://www.hazard.com/

White House
http://www.whitehouse.gov

World Health Organization
http://www.who.ch

WWW.Industrial Hygiene.Com
http://www.industrialhygiene.com

Appendix EE: NIOSH Healthcare Worker Information

Healthcare is the fastest-growing sector of the US economy, employing over 18 million workers. Women represent nearly 80% of the healthcare workforce. Healthcare workers face a wide range of job hazards including needlestick injuries, back injuries, latex allergy, violence, and stress. Although it is possible to prevent or reduce healthcare worker exposure to these hazards, healthcare workers continue to experience injuries and illnesses in the workplace. Cases of nonfatal occupational injury and illness among healthcare workers are among the highest of any industry sector. By contrast, two of the most hazardous industries, agriculture and construction, are safer today than they were a decade ago. National Institute for Occupational Safety and Health (NIOSH) has created a series of six Fast Facts cards that provide brief explanations of individual hazards to home healthcare workers and preventative steps. These were designed to be used by employers for training and to be kept by the workers for quick reference. They are available in English, Spanish, Chinese, and Polish.

- How to prevent violence on the job
- How to prevent latex allergies
- How to prevent musculoskeletal disorders
- How to prevent exposure in unsafe conditions
- How to prevent driving-related injuries
- How to prevent needlestick and sharps injuries

Healthcare and Social Assistance Identification of Research Opportunities for the Next Decade of NORA DHHS (NIOSH) Publication No. 2009-139 (June 2009)

Healthcare and Social Assistance-Advancing priorities through research and partnerships DHHS (NIOSH) Publication No. 2009-149 (June 2009)

NIOSH Program Portfolio–Health Care and Social Assistance

The mission of the NIOSH research program for the HCSA sector is to eliminate occupational diseases, injuries, and fatalities among individuals working in this sector through a focused program of research and prevention.

A Compendium of NIOSH Health Care Worker Research 2001

DHHS (NIOSH) Publication No. 2003-108 (December 2002)

Overview of Research Projects Related to the Healthcare Industry

NIOSH Hazard Review: Occupational Hazards in Home Healthcare, DHHS (NIOSH) Publication No. 2010-125 (January 2010). The publication describes the risks and offers preventative strategies for home healthcare employers and workers.

Respirator Use in Healthcare Workplaces—A Toolkit for Respirator Program Administrators was developed by the California Department of Public Health with funding from the NIOSH National Personal Protective Technology Laboratory.

Preventing Transmission of Pandemic Influenza and Other Viral Respiratory Diseases: Personal Protective Equipment for Healthcare Personnel was updated in January 27, 2011. This report for NIOSH from the Institute of Medicine assesses the progress of PPE research and identifies future directions for PPE for healthcare personnel.

Immunization of Healthcare Personnel Recommendations of the Advisory Committee on Immunization Practices (ACIP)

HHS Action Plan to Prevent Healthcare-Associated Infections: Influenza Vaccination of Healthcare Personnel describes an initiative of the Department of Health and Human Services (HHS) to improve vaccination rates for influenza among healthcare workers.

Interim Guidance on Planning for the Use of Surgical Masks and Respirators in Health Care Settings during an Influenza Pandemic (October 2006) provides a science-based framework to facilitate planning for surgical mask and respirator use in healthcare settings during an influenza pandemic.

Recommendations for Protecting Laboratory, Field, and Clinical Workers from West Nile Virus Exposure

DHHS (NIOSH) Publication No. 2006-115 (December 2005) provides information for protecting workers

NIOSH List of Hazardous Drugs in Healthcare Settings Allows Healthcare Workers to Minimize Exposure and Reduce Health Risks, DHHS (NIOSH) Publication No. 2011-189 (August 2011)

Best Practices for the Safe Use of Glutaraldehyde in Healthcare (2006) is a handbook that can help employers and employees understand and control exposures to glutaraldehyde, a toxic chemical used to disinfect and clean heat-sensitive medical, surgical, and dental equipment, Occupational Safety and Health Administration (OSHA).

Glutaraldehyde: Occupational Hazards in Hospitals, DHHS (NIOSH) Publication No. 2001-115 (May 2001) describes the adverse effects of exposure to glutaraldehyde, occupational exposures, and control.

Control of Smoke From Laser/Electric Surgical Procedures (Hazard Control), DHHS (NIOSH) Publication No. 96-128 (March 1998) describes how to control airborne contaminants generated by these surgical devices.

Waste Anesthetic Gases—Occupational Hazards in Hospitals, DHHS (NIOSH) Publication No. 2007-151 (September 2007) provides information about the adverse health effects of waste anesthetic gases, describes how workers are exposed, recommends work practices to reduce these exposures, and identifies methods to minimize leakage of anesthetic gases into the work environment.

Workplace Solutions: Preventing Work-Related Musculoskeletal Disorders in Sonography

DHHS (NIOSH) Publication No. 2006-148 provides case summaries and recommendations for preventing MSDs in healthcare workers giving sonograms.

Safe Lifting and Movement of Nursing Home Residents, DHHS (NIOSH) Publication No. 2006-117 (February 2006) provides guidance for nursing home owners, administrators, nurse managers, safety and health professionals, and workers who are interested in establishing a safe resident lifting program.

Research to Improve Safety for Ambulance Service Workers and EMS Responders, DHHS (NIOSH) Publication No. 2011-190 (August 2011)

Public Health Notification from FDA, CDC, EPA, and OSHA: Avoiding Hazards with Using Cleaners and Disinfectants on Electronic Medical Equipment (October 31, 2007) describes problems such as equipment fire and malfunction and healthcare worker burns resulting from inappropriate use of cleaning and disinfecting liquids on electronic medical equipment.

FDA and NIOSH Public Health Notification: Oxygen Regulator Fires Resulting from Incorrect Use of CGA870 Seals (June 19, 2006) alerts healthcare professionals and the public about a potential occupational hazard associated with the improper use of oxygen regulator gaskets.

NIOSH Fast Facts: Home Healthcare Workers: How to Prevent Violence on the Job, DHHS (NIOSH) Publication No. 2012-118 (February 2012)

Violence: Occupational Hazards in Hospitals, DHHS (NIOSH) Publication No. 2002-101 (April 2002) provides information about increasing worker and employer awareness of the risk factors for violence in hospitals and to provide strategies for reducing exposure to these factors.

Workplace Violence and Prevention in New Jersey Hospital Emergency Departments, New Jersey Department of Health and Senior Services, describes the findings of an NIOSH-funded study on workplace violence among hospital emergency department workers.

Exposure to Stress: Occupational Hazards in Hospitals, DHHS (NIOSH) Publication No. 2008-136 (July 2008) identifies the sources and adverse health effects of occupational stress and recommends work practices to reduce occupational stress in the healthcare industry.

Workplace Solutions: Medical Surveillance for Health Care Workers Exposed to Hazardous Drugs

DHHS (NIOSH) Publication No. 2007-117 (April 2007) addresses hazards for healthcare workers who handle, prepare, or administer hazardous drugs. Workers may face risks to their own health such as skin rashes, cancer, and reproductive disorders. NIOSH recommends that employers establish a medical surveillance program to protect workers who handle hazardous drugs in the workplace.

Appendix FF: OSHA Publication Listing

Abatement: Small Entity Compliance Guide for OSHA's Abatement Verification Regulation (29 CFR 1903.19) (1997).

Alliance—OSHA Alliance Program Fact Sheet (OSHA FS-3645—2013).

Asbestos Standard for the Construction Industry (OSHA 3096—2002).

Automated External Defibrillators: Saving Sudden Cardiac Arrest Victims in the Workplace (OSHA 3185—2003).

Avian Flu Healthcare Workers Quick Card™ (OSHA 3308—2006).

Bloodborne Pathogens: Model Plans and Programs for the OSHA Bloodborne Pathogens and Hazard Communications Standards (OSHA 3186—2003).

Cold Stress Quick Card™ (OSHA 3138—2004).

Construction—Pocket Guide (OSHA 3252—2005).

Construction Industry Digest (OSHA 2202—2011).

Distracted Driving (OSHA 3416—2012).

Electrical Hazards: Controlling Electrical Hazards (OSHA 3075—2002).

Emergency Action Plans: How to Plan for Workplace Emergencies and Evacuations (OSHA 3088—2001).

Emergency Response: Best Practices for Protecting EMS Responders during Treatment and Transport of Victims of Hazardous Substance Releases (OSHA 3370—2009).

Emergency Response: Hospitals and Community Emergency Response—What You Need to Know (OSHA 3152—Printed: 2008).

Employer Rights and Responsibilities Following an OSHA Inspection (OSHA 3000—2011).

Ergonomics: Guidelines for Nursing Homes: Ergonomics for the Prevention of Musculoskeletal Disorders—OSHA's Guidelines for Nursing Homes focuses on practical recommendations for employers to reduce the number and severity of workplace injuries by using methods found to be successful in the nursing home environment (OSHA 3182—2007).

Ethylene Oxide (ETO): Understanding OSHA's Exposure Monitoring Requirements (OSHA 3325—2007).

Fall Prevention Fact Sheet (OSHA 3533—2012).

Fire Service Features of Buildings and Fire Protection Systems: Explains how fire service operations can be influenced by different building features and offers considerations for design professionals that can help facilitate these operations. The manual includes chapters and narratives on building and site design, sprinkler systems, standpipe systems, fire department connections, fire alarm and communications systems, as well as various firefighting systems (OSHA 3256—2006).

First Aid: Best Practices Guide—Fundamentals of a Workplace First-Aid Program: This guide identifies four essential elements for first aid programs to be effective and successful: management leadership and employee involvement, worksite analysis, hazard prevention and control, and safety and health training. It also includes best practices for planning and conducting safe and effective first-aid training (OSHA 3317—2006).

General Industry Digest (OSHA 2201—2012).

Glutaraldehyde: Best Practices for the Safe Use of Glutaraldehyde in Health Care (OSHA 3258—2006).

Hand and Power Tools (OSHA 3080—2002).

Hazard Communication Guidance for Combustible Dusts (OSHA 3371—2009).

Hazard Communication Guidelines for Compliance (OSHA 3111—2000).
Hazard Communication Safety Data Sheets (OSHA 3493—2012).
Hazard Communication Standard Labels (OSHA 3492—2012).
Hazard Communication Standard Pictogram (OSHA 3491—2012).
Hazardous Waste & Emergency Response (OSHA 3114—2008).
Hearing Conservation (OSHA 3074—2002).
Heat Illness Prevention Training Guide, a Lesson Plan for Employers—Use this training guide to lead interactive training with workers and supervisors (OSHA 3437—2011).
Heat Illness: OSHA-NIOSH Heat Illness Info Sheet: Protecting Workers from Heat Illness—At times, workers may be required to work in hot environments for long periods. This fact sheet provides information to employers on measures they should take to prevent heat-related illnesses and death (OSHA 3438—2011).
Industrial Hygiene (OSHA 3143—1998).
Job Hazard Analysis Guide (OSHA 3071—2002).
Job Safety and Health—It's the Law Poster (OSHA 3495).
Laboratory Safety Guidance (OSHA 3404—2011).
Laboratory Safety: Autoclaves/Sterilizers Quick Facts (OSHA 3405—2011).
Laboratory Safety: Biosafety Cabinets (BSCs) Fact Sheet (OSHA FS-3460—2011).
Laboratory Safety: Centrifuges Quick Facts (OSHA 3406—2011).
Laboratory Safety: Chemical Fume Hoods Quick Facts (OSHA 3407—2011).
Laboratory Safety: Chemical Hygiene Plan (CHP) Fact Sheet (OSHA FS-3461—2011).
Laboratory Safety: Ergonomics for the Prevention of Musculoskeletal Disorders Fact Sheet (OSHA FS-3462—2011).
Laboratory Safety: Labeling and Transfer of Chemicals Quick Facts (OSHA 3410—2011).
Ladder Safety: Falling Off Ladders Can Kill: Use Them Safely (OSHA 3625—2013).
Lockout/Tagout: Control of Hazardous Energy Lockout-Tagout (OSHA 3120—2002).
Materials Handling and Storage (OSHA 2236—2002).
Medical Records: Access to Medical and Exposure Records (OSHA 3110—2001).
Methylene Chloride (OSHA 3144—2003).
Mold: Preventing Mold-Related Problems in the Indoor Workplace (OSHA 3304—2006).
Motor Vehicle Guidelines for Employers—This document offers useful information to help employers design an effective driver safety program in their workplace. It features a 10-step program outlining what an employer can do to improve traffic safety performance and minimize the risk of motor vehicle crashes. It also includes success stories from employers who have benefited from effective driver safety programs (2005).
OSHA: All about OSHA—An OSHA handbook providing an overview of the agency, its regulatory responsibilities, policies, procedures, and programs (OSHA 3302—2012).
Pandemic Flu: Guidance on Preparing Workplaces for an Influenza Pandemic—Developed in coordination with the Department of Health and Human Services (HHS), this publication provides general guidance for all types of workplaces; describes the differences between seasonal, avian, and pandemic influenza; and presents information on the nature of a potential pandemic, how the virus is likely to spread, and how exposure is likely to occur (OSHA 3327—2009).
Personal Protective Equipment (OSHA 3151—2003).
Respiratory Protection Standard: Small Entity Compliance Guide (OSHA 3384—2011).
Respiratory Protection: Assigned Protection Factors for the Revised Respiratory Protection Standard (OSHA 3352—2009).
Safety and Health Program Management: Voluntary Safety and Health Program Management Guidelines Fact Sheet Scaffolding (OSHA 3150—2002).
Screening and Surveillance: A Guide to OSHA Standards (OSHA 3162—2009).
Small Business Handbook (OSHA 2209—2005).

Small Business: Safety and Health Add Value—Summarizes how effective safety and health programs can benefit small businesses (OSHA 3180—2003).
Stairways and Ladders (OSHA 3124—2003).
Toluene: Toluene Safety in the Workplace Info Sheet (OSHA 3646—2013).
Training Requirements in OSHA Standards and Training Guidelines (OSHA 2254—1998).
Workers' Rights *Booklet* (OSHA 3021—2011).
Workplace Violence: Guidelines for Preventing Workplace Violence for Health Care and Social Service Workers (OSHA 3148—2004).

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