2 Safety and Preparedness

essential terms

- biohazards
- Bloodborne Pathogens Standard
- chemical hazards
- chemical hygiene plan
- electrical hazards
- emergency preparedness
- ergonomics
- exposure control plan
- fire and explosive hazards
- Globally Harmonized System (GHS)
- hazardous materials (HAZMATS)
- hazard statement
- needlestick injury
- Needlestick Safety and Prevention Act
- other potentially infectious materials (OPIM)
- Occupational Safety and Health Administration (OSHA)
- physical hazards
- pictogram
- precautionary statement
- radioactive hazard
- safety data sheets (SDS)
- shelter-in-place
- signal word

David Moyer,/McGraw-Hill Education

Learning Outcomes

2.1 Discuss practices to ensure safety and reduce the risk of infection from medical biohazards in compliance with state and federal standards and regulations.

2.2 Recognize symbols and systems and apply techniques to ensure the physical safety of healthcare workers and patients.

Related NAACLS Competencies

2.1 Demonstrate knowledge of infection control and safety.

2.2 Identify policies and procedures for maintaining laboratory safety.

2.4 Comply with federal, state, and locally mandated regulations regarding safety practices.

2.4.1 Observe the OSHA Blood borne Pathogens Standard and Needle Safety Precautions Act.

2.4.2 Use prescribed procedures to handle electrical, radiation, biological and fire hazards.

2.4.3 Use appropriate practices, as outlined in the OSHA Hazard Communications Standard, including the correct use of the Material Safety Data Sheet as directed.

2.5 Describe measures used to ensure patient safety in various patient settings, e.g., Inpatient, outpatient, pediatrics, etc.

Introduction

All healthcare personnel must provide for their own safety, as well as the safety of patients and co-workers. This chapter discusses the various hazards that may be present in the clinical setting, including methods to maintain safety and preparedness for these hazards.

2.1 Medical Biohazards

Biological substances that can threaten human health are called **biohazards.** Medical biohazards include any materials that may be contaminated with infectious agents. They include blood and body fluids, medical waste, and laboratory specimens and cultures. The handling and disposal of biohazardous wastes are regulated both by individual state regulatory committees and by OSHA and the CDC at the federal level. As state regulations often exceed federal requirements, be sure you know the applicable laws in your state.

Always wear gloves when handling biohazardous waste and place them only in bags or containers that are red and are clearly labeled as biohazards. Biohazardous waste containers should be placed close to locations where biohazardous waste is generated, such as next to a phlebotomy station.

Bloodborne Pathogens Standard

To help reduce the risk of injury and infection from biohazardous wastes, in 1991 OSHA developed the **Bloodborne Pathogens Standard.** This standard requires that healthcare facilities provide annual employee training on preventing exposure to bloodborne pathogens as well as using the necessary personal protective equipment (PPE). The use of PPE according to the standard applies to all blood products, body fluids, human tissues and cultures, vaccines, and any supplies, instruments, or equipment that have been in contact with any of these biohazards. Also according to the standard, all potentially biohazardous waste must be discarded in an appropriate manner or processed according to strict guidelines.

To comply with the Bloodborne Pathogens Standard, employers must provide documented training to all employees. Training covers general information about infectious diseases caused by bloodborne pathogens, the use of PPE, universal precautions, and devices engineered to prevent exposure. It also includes procedures employees should follow when exposure occurs.

The Bloodborne Pathogens Standard also mandates other requirements. Employers must offer the hepatitis B vaccine (HBV) at no charge to all employees who are reasonably expected to come in contact with blood or **other potentially infectious materials (OPIM).** In addition, each healthcare facility is required to have an occupational **exposure control plan,** which is a protocol to be followed in the event an employee is exposed to bloodborne pathogens.

Needlestick Safety and Prevention Act

One of the most common biohazards in the healthcare setting is the risk of injury or infection from needles. A **needlestick injury** is a percutaneous (through the skin) piercing wound that is caused by the point of a needle. Injuries caused by other sharp instruments or objects, such as lancets, blades, or glass slides, are also included in this category.

Needlestick injuries are preventable with proper education, safety equipment, and the elimination of needles whenever possible. Through the recommendation of the National Institute for Occupational Safety and Health

(NIOSH) and the **Occupational Safety and Health Administration (OSHA),** the Needlestick Safety and Prevention Act was passed in 2000. In response, OSHA updated the Bloodborne Pathogen Standard in 2001.

The **Needlestick Safety and Prevention Act** mandates the use of safety devices that reduce needlestick injuries in the clinical setting. The introduction of needleless equipment and protected needles has significantly reduced the risk of needlestick injuries. All devices selected for phlebotomy must be equipped with needlestick prevention features, such as one-handed needle covering devices or retractable needles. These devices, called *engineering controls,* will be discussed in more detail in the chapter *Blood Collection Equipment*. To reduce the chance of a needlestick injury, never break off, recap, or reuse needles.

Figure 2-1 A sharps disposal container provides a place to safely dispose of used needles in order to prevent a needlestick injury.
Leesa Whicker

In addition, a sharps container must be used for the proper disposal of needles and other sharps. Immediately after using a needle or other sharp device, engage the safety feature and place it in the sharps container (see Figure 2-1). Sharps containers should be discarded into a designated biohazardous waste container when they become two-thirds to three-quarters full.

The ultimate objective of the Needlestick Safety and Prevention Act is to protect both employees and patients from coming in contact with potentially harmful materials, such as contaminated needles and other sharps. Proper disposal of venipuncture equipment greatly decreases the incidence of accidental needlestick injuries and exposure.

Exposure to Hazardous Drugs

Research has shown that long-term exposure to hazardous drugs, such as antiviral and cancer drugs, can cause both acute and chronic illnesses in healthcare workers. In 2004, the National Institute for Occupational Safety and Health (NIOSH) published the NIOSH Alert: Preventing Occupational Exposures to Antineoplastic and Other Hazardous Drugs in Health Care Settings. This Alert is frequently updated and includes a list of hazardous drugs and recommendations for safe handling. Phlebotomists should be aware of the existence of these hazardous drugs, especially when repeatedly drawing blood from patients using them, such as oncology (cancer) patients.

Cleaning Up Biohazardous Spills

No matter how careful healthcare personnel may be, biohazardous spills do occasionally occur. Such spills must be handled carefully and according to federal guidelines. Depending on the type of spill, a biohazard spill cleanup kit may be needed. These kits contain special hazardous waste control products such as disposable dustpans and brushes for cleaning up broken glass that has contained blood or other biohazardous material (see Figure 2-2).

Figure 2-2 A biohazard cleanup kit.
Sandra Mesrine/McGraw-Hill Education

Clean up all biohazardous spills or splatters immediately. Always use appropriate PPE; never allow hazardous substances to come in contact with your skin. If the spill involves broken glass, use the disposable equipment in the spill kit to collect the contaminated glass and to dispose of it in a sharps container.

Checkpoint Questions 2.1

1. Explain the rules and regulations instituted by the federal government to protect healthcare workers from biohazards.
2. What is the ultimate objective of disposing of sharps in a specially made container?

2.2 Personal Safety and Preparedness

Complying with regulations and guidelines not only helps protect patients, personnel, and visitors from potentially contracting infections, but it also keeps everyone safe in other ways. Everyone involved in delivering quality healthcare must be aware of and comply with safety regulations and mandates from all levels of governmental and employer-developed policies.

In hospital laboratories, a designated safety officer is responsible for implementing a laboratory safety program. Injury and illness can occur because of improper handling of equipment during procedures or modification of the steps of the procedures. Each member of the healthcare team is responsible for his or her own safety as well as the safety of patients and other people in the immediate area. As part of preparation for working safely in a laboratory, use the competency checklist *Safety Equipment in the Clinical Setting* at the end of this chapter to review and practice identifying all the safety equipment in your laboratory.

Physical hazards in the healthcare setting are any nonbiological objects that may cause injury or illness to healthcare employees, patients, or visitors. Physical hazards include allergen exposure, chemical hazards, compressed gas cylinders, electrical systems, fire hazards, radiation hazards, temperature hazards, and vacuum systems. In addition, physical hazards can result from using improper ergonomics in the workplace or lack of commonsense practices.

Common Sense and Ergonomics

Commonsense precautions should be applied in almost every environment, but especially in the healthcare setting. Avoid running or rushing, be aware of wet floors, avoid wearing dangling jewelry, and tie back long hair. Dangling jewelry and long hair may be obstacles in performing phlebotomy. More importantly, they can become contaminated and increase the risk of infection transfer, including healthcare-associated infections (HAIs). HAIs are discussed further in the *Infection Control* chapter.

While processing specimens in the laboratory, operate laboratory equipment as recommended by the manufacturer. Again, wearing dangling jewelry and long hair untied may create a hazard when using equipment such as centrifuges. Keeping the workplace clean and organized also helps create a safe work environment.

Phlebotomists may need to process specimens of various temperatures. For example, some specimens must be frozen at –112°F (–80°C) or even stored in liquid nitrogen. Other specimens may need to be placed in a heated water bath. Care must be taken to use appropriate protective equipment, such as

A

B

C

Figure 2-3 Specimen processing may require (A) cooling or (B) warming samples. (C) Specimens may also need to be transported on dry ice.
(A) McGraw-Hill Education/Sandra Mesrine; (B) Sandra Mesrine/McGraw-Hill Education; (C): Lillian Mundt

thermal gloves and hot mitts, when handling heated or cooled specimens. Ordinary gloves may be used when handling cooled or warmed specimens that are not stored at extreme temperatures. However, thermal gloves should be worn when handling dry ice for frozen specimen transport (see Figure 2-3).

Safety awareness is also important when using the vacuum systems that are found in most hospitals. These systems are used to transport pneumatic tubes to and from the laboratory. The suction in these systems is strong and can cause injury if used inappropriately. Caution must be used when opening these tubes, as the specimen container may have broken on its way to the lab, creating a biohazard (see Figure 2-4). The use of the pneumatic tube system must be validated for every analyte intended to be tested on specimens transported to the laboratory by this method. The facility's SOPs (standard operating procedures) should contain the types of specimens approved for pneumatic tube transport, how they are to be wrapped or cushioned in the transport tubes, and a list of specimens that should never be sent by pneumatic tube.

Tripping hazards are unnecessary clutter left on the floor or hanging off a wall. Boxes of supplies or

Figure 2-4 Vacuum system pneumatic tube station.
Sandra Mesrine/McGraw-Hill Education

discarded boxes, purses, loose cords, and liquid spills or leaks are examples of tripping or slipping hazards dangerous to the phlebotomist and patient alike.

Ergonomics is the practice of adapting a job task or equipment so that you can perform the task safely and productively. In phlebotomy, this includes sitting rather than standing and bending to perform a blood collection, lowering a bedrail to provide full access to the patient's arm (remember to replace the bedrail to its original position when you are finished), and placing equipment close to the procedure area to avoid reaching. Most healthcare employees use a computer to record and/or process patient information. Adjusting the height of the chair, the angle of the computer screen, and the position of your wrist when using a mouse will help you avoid the long-term physical effects of computer use.

Proper **body mechanics** should be used when lifting and moving objects. Bend your knees and use your leg muscles when lifting awkward or heavy objects to help prevent back strain. If you are in doubt about whether an object is too heavy to lift by yourself, ask a co-worker to help you. Be prepared to assist a patient who is fainting by supporting the head and keeping them close to your body while using your leg muscles to assist to the chair, table, or ground.

Allergen Exposure

It is not uncommon for healthcare workers to have or develop allergies to products used in the healthcare setting. For example, healthcare providers may come into contact with latex routinely. Natural rubber latex (NRL) may be found in equipment used in phlebotomy, such as gloves, tourniquets, bandages, and tape. Healthcare employees and patients who are allergic to latex may experience symptoms ranging from itchy, red, watery eyes to chest tightness, shortness of breath, and shock. Latex can also cause bumps, sores, or red, raised areas on the part of the skin exposed to latex. Powdered gloves are especially dangerous because, when the gloves are removed, the powder disperses into the air. Powdered latex gloves should *never* be used for phlebotomy. Instead, use only powder-free, nonlatex gloves.

Because latex can be found in several types of items, latex allergies are not to be taken lightly. Severe allergic reactions and even deaths have resulted from latex allergies. If you suspect that you are allergic to latex, you may consider undergoing specialized immunologic evaluations, such as skin tests and blood testing. However, the simplest way to avoid an allergic reaction is to avoid latex entirely. Most facilities now provide nonlatex equipment and supplies routinely.

In rare cases, patients and healthcare employees may develop allergies to nonlatex gloves and to the alcohol used in alcohol prep pads. Being aware of any possible allergy is essential for preventing allergic reactions.

Electrical Hazards

Electrical hazards include any contact with electrical equipment or the failure of equipment that creates a dangerous condition, which can result in electric shock, burn, electrocution, or even an explosion. These events are caused when electrical potentials move across a person. Ways to minimize electrical hazards include the following:

- Use three-pronged, grounded plugs to avoid short-circuits between incoming electricity, lab instruments, and the person(s) touching the instruments.
- Avoid touching electrical equipment that is wet from spilled liquids.
- Do not touch equipment with wet hands.

- If equipment is damaged, malfunctions, smells unusual, or makes a loud noise, turn it off.
- Do not stretch electrical cords.
- Do not use extension cords.
- Do not use equipment with damaged electrical cords until they are repaired.
- Turn off electrical equipment during a power failure to avoid a surge when power is restored.

In the event that you encounter a victim of electrical shock, always disconnect the power before attempting to rescue the victim.

Fire and Explosive Hazards

Fire and explosive hazards include situations in which a likelihood of fire or explosions exists. Fire hazards also include blocked fire escapes that prevent evacuation if a fire occurs. Fires and explosions can occur due to overloaded electrical circuits, the misuse of chemicals, a lack of training, or carelessness. Your participation in fire training and fire drills helps speed up the escape process in the event of a real fire. As the phlebotomist, you may be the first one to notice a fire as you enter a patient's room.

All healthcare employees should be trained in proper rescue procedures and the use of fire extinguishers. If a fire does occur, perform the four basic steps in fire emergency response, which is abbreviated *RACE* (**R**escue, **A**larm, **C**ontain, and **E**xtinguish). The RACE procedure includes:

R: Rescue those who need immediate help.
A: Activate the fire alarm or phone in the alarm.
C: Contain the fire as much as possible.
E: Extinguish the fire, if possible.

These steps should be shared among several responders to speed the process. Everyone should be evacuated from the area of the fire quickly. Becoming familiar with the types of fire extinguishers available will help you select the correct one for each and every situation. See Table 2-1.

An easy way to remember the appropriate use of each type of fire extinguisher is to associate the letters for these extinguishers to the type fire they are designed to put out. A is for ashes. This includes anything that results in ash when it burns such as paper and cloth. B is for bubbles and boils. This includes any flammable liquids. And C is for circuit or current. This includes any electrical cords or appliances. An "ABC" fire extinguisher is commonly available in most healthcare settings, taking the guessing out of which type of fire extinguisher to use.

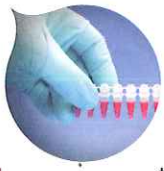
TABLE 2-1 Classes of Fires and Extinguishers to Use

Class	Type of Fire	Type of Extinguisher
A	Ordinary combustibles such as cloth, paper, or wood; in a healthcare setting, this might be a trashcan fire	Pressurized water, dry chemical
B	Flammable liquids such as oils, alcohol, and grease; in the medical laboratory, many liquid chemicals are flammable	Dry chemical, carbon dioxide
C	Electrical equipment and its wiring, such as appliances and electronic devices; many electronic devices and instruments are used in healthcare settings and in the laboratory	Dry chemical, carbon dioxide, halon
D	Combustible metals, which are not usually found in the healthcare setting	Sand or special extinguishing agent

Figure 2-5 Fire extinguishers commonly found in the healthcare setting are small enough to be carried to the fire. A. **P**ull the safety pin to activate the fire extinguisher. B. **A**im at the base of the fire. C. **S**queeze the trigger. D. **S**weep from side to side until the fire has been extinguished.

The type of fire that healthcare workers are most likely to encounter is the trashcan fire. After performing the first three steps in the RACE response sequence, you may be able to attempt extinguishing the fire. Using the acronym PASS will help you remember the correct sequence in using a fire extinguisher. (1) **P**ull out the pin. (2) **A**im (at the base of the fire, not at the flames). (3) **S**queeze the trigger. (4) **S**weep the base of the fire (see Figure 2-5).

Safety & Infection Control



Patient on Fire!

A patient has been smoking and fallen asleep or otherwise has caught their clothing on fire. In this case, you *do not* use a fire extinguisher because of the chance of choking. Instead, protect yourself with a blanket or other type of covering. Approach the patient with the blanket, sliding it under the patient's chin to protect the airway. If possible, tuck the blanket around the patient on both sides and beginning at the chin, sweep the blanket down toward the feet to put out the fire. Sweep as many times as necessary to put out the flames. Practicing this technique during a supervised fire safety training event will help you become confident in this procedure.

If the patient is conscious, have them stop, drop, and roll: Stop what they are doing. Drop to the floor. Roll to help extinguish the fire.

Chemical Hazards

Chemical hazards include harmful or potentially harmful chemicals used by healthcare employees. Chemicals such as strong acids and bases can burn unprotected skin or cause serious damage if splashed in the eyes. For example, in some healthcare settings, phlebotomists may need to add preservatives to 24-hour urine collection containers. These preservatives contain potentially harmful chemicals, so handling them properly is of the utmost importance. Guidelines for handling chemicals include the following:

- Use glassware appropriate for the task.
- Use PPE and engineering controls and never pipet by mouth. PPE for handling chemicals include a lab coat, gloves, and a face shield or goggles.
- When diluting an acid, add the acid to water. Never add water to an acid. Adding water to an acid can splatter or generate a great amount of heat and may cause a burn.
- Observe state and federal regulations when storing or disposing of chemicals. Some chemicals need to be stored in a flameproof metal cabinet (see Figure 2-6).
- Compressed gas cylinders must be chained to the wall or to a handcart during transport. Dropping a gas cylinder may prove fatal, as it can release its contents with explosive pressure and become a destructive projectile.

Figure 2-6 Chemical safety cabinet.
Sandra Mesrine/McGraw-Hill Education

Regulations require that chemicals be labeled with the contents of the container, the date of purchase or preparation, and the initials of the preparer. In addition, OSHA recommends that all containers that hold hazardous chemicals be marked with a hazard symbol that specifies their level of risk (see Figure 2-7).

OSHA modified its Hazard Communication Standard (HCS) to include the **Globally Harmonized System (GHS).** The GHS is an internationally agreed-upon system for communicating chemical hazards in order to improve safety and health in the workplace. The GHS provides detailed criteria for determining a chemical's hazardous effects, standardized labeling criteria, and a standard (harmonized) format for safety data sheets. Hazard classifications are definitions of hazards that are grouped under health hazards and physical hazards. Under the current HCS, the label must include the identity of the chemical and the appropriate hazard warnings by displaying a standardized signal word, a pictogram, and a hazard statement. A **pictogram** is a symbol (including border and background color) that is intended to convey specific information about the hazards of a chemical. The GHS has nine pictograms. A **signal word** (either "danger" or "warning") is used on the label to indicate the hazard's relative level of severity. A **hazard statement** describes the nature and degree of the chemical's hazard(s). A **precautionary statement,** on the other hand, lists measures to minimize or prevent adverse effects resulting from exposure to a hazardous chemical. Figure 2-8 shows a sample label.

Labeling systems that are currently in use may partially or completely meet OSHA requirements. Two such systems that you may encounter in the clinical laboratory setting include the hazards identification systems developed by the National Fire Protection Agency (NFPA) and by the American Coatings Association, Inc. (ACA). Each facility must determine which system or combination of systems is most appropriate for its needs.

GHS Pictograms and Hazard Classes		
		
▪ Oxidizers	▪ Flammables ▪ Self Reactives ▪ Pyrophorics ▪ Self-Heating ▪ Emits Flammable Gas ▪ Organic Peroxides	▪ Explosives ▪ Self-Reactives ▪ Organic Peroxides
		
▪ Acute Toxicity (severe)	▪ Corrosives	▪ Gases Under Pressure
		
▪ Carcinogen ▪ Respiratory Sensitizer ▪ Reproductive Toxicity ▪ Target Organ Toxicity ▪ Mutagenicity ▪ Aspiration Toxicity	▪ Environmental Toxicity	▪ Irritant ▪ Dermal Sensitizer ▪ Acute Toxicity (harmful) ▪ Narcotic Effects ▪ Respiratory Tract ▪ Irritation

Figure 2-7 Hazardous chemicals must be marked with a pictogram (as found on the OSHA website).

In the NFPA system, a diamond is the most commonly used symbol (Figure 2-9). Table 2-2 outlines the meaning of each part of the NFPA diamond. The NFPA diamond is designed for use in emergency situations where quick access to information about the effects of short or acute exposure is needed.

To meet the requirements of the OSHA Hazard Communication Standard, the ACA developed a Hazardous Materials Identification System (HMIS) that is being adopted by some healthcare facilities. The HMIS uses a color bar (Figure 2-10) that is similar to the NFPA diamond. However, the purpose of the HMIS color bar is not for emergencies; rather it conveys information about

SAMPLE LABEL

PRODUCT IDENTIFIER

CODE _____
Product Name _____

SUPPLIER IDENTIFICATION

Company Name_____

Street Address _____
City _____ State _____
Postal Code _____ Country _____
Emergency Phone Number _____

PRECAUTIONARY STATEMENTS

Keep container tightly closed. Store in cool, well ventilated place that is locked.
Keep away from heat/sparks/open flame. No smoking.
Only use non-sparking tools.
Use explosion-proof electrical equipment.
Take precautionary measure against static discharge.
Ground and bond container and receiving equipment.
Do not breathe vapors.
Wear protective gloves.
Do not eat, drink or smoke when using this product.
Wash hands thoroughly after handling.
Dispose of in accordance with local, regional, national, international regulations as specified.

In Case of Fire: use dry chemical (BC) or Carbon dioxide (CO2) fire extinguisher to extinguish.

First Aid
If exposed call Poison Center.
If on skin (on hair): Take off immediately any contaminated clothing. Rinse skin with water.

HAZARD PICTOGRAMS

SIGNAL WORD

Danger

HAZARD STATEMENT

Highly flammable liquid and vapor.
May cause liver and kidney damage.

SUPPLEMENTAL INFORMATION

Directions for use

_____
_____
_____

Fill weight: _____ Lot Number _____
Gross weight: _____ Fill Date: _____
Expiration Date: _____

Figure 2-8 All the elements required by OSHA for labeling of chemicals are shown in this sample label from the OSHA Hazard Communication Labeling Quick Card (pictogram, signal word, hazard statement, and precautionary statement).

broader health warnings. Table 2-3 outlines the meaning of each color bar of the HMIS. Hazards are rated from 0 (minimum) to 4 (severe) and recommended PPEs are shown using pictograms (Figure 2-11).

If a chemical contacts the skin or eyes, the best first aid is immediate flushing with large amounts of water. Use the competency checklist *Using an Eyewash Station* at the end of this chapter to review and practice the procedure. Emergency showers and eyewashes are located throughout the medical laboratory (Figure 2-12). Be sure you know their locations and how to use them. Contaminated clothing should be removed as soon

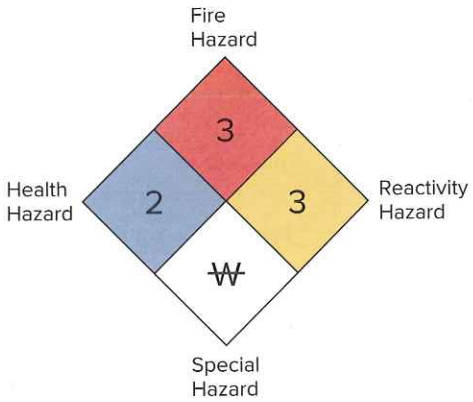


Figure 2-9 NFPA diamond hazard symbol.

Figure 2-10 The HMIS label uses colors similar to those used in the NFPA diamond. Newer labels have replaced yellow with orange for the physical hazard indicator. The HMIS® trademark and related content are used under license of the American Coatings Association.

TABLE 2-2 National Fire Protection Agency Chemical Hazard Code

Color	Location	Meaning
RED	Upper quadrant	Indicates a chemical's degree of flammability hazard Numbers represent relative flash point in degrees Fahrenheit 0—will not burn 1—not exceeding 200°F 2—above 100°F 3—below 100°F 4—below 73°F
BLUE	Left middle quadrant	Indicates the level of hazard the chemical poses to health. 0—no health concerns 1—slightly hazardous 2—hazardous 3—extreme danger 4—deadly
YELLOW	Right middle quadrant	Indicates the chemical's reactivity or stability at certain temperatures. 0—stable 1—unstable if heated 2—violent chemical change 3—shock and heat 4—may detonate
WHITE	Lower quadrant	Indicates the existence of additional hazards. Abbreviations are used to indicate ACID—acid ALK—alkali COR—corrosive OXY—oxidizer P—polymerization W—reacts with water  Radiation symbol indicates radiation hazard. Lillian Mundt

TABLE 2-3 HMIS Color Bar Meanings

Color	Location	Meaning
BLUE	Top bar	Indicates the level of hazard the chemical poses to health
RED	Second bar	Indicates a chemical's degree of flammability hazard
YELLOW or ORANGE	Third bar	Indicates the chemical's level of physical hazard
WHITE	Bottom bar	Indicates the types of personal protection needed

as possible. Chemical spill kits (Figure 2-13) are available to neutralize chemicals spilled on laboratory surfaces and to help minimize exposure.

OSHA mandates that healthcare facilities develop and implement plans to protect healthcare workers from exposure to various hazards. These plans include a **chemical hygiene plan,** a biohazard exposure control plan, and a plan for handling **hazardous materials (HAZMATS).** State "right-to-know documents" and OSHA document 29 CFR 1910 set standards for chemical

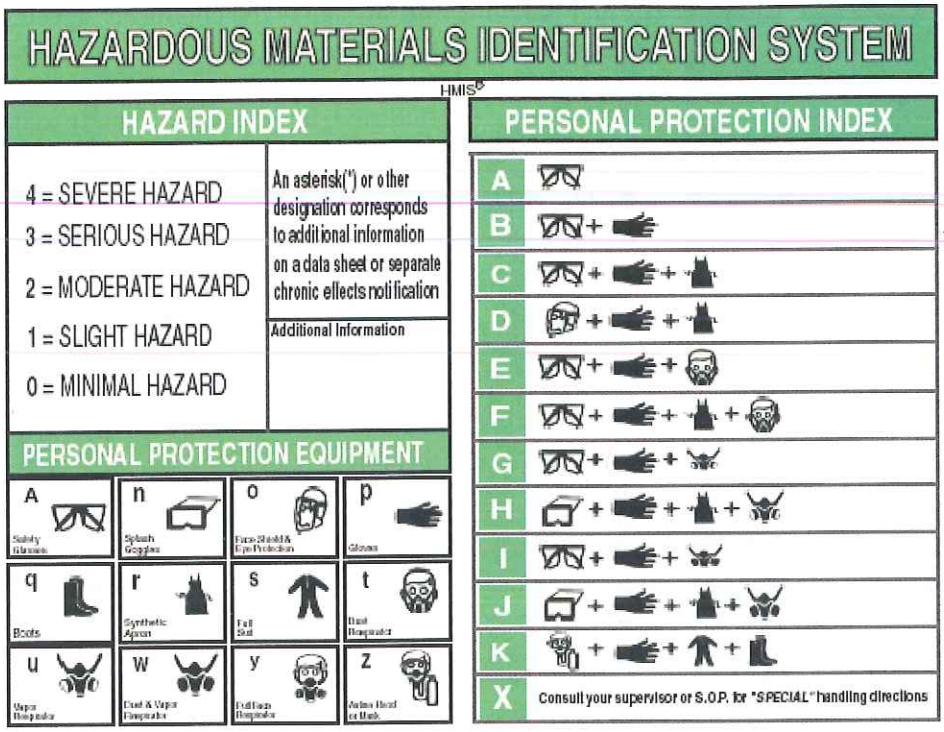
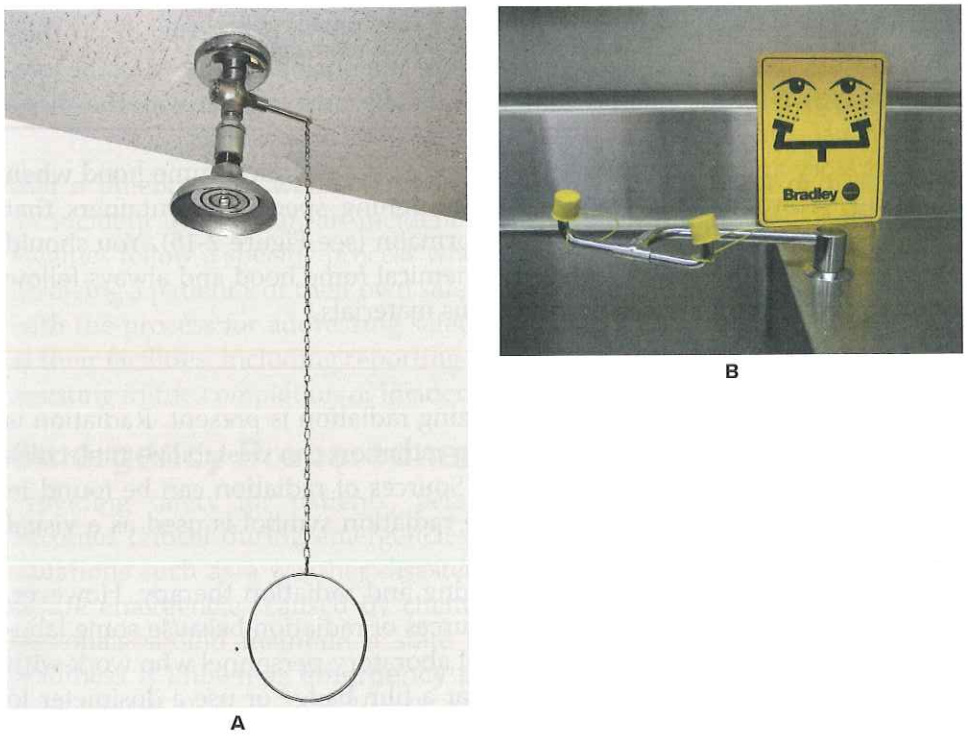


Figure 2-11 The HMIS uses a 0 to 4 rating scale for the hazard index and a variety of pictograms to indicate the recommended PPE to use when handling the chemical. The HMIS® trademark and related content are used under license of the American Coatings Association.



A B

Figure 2-12 (A) Emergency shower. (B) Emergency eyewash.
A: Sandra Mesrine/McGraw-Hill Education; B: Phyllis Cox

hazard communication (HAZCOM) to educate employees about their work environment and to keep them informed of potential hazards.

OSHA requires employers to provide **safety data sheets (SDS)** for every chemical purchased by or kept in a facility (see Figure 2-14). These data sheets, developed by the chemical suppliers, provide important information about

Figure 2-13 Chemical spill kit.
Sandra Mesrine/McGraw-Hill Education

proper handling and storage of the chemicals, specific hazards associated with them, first-aid measures, and personal protection required as well as other relevant information. As outlined by the GHS, safety data sheets must include the following information:

1. Identification
2. Hazard(s) identification
3. Composition/information on ingredients
4. First-aid measures
5. Firefighting measures
6. Accidental release measures
7. Handling and storage
8. Exposure controls/personal protection
9. Physical and chemical properties
10. Stability and reactivity
11. Toxicological information
12. Ecological information
13. Disposal considerations
14. Transport information
15. Regulatory information
16. Other information, including date of preparation or last revision

Employers should ensure that SDS are available in print copy or on their company's employee website. Employees are responsible for knowing the location of the SDS for the chemicals they handle. Become familiar with the chemicals you use and know what to do in case of spills or accidents.

Laboratory and other healthcare workers use a chemical fume hood when handling hazardous chemicals or when opening specimen containers that have hazardous preservatives, such as formalin (see Figure 2-15). You should obtain proper training on the use of a chemical fume hood and always follow facility procedures for handling hazardous materials.

Radioactive Hazards

A **radioactive hazard** exists where ionizing radiation is present. Radiation is energy traveling through space. Ionizing radiation can destabilize molecules within cells and lead to tissue damage. Sources of radiation can be found in several areas of healthcare settings. The radiation symbol is used as a visual warning of this hazard.

Radiation is used for diagnostic imaging and radiation therapy. However, the medical laboratory may also have sources of radiation because some laboratory tests use radioactive compounds. Laboratory personnel who work with radioactive materials are required to wear a film badge or use a dosimeter to monitor their exposure to radiation. As a phlebotomist, you will need to be aware of those areas where radiation is used and limit the time you stay in those areas. In addition to limiting your exposure time, keeping a safe distance and using appropriate radiation shielding will help minimize your exposure to radiation. Follow the policies and procedures established at your facility.

Reporting Hazards

Most facilities have an office of Risk Management, Safety and Security, or another office to which hazards concerns should be reported. Note, however,

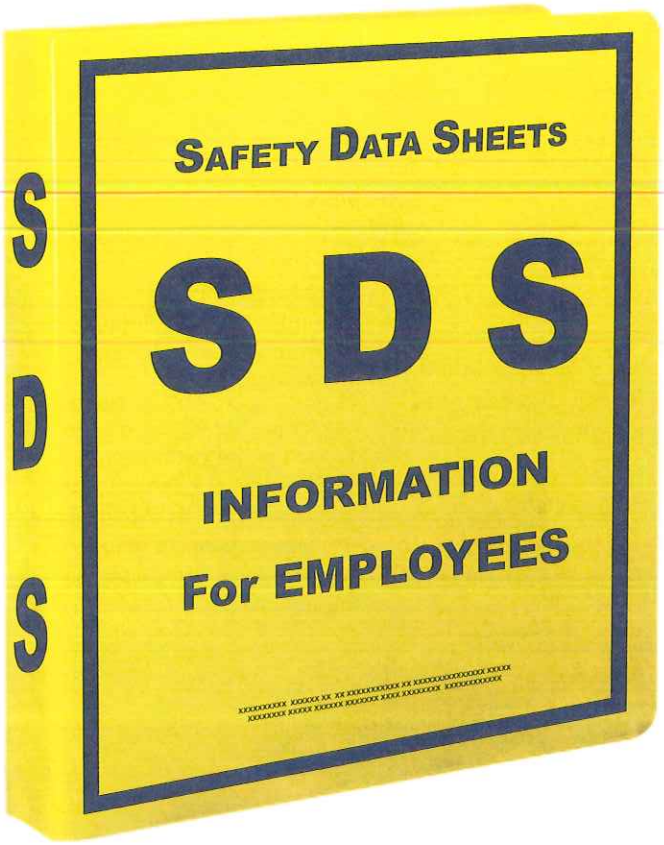


Figure 2-14 Safety data sheets may be stored in a clearly marked binder and placed where easy to find.

Figure 2-15 Chemical fume hood.
Aaron Roeth Photography

that a phlebotomist would report concerns to their supervisor first. When an incident does occur, an incident report is filed. Employees of healthcare facilities follow a specific process when filing an incident report for any event involving a patient's or their own safety. Phlebotomists should become familiar with the process for addressing safety concerns and occurrences of incidents at their facilities, including reporting hazards and incidents and completing or assisting in the completion of incident reports when appropriate.

Emergency Preparedness

Providing safety for patients, personnel, and visitors is mandatory and becomes critical during emergencies and extreme conditions. These include situations such as a weather disaster, bioterrorist attack, mass casualties, or severe emergencies caused by chemicals, radiation, or fire. Healthcare professionals should maintain a state of professional readiness. This state of readiness is known as **emergency preparedness.** Training at your place of employment about how to handle each type of emergency may be required, including first aid and cardiopulmonary resuscitation (CPR) and the use of an *automated external defibrillator (AED).* In all cases, during an emergency you should remember to stay calm and think through each situation in order to respond appropriately and create the best outcome.

In order to respond and react appropriately to emergencies, you should be aware of certain signs, symbols, and labels that are found in healthcare facilities. See Table 2-4. Additionally, The Joint Commission has made recommendations for health care facilities to create a standard set of color and word codes to represent various types of emergencies. Individual facilities may develop

TABLE 2-4 Signs, Symbols, and Labels

Sign, Symbol, or Label	Title	Meaning
	Biohazard	Indicates the actual or potential presence of a biohazard including equipment, containers, rooms, and materials that present a risk or potential risk The biohazard symbol is black. The background is typically fluorescent orange, orange-red, or other contrasting color
	Fire Safety	A fire extinguisher sign is placed at the location of the extinguisher. An exit sign like this one indicates the appropriate method of exit in case of a fire. Elevators and escalators are not typically in use during an emergency
	First Aid and Automated External Defibrillator (AED)	First aid and AED signs are placed at the location of the equipment to make the equipment easier to find
	Wash Your Hands	Hands should be washed frequently. This reminder is usually placed in locations where contamination to hands can occur and handwashing equipment is available nearby
	Handicap	This symbol indicates the route a person with a disability should take. Consider this for patients who are unable to walk or need to avoid steps for any reason
	Emergency Eyewash Station	An eyewash station is used when chemicals, blood, or other foreign items get in the eye
	Radiation Hazard	Indicates radiation in use that is damaging to cells. Limit exposure or wear protective gear. If working in these areas, wear a film badge or dosimeter to measure amount of exposure

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codes to be used within the facility. Healthcare professionals must be aware of the emergency codes used at the facility where they are employed. Some healthcare systems use plain language alerts instead of color-assigned codes. Using simple language alerts reduces the need for employees to memorize or otherwise try to remember the meaning of all the codes. Table 2-5 displays the recommended emergency codes including plain language and colors.

Evacuation and Shelter-in-Place Plans

Every healthcare facility should have evacuation and shelter-in-place plans in the event of an emergency. For evacuation, maps of the facility with escape routes clearly marked should be posted at visible locations for your reference. **Shelter-in-place** is an act of seeking safety within the building one already occupies, rather than evacuating the area or seeking a community emergency shelter. Employees are trained in evacuation and shelter-in-place procedures and periodic practice drills should be performed. Evacuation and shelter-in-place protocols differ and you should be aware of the correct procedures for each type of emergency plan at your facility.

TABLE 2-5 Emergency Code Colors and Plain Language Recommendations

Overhead Emergency Codes		
Facility Alert		
Incident / Event	Recommended Plain Language	Alternative Code
Evacuation	"Facility Alert + Evacuation + Descriptor (location)"	No color code; Use plain language only
Plant facility system alert	Facility Alert + Descriptor (location)	No color code; Use plain language only
Fire	"Code Red + Descriptor (location)"	**Code Red**
Hazardous spill	"Code Orange + Descriptor (location)" -or- Facility Alert + Hazardous Spill + Descriptor (location)	**Code Orange**
Security Alert		
Incident / Event	Recommended Plain Language	Alternative Code
Active shooter	"Security Alert + Active Shooter + Descriptor (location)"	No color code; Use plain language only
Armed, violent intruder	"Security Alert + Descriptor (threat/location)"	No color code; Use plain language only
Hostage situation	"Security Alert + Descriptor (threat/location)"	No color code; Use plain language only
Need for security personnel	Code Gray + Descriptor (threat/location) -or- "Security Alert + Descriptor (threat/location)" -or- "Security Alert + Security Assistance Needed + Descriptor (threat/location)"	**Code Gray**

(continued)

Overhead Emergency Codes		
Infant / child abduction	"Code Pink + Descriptor (age) + Descriptor (threat/location)" -or- Security Alert + Descriptor (threat/location) + Descriptor (age)	Code Pink
Bomb threat	"Code Pink + Descriptor (threat/location)" -or- Security Alert + Descriptor (threat/location)	Code Black
Medical Alert		
Incident / Event	Recommended Plain Language	Alternative Code
Emergency Operations Plan Activation	"Code Green + Descriptor" -or- "Medical Alert + Mass Casualty / Disaster Secenario + Descriptor"	Code Green
Medical decontamination (Includes chemical and radiological exposure for small and large incidents)	"Code Orange + Medical Decontamination (or Decontamination) + Descriptor (location)" -or- "Medical Alert + Medical Decontamination (or Decontamination) + Descriptor (location)"	Code Orange
Medical emergency	"Code Blue + Location" -or- "Medical Alert + Medical Emergency + Location"	Code Blue

Source: The Joint Commission

Checkpoint Questions 2.2

1. List at least four types of physical hazards and provide an example of each within a healthcare facility.
2. What is the difference between a chemical spill kit and a biohazard cleanup kit?
3. List at least three examples of how phlebotomists can work ergonomically.
4. Name two allergies that may develop in healthcare employees in the workplace.
5. If a phlebotomist notices that a specific hazard exists in the workplace, what should they do?
6. What is emergency preparedness?
7. Why should all healthcare facilities have both evacuation plans and shelter-in-place plans?

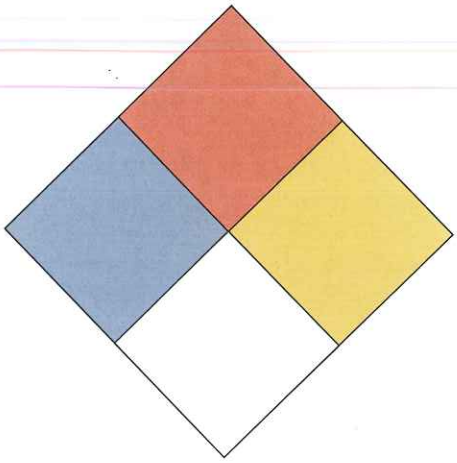
Chapter Summary

Learning Outcome	Key Concepts/Examples	Related NAACLS Competency
2.1 Discuss practices to ensure safety and reduce the risk of infection from medical biohazards in compliance with state and federal standards and regulations.	Safety practices include compliance with the Bloodborne Pathogens Standard, the Needlestick Safety and Prevention Act, and all other state and federal guidelines for preventing bloodborne and other diseases.	2.1, 2.2, 2.4, 2.4.1, 2.5
2.2 Recognize symbols and systems and apply techniques to ensure the physical safety of healthcare workers and patients.	Physical hazards found in healthcare settings include exposure to allergy-causing equipment and supplies, including those containing latex; electrical and fire hazards; and exposure to hazardous chemicals and radiation. Many hazards can be avoided by taking commonsense precautions.	2.4.2, 2.4.3, 2.5

Chapter Review

A: Labeling

Label the NFPA diamond by indicating each quadrant's color and hazard identification.



1. [LO 2.2] _____
2. [LO 2.2] _____
3. [LO 2.2] _____
4. [LO 2.2] _____

B: Matching I

Match each pictogram with its meaning.

A. 

B. 

C. 

D. 

___ 5. [LO 2.2] Carcinogen

___ 6. [LO 2.2] Explosive

___ 7. [LO 2.2] Flammable

___ 8. [LO 2.2] Oxidizer

C: Matching II

Match each letter of the *RACE* acronym to its corresponding action.

___ 9. [LO 2.2] R

___ 10. [LO 2.2] A

___ 11. [LO 2.2] C

___ 12. [LO 2.2] E

a. closing doors leading to the room with the fire

b. moving people to a safe location

c. notifying the switchboard operator of the fire

d. putting out the fire

D: Fill in the Blank

Write in the word(s) to complete the statement.

13. [LO 2.1] Used needles must be disposed of into a(n) _____.

14. [LO 2.1] Sharps containers should be replaced when they are _____ or _____ full.

15. [LO 2.2] Safety data sheets include information about the _____ and chemical properties of chemicals.

16. [LO 2.2] For chemicals for which controls are specified by the government, an SDS contains government _____ information.

17. [LO 2.2] For flammable chemicals, the SDS includes _____ measures.

18. [LO 2.2] Before handling any chemical for the first time, a laboratory worker should check the chemical's SDS for required _____ protection equipment.

19. [LO 2.2] The hazard identification systems most frequently used in clinical laboratories are those developed by the American Coatings Association and by the _____.

20. [LO 2.2] Whereas a(n) _____ statement lists measures to minimize or prevent adverse effects resulting from exposure to a hazardous chemical, a(n) _____ statement simply describes the nature and degree of the chemical's hazards.

E: Sequencing

Place the actions to take when encountering a fire in the correct order (from 1 to 4).

_____ **21.** [LO 2.2] Activate the fire alarm or phone in the alarm.

_____ **22.** [LO 2.2] Contain the fire as much as possible.

_____ **23.** [LO 2.2] Extinguish the fire if possible.

_____ **24.** [LO 2.2] Rescue those who need immediate help.

Place the actions to take when using a fire extinguisher in the correct order (from 1 to 4).

_____ **25.** [LO 2.2] Aim the nozzle.

_____ **26.** [LO 2.2] Squeeze the trigger.

_____ **27.** [LO 2.2] Pull out the pin.

_____ **28.** [LO 2.2] Sweep the base of the fire.

F: Case Studies/Critical Thinking

29. [LO 2.2] You are opening a tube of blood for testing at a physician office laboratory (POL). The specimen splashes in your face.
    - **a.** What is the health risk of biohazard exposure?
    - **b.** What are the proper steps for handling this incident?
    - **c.** What should have been done to prevent this incident from happening?

30. [LO 2.2] A new electronic instrument is purchased for a POL. It has a 3-foot cord on it. The place that would currently accommodate the instrument is 5 feet away from the nearest electrical outlet. What guidelines should be considered when installing this instrument?

31. [LO 2.2] As a phlebotomist was preparing a 24-hour urine collection container, the preservative splashed into his face.
    - **a.** What is the health risk of hazardous chemical exposure?
    - **b.** What are the proper steps for handling this incident?
    - **c.** What should have been done to prevent this incident from happening?

32. [LO 2.2] A person who is processing specimens first cleans her hands with an alcohol-based sanitizer, then immediately presses the centrifuge's "on" button. She feels a mild shock as the centrifuge turns on.

a. Why did this electrical hazard event occur?

b. What should have been done to prevent this incident from happening?

33. [LO 2.2] When unpacking a chemical, you notice that it has two different types of identification labels, the NFPA label and the HMIS label. Explain the difference in the purpose of the white areas on these two labels.

G: Exam Prep

Choose the best answer for each question.

34. [LO 2.2] Which of the following is a document that summarizes a chemical's characteristics as well as its handling and storage guidelines?

a. HAZMAT

b. HEPA

c. NFPA

d. SDS

35. [LO 2.1] Needlesticks can be prevented by

a. recapping needles.

b. cutting needles with a needle cutter.

c. using a one-handed technique to engage the engineering control.

d. bending needles before placing them into a sharps container.

36. [LO 2.2] Physical hazards include all of these *except*

a. blood and body fluids.

b. electrical equipment.

c. latex gloves.

d. radiation.

37. [LO 2.2] Which of the following is an example of a biohazard?

a. Touching electrical equipment with wet hands

b. The potential for starting a fire

c. Splashing blood when a cap is removed

d. Spilling a chemical on a countertop

38. [LO 2.2] Which of the following is unsafe to wear in a laboratory?

a. Dangling jewelry

b. Buttoned-up lab coat

c. Facial makeup

d. Closed toed shoes

39. [LO 2.2] An electronic instrument has a three-pronged cord that is too short to reach the outlet. There is an extension cord in the closet that will work only with a two-pronged plug. What is the safest way to connect power to this instrument?

a. Cut off the third prong of the instrument plug.

b. Move the instrument closer to the outlet.

c. Find a three-pronged extension cord.

d. Have an electrician change the instrument's plug to two-pronged.

40. [LO 2.2] A physician office laboratory wants to ensure that it is disposing of medical waste properly. Which agency should it consult for medical-waste-handling guidelines?

a. DHHS

b. DOT

c. EPA

d. OSHA

41. [LO 2.2] What precautions should you take when adding a chemical to a container for at-home specimen collection?

a. Label the container with the contents, the date, and your initials.

b. Dilute strong acids by adding them first, then water.

c. Wear PPE only if the chemical is considered a biohazard.

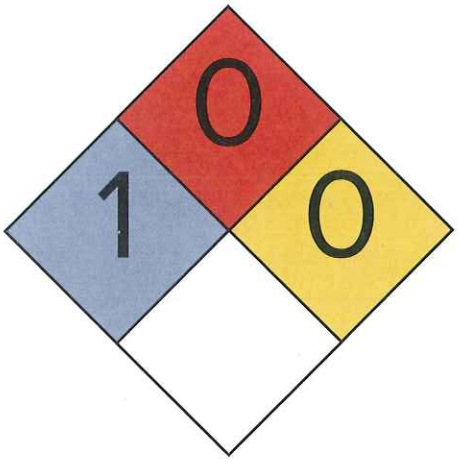
d. Laboratory personnel are not responsible for preparing these containers.

42. [LO 2.2] A medical laboratory assistant (MLA) is asked to help unpack a shipment of chemicals for the laboratory. The MLA should first

a. don all personal protective equipment.
b. check the NFPA label to see if there is a fire hazard.
c. read the SDS for storage requirements.
d. place all the chemicals in the chemical storage cabinet.

43. [LO 2.2] When you are handling a chemical, you notice the NFPA label. What does this label indicate?

a. Slight health risk
b. High fire risk
c. High reactivity risk
d. Not to be mixed with water



44. [LO 2.1] Which of the following items is *not* considered a medical biohazard?

a. Blood sample
b. Surgical specimen
c. Urine specimen
d. Used facial tissue

45. [LO 2.1] Biohazardous waste must be disposed of in containers that are colored

a. blue.
b. orange.
c. red.
d. yellow.

46. [LO 2.1] A container with which symbol below is appropriate for medical waste?

a.

b.

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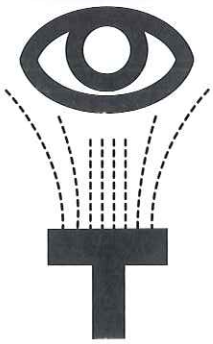
c.



d.

47. [LO 2.1] Which of the following items that a phlebotomist uses is *not* considered a "sharp"?

a. Glass slide
b. Lancet
c. Needle
d. Pen tip

48. [LO 2.2] When a fire is reported to the emergency center of a healthcare facility, the most commonly used code designation is Code

a. Blue.
b. Green.
c. Red.
d. Yellow.

49. [LO 2.2] If a hazardous material is spilled and requires evacuation of staff and patients to prevent exposure, what code will be announced?

a. Code Blue
b. Code Green
c. Code Red
d. Code Orange

50. [LO 2.2] A situation arises that requires the execution of "shelter-in-place." Where should you seek refuge?

a. In a hallway with a connection to the outside
b. In an internal room with no windows
c. In a room along the exterior of the building with windows
d. In a stairwell leading to the roof

51. [LO 2.2] What part of the body should be protected when you see this image?

a. Entire body
b. Eyes
c. Feet
d. Hands

52. [LO 2.2] How should specimens be handled that need to be placed into a freezer at zero degrees Celsius?

a. Wear latex or nitrile gloves.
b. Wear special thermal gloves.
c. No gloves are necessary.
d. Use tongs.

53. [LO 2.2] How should specimens be handled that need to be placed in a freezer at -80 degrees Celsius or when handling dry ice?

a. Wear latex or nitrile gloves.
b. Wear special thermal gloves.
c. No gloves are necessary.
d. Use tongs.

54. [LO 2.2] How should specimens be handled that need to be placed in a water bath to maintain body temperature?

a. Wear latex or nitrile gloves.
b. Wear special thermal gloves.
c. No gloves are necessary.
d. Use tongs.

55. [LO 2.1] A common allergen found in blood collection equipment is

a. latex.
b. nitrile.
c. vitrine.
d. vinyl.

56. [LO 2.1] A patient enters an outpatient laboratory for testing. The phlebotomist notices that, after applying alcohol to the patient's skin prior to the blood collection procedure, the skin turned red. What question should the phlebotomist ask the patient?

a. "Are you allergic to any medications?"
b. "Do you have any allergies to alcohol or antiseptics?"
c. "Are you feeling all right?"
d. No questions are needed. Developing a red color is normal when alcohol touches the skin.

NAME: _____ DATE: _____

COMPETENCY CHECKLIST: USING AN EYEWASH STATION

Procedure Steps	Practice 1	2	3	Performed Yes	No	Master
Preprocedure						
1. Ensures that the eyewash sign is easily visible.						
2. Ensures that the unit comes on in 1 second and stays on when activated.						
3. Ensures that the water temperature is between 60°F and 100°F.						
Procedure						
4. Helps the victim to the eyewash station.						
5. Activates the eyewash unit.						
6. Helps the victim lean into the eyewash, keeping the affected eye(s) open.						
7. If necessary, puts on gloves and gown and helps the victim keep the eye(s) open.						
8. Flushes the eyes continuously for at least 15 minutes or longer, if recommended on the SDS.						
Postprocedure						
9. Alerts the physician or EMS, depending on your facility's policy.						
10. Completes an accident or incident report if required.						
11. Stays with the victim until help arrives.						

COMMENTS: _____

_____

SIGNED

EVALUATOR: _____

STUDENT: _____

NAME: _____ DATE: _____

COMPETENCY CHECKLIST: SAFETY EQUIPMENT IN THE CLINICAL SETTING

Procedure Steps	Able to Locate Item		Can Explain or Demonstrate Use of Item	
	Yes	No	Yes	No
Procedure: Locate and explain or demonstrate the use of each item.				
1. Biohazard cleanup kit				
2. Biologic and/or chemical fume hood				
3. Chemical spill cleanup kit				
4. Emergency codes and definitions				
5. Emergency exits				
6. Emergency shower				
7. Evacuation and shelter-in-place plans				
8. Eyewash station				
9. Flammable liquids storage cabinet				
10. Fire extinguisher				
11. Goggles and/or splash shields				
12. Ground fault interrupters				
13. HMIS labels				
14. NFPA labels				
15. Safety data sheets				
16. Sharps container				
17. Special gloves for handling hot or cold items				

COMMENTS: _____

_____

SIGNED

EVALUATOR: _____

STUDENT: _____

Design Element: Safety & Infection Control icon (samples in hand) ©motorolka/Shutterstock.com RF.