unit

I

INTRODUCTION TO THE PHYSICIAN'S OFFICE LABORATORY

Chapter 1 Safety in the Laboratory

Chapter 2 The Microscope

Chapter 3 Math in the POL

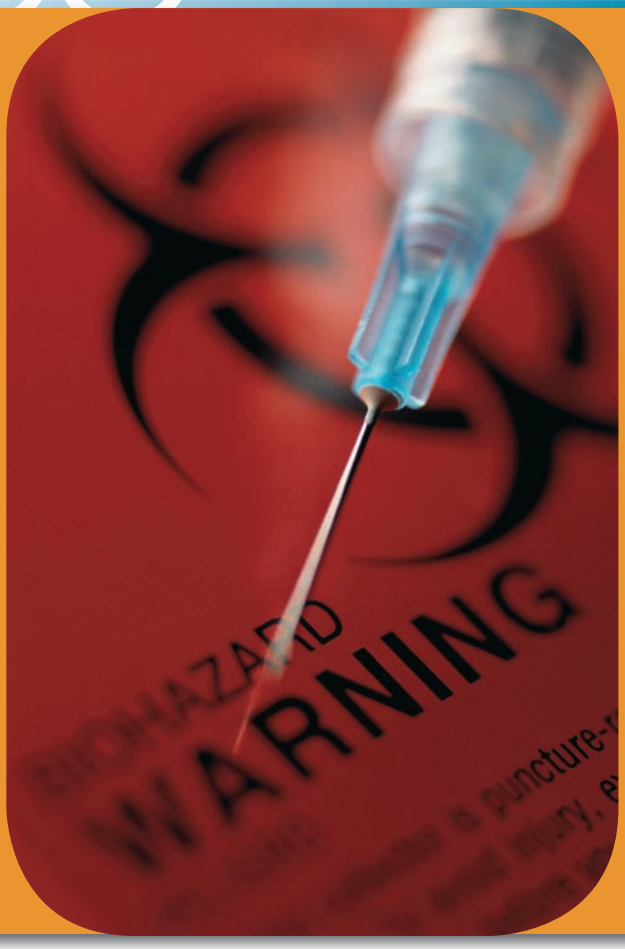
Chapter 4 Statistics in the POL

Chapter 5 Quality Assurance and Quality Control

Chapter 6 Record Keeping in the Lab

1 chapter

Safety in the Laboratory



COGNITIVE OBJECTIVES

After studying this chapter, you should be able to

1.1 use each of the vocabulary terms appropriately.

1.2 identify the agencies primarily responsible for regulating lab safety.

1.3 list three major types of laboratory hazards and give examples of each.

1.4 identify four types of control methods used to promote lab personnel safety and describe one example of each.

1.5 discuss the role of HBV vaccination in promoting lab personnel safety.

1.6 describe how lab personnel are evaluated and the follow-up after exposure to a biohazard in the lab.

1.7 explain how biohazardous materials can be safely disposed of in laboratories.

1.8 discuss the role of good housekeeping practices in maintaining a safe work environment in the lab.

1.9 describe the areas in which lab personnel should be educated in order to be safe on the job.

1.10 identify four safety tips for using lab chemicals.

1.11 describe how reagents should be labeled and stored.

1.12 explain why acids and bases pose special risks for lab personnel.

1.13 describe how to prevent injury from electrical, fire, weather, and personal hazards.

1.14 explain why a professional attitude is important for safety in the lab.

1.15 list seven reasons for lab accidents that are related to personnel characteristics.

1.16 discuss steps that can be taken to alleviate stress on the job.

PERFORMANCE OBJECTIVES

After studying this chapter, you should be able to

1.17 plan a lab safety orientation program for new employees.

1.18 devise a waste-disposal plan for a physician's office laboratory.

1.19 develop an accident-proofing program for the lab.

1.20 plan fire and severe weather drills for lab personnel.

1.21 design posters that remind lab personnel to follow important safety guidelines and procedures.

1.22 evaluate a lab on campus for safety and prepare a report listing ways in which safety can be enhanced.

1.23 locate Internet sources for OSHA and CDC updates and recommendations.

TERMINOLOGY

acid: a chemical that donates hydrogen ions (H^+), lowers the pH of solutions, and reacts with bases to form water and chemical salts.

aerosolization: the conversion of a liquid, such as blood or blood products, or a solid, such as a powdered chemical, into a fine mist that travels through the air.

autoclave: a device utilizing steam under pressure to sterilize medical instruments and laboratory specimens.

base: a chemical that yields hydroxide ions (OH^-) when dissolved in water (e.g., sodium hydroxide). Bases raise the pH of a solution and react with acids to form chemical salts and water.

biohazard: a biological specimen containing blood or other body fluid that has the potential for transmitting disease.

biological specimen: a specimen that originates from a living organism. Examples are blood, blood products, other body fluids such as cerebrospinal fluid or urine, biopsy samples, bacterial smears, and bacterial cultures.

bloodborne pathogens: microorganisms that cause disease and can be transmitted through blood or other body fluids. HIV is an example.

caustic: burning or corrosive; usually destructive to living tissue.

CDC: Centers for Disease Control and Prevention.

chain of transmission: the unbroken line of transmission of a disease from one host with the disease to a new host.

chemical hazard: a source of danger from exposure to chemicals.

contamination: the pollution of an area or substance with unwanted extraneous material such as pathogens or hazardous chemicals.

disinfection: any practical procedure for reducing the pathogen contamination in the inanimate environment, as in the air, on work counters, or on equipment.

engineering control: a device that keeps biohazards away from laboratory personnel.

exposure incident: a situation in which laboratory personnel are exposed to a potentially hazardous substance, such as blood or a toxic chemical.

hazardous chemical list: a list maintained by OSHA that identifies toxic chemicals used in laboratories. It may be consulted to determine the toxicity of a chemical.

HBV (hepatitis B virus): the virus that causes hepatitis B, a type of severe hepatitis transmitted by sexual contact, by needle sharing, or through contaminated blood, blood products, or other body fluids.

HCV (hepatitis C virus): previously known as Non-A Non-B hepatitis virus; the virus that causes hepatitis C, a serious type of hepatitis transmitted by contaminated blood and blood products, needles, and sexual contact. There is presently no vaccine for HCV.

HIV (human immunodeficiency virus): the virus that causes AIDS (acquired immunodeficiency syndrome).

ICP (infection control program): a program that provides the maximum protection for health care workers against occupational sources of disease.

MSDS (Material Safety Data Sheet): included with all chemical shipments describing precautions and disposal information.

NFPA Diamond: a symbol, issued by the National Fire Protection Association, in the shape of a diamond with four colored quadrants that can be used in laboratories to label hazardous materials to show the type and level of hazard.

OSHA (Occupational Safety and Health Administration): a federal agency within the U.S. Department of Labor. OSHA works to assure the safety and health of workers.

pathogen: disease-causing microorganism.

physical hazard: a source of danger in the environment, such as shock, housekeeping accidents, and falls.

POL: physician's office laboratory.

post-exposure evaluation: a set of procedures required by OSHA as a follow-up to exposure incidents.

post-exposure prophylaxis: preventive treatment for exposure to possible pathogenic microorganisms, HIV, HBV, and HCV, for example.

PPE (personal protective equipment): clothing and other equipment that shield health care workers from outside contaminants. PPE includes gloves, uniforms, fluid-proof aprons, masks, and eye-shields.

specimen: a small amount of body tissue (e.g., urine, blood, or tumor biopsy) taken for purposes of examination. The sample is assumed to represent the whole and to provide meaningful results for the total individual.

Standard Precautions: guidelines that use the CDC Universal Precautions and OSHA Bloodborne Pathogen Standards to direct health care workers in protection against pathogens transmitted by infectious patients.

STD: sexually transmitted disease.

toxic: poisonous.

Universal Precautions: a set of recommendations formulated by the CDC to protect workers against HIV and other pathogens. The precautions impose isolation of all specimens of blood, blood products, and other body fluids capable of transmitting pathogens.

vector: a carrier, such as an insect, of a pathogen.

work-practice control: a method that incorporates safety into laboratory procedures.

INTRODUCTION

Safety in the **POL,** physician's office laboratory, is an essential part of all laboratory work. No laboratory procedure is complete unless it includes controls against infection, chemical toxicity, and physical hazards.

WORKING TOWARD A SAFE LABORATORY

Laboratory safety requires knowledge of laboratory procedures, equipment, and reagents, as well as constant watchfulness for danger. One careless worker can undo all the safety practices followed by coworkers in the lab.

Regulating Lab Safety

A major concern for personnel in the medical laboratory is infectious disease and exposure to infectious microorganisms from patient **specimens.** This concern stems largely from the epidemic of AIDS, a fatal bloodborne disease caused by human immunodeficiency virus (HIV), and from the spread of hepatitis B virus and hepatitis C virus. Legislation to enforce laboratory standards of safety has been passed, and as a result clinical laboratories are safer now than they were in the past when disease prevention received less emphasis.

Two government agencies have had primary responsibility in monitoring medical lab safety: **Centers for Disease Control and Prevention (CDC),** which is within the U.S. Department of Health and Human Services (www.hhs.gov), and the **Occupational Safety and Health Administration (OSHA),** which is within the U.S. Department of Labor (www.dol.gov). These two agencies formulated important regulations and guidelines for laboratory safety. The CDC developed a set of principles called **Universal Precautions** that heighten awareness of the potential risk that medical laboratory specimens pose to the personnel who handle them. This led OSHA to develop a set of guidelines known as Bloodborne Pathogens Standards for the protection of health care workers at risk for exposure to bloodborne pathogens. CDC extended these standards and issued the Guide to **Standard Precautions** for Infection Control to control hospital infections, to protect health care personnel, and also to protect the patients.

Hazards

Potential hazards in POLs fall into three categories:

- **Biohazards** are sources of danger from living ("bio") specimens, including blood and other body fluids, microbiology specimens, and cultures.
- **Chemical hazards** are sources of danger from exposure to laboratory chemicals, including immediate and long-term effects on the health of workers.
- **Physical hazards** are sources of danger in the environment, including electrical shock, housekeeping accidents, and falls.

The federal government mandates addressing all three types of potential hazards in the procedure manuals of POLs. You should familiarize yourself with the procedure manual in any lab where you work. The rest of this chapter describes potential dangers and how to deal with them for each of these three types of hazards.

BIOHAZARDS

Lab specimens sometimes contain disease-causing microorganisms, called **pathogens.** Exposure of lab personnel to pathogens is likely to vary from one medical practice to another. A small rural family practice clinic will have a much different patient population with different health problems than will a specialty practice in a large metropolitan area. Nonetheless, general principles of hygiene and safety should be followed in all POLs to decrease the risk of disease transmission.

Safety and Procedure Manuals

Specific safety procedures addressed in POL procedure manuals include the following:

- safe workplace practices
- disinfection
- hepatitis B vaccine
- avoiding and reporting needlestick injuries
- spills and cleanups
- labeling of hazardous materials
- waste disposal
- hygienic practices
- OSHA accident log (for reporting accidents)
- safety education
- storage, inventory, and handling of chemicals
- first aid
- fire prevention and use of fire blankets

Biohazards

Potentially infective biospecimens encountered in clinical laboratories include the following:

- blood
- body fluids
- body tissue biopsies
- urine
- exudates (pus, mucus, sputum)
- bacterial smears
- bacterial cultures

How Diseases Are Transmitted

To know how to avoid disease transmission in the lab, you first must understand how diseases are transmitted. Most infectious disease pathogens gain entry to the body through one of the body's systems, most commonly the skin, respiratory system, or gastrointestinal tract (see Table 1-1). In order to cause disease in a susceptible person, the pathogen must leave the first host and enter an uninfected individual in an unbroken **chain of transmission.** Pathogens in test specimens and on contaminated equipment may infect laboratory personnel who handle them. To prevent infection in the lab, barriers must be maintained between workers and biohazardous material, thereby breaking the chain of transmission.

Table 1-1 Major Routes of Disease Transmission

Type of Contact*	Infections
Direct skin contact	Staph, strep, measles, colds, influenza, tuberculosis
Mucus-to-mucus contact	Strep, syphilis, gonorrhea, herpes, HIV, HCV, other **STDs**
Aerosols and dust	Colds, influenza, measles, tuberculosis, chicken pox
Food and water	Food poisoning, typhoid, hepatitis A, cholera, intestinal parasites
Blood and other body fluids	HIV, HBV, HCV
Animal **vectors**	Tularemia, malaria, Rocky Mountain spotted fever, Lyme disease

*This list is not inclusive. For example, rabies can be transferred by a rabid animal's bite or by infected tissue in surgical transplants.

Disease Risks in the Lab

Because blood is so frequently encountered, bloodborne diseases are a special risk for lab personnel, but almost any type of infection can pose a risk for those who work in a medical lab. See Figure 1-1.

Bloodborne Infections. Even though they usually cannot survive for long outside body fluids or tissues, **bloodborne pathogens** pose the greatest

Figure 1-1 To avoid the risk of infection in the POL, keep it clean and orderly at all times.

potential risk to lab personnel. Most important of these are **HIV, human immunodeficiency virus; HBV, hepatitis B virus;** and **HCV, hepatitis C virus.** They are usually transmitted by the direct contact of body fluids, such as blood or semen, from one person to another in some manner, most often through sexual activity or use of contaminated needles. These viruses may cause infection in which the virus is present in body tissues and fluids even though the patient has no symptoms of disease. Because clues may not be apparent from patients or specimens to warn the laboratory personnel of infection, all **biological specimens** should be considered potentially infectious and handled as such. Needlesticks are the leading cause of bloodborne infections of lab personnel. Improper handling of sharps, such as broken glass tubes, slides, or lancets, may result in cuts to lab personnel.

The actual number of people contracting HIV through work in clinical laboratories is very small. There are only a few documented cases of HIV being transmitted through occupational exposure of health workers.

The number of people infected with HIV remains high, so exposure of health workers is still a concern. In 2008, the U.S. Public Health Service reported that at the end of 2003, approximately one million persons in the United States were living with HIV infection, including approximately 250,000 who do not know they are infected (**www.cdc.gov**). AIDS, the disease caused by HIV, results when the virus damages the immune system, allowing other diseases to ravage the body. There is no cure for AIDS, thus preventive measures must be 100 percent effective to ensure the safety of lab personnel.

There is a higher risk of infection of health care workers from HBV and HCV. The good news is there has been a significant decrease in the number of HBV infections, 260,000 in the 1980s to 46,000 in 2006, due to the vaccine available to prevent HBV infections. HCV was discovered in 1990 and is the most chronic bloodborne infection in the United States. Workers exposed to blood represent 2–4 percent of total new cases of HCV occurring each year (**www.cdc.gov/NIOSH/topics**). Unfortunately, there is no vaccine for HCV and prevention must be completely effective.

WORKING SAFELY WITH BIOHAZARDS

Although hazards such as disease-contaminated biospecimens must always be part of laboratory work, they need not pose a serious threat to the safety of lab personnel. Personal protective equipment, if properly worn, is an important safeguard. In addition, automation has greatly reduced the need to handle contaminated specimens and toxic chemicals. Microtesting procedures using very small amounts of specimens and chemicals also make clinical laboratories safer.

OSHA has established laboratory guidelines and procedures to reduce the risk of infection from biohazards. OSHA's Infection Control Program details procedures to be used in the following areas, each of which is addressed in the remainder of this section:

- control methods
- HBV vaccination
- post-exposure treatment, evaluation, and follow-up
- disposal of infectious waste and biohazardous material
- housekeeping practices
- employee education

Control Methods

Control methods refer to procedures and devices meant to eliminate or prevent **exposure incidents** in POLs. They include Universal/Standard Precautions, engineering controls, work-practice controls, and personal protective equipment.

Universal/Standard Precautions. CDC's guidelines use Universal Precautions, which are based on the premise that all body fluids and tissues are potentially infected with HIV, HBV, HCV, or other pathogens and lab personnel are safe only when they are completely isolated from direct contact with biological specimens. These precautions, in combination with the Bloodborne Pathogens Standards by OSHA, help ensure that all human blood and other potentially infectious materials are isolated to protect workers from infection. The Bloodborne Pathogens Standard issued by OSHA can be found in Appendix B.

Engineering Controls. Devices that provide a safer laboratory environment are called **engineering controls.** These are meant to eliminate or minimize worker exposure to biohazards. They may enclose the biohazard completely, shield the biohazard from aerosolization and spattering, clean and disinfect contaminated equipment, or identify and enclose hazardous waste. It is imperative for worker safety that all engineering control devices be inspected on a regularly scheduled basis and repaired or replaced as needed.

Body Fluids and Disease

Body fluids capable of transmitting HIV and HBV include the following:

- blood and blood products
- semen
- vaginal secretions
- spinal fluid
- pleural fluid
- synovial fluid
- peritoneal fluid
- pericardial fluid
- amniotic fluid

Some body secretions, such as urine, saliva, sputum, and tears may be capable of transmitting HIV if they contain blood. It is important to remember that minute amounts of blood in body fluids may not be obvious or easily detected. These body fluids may carry other pathogens as well. The fact that the body fluid is being tested in a clinical laboratory suggests that it is likely to have a higher than average probability of disease.

Figure 1-2 Safety needles now reduce the risk of needle injuries.

Following are descriptions of engineering controls that you should employ to ensure safety in the medical lab:

- *Needlestick safety.* In response to The Needlestick Safety and Prevention Act passed in 2000, OSHA now requires employers to use new safety needles that decrease the risk of needle injuries. Safety needles provide shields permitting lab personnel to dispose of contaminated needles without recapping or touching the needles, thus reducing the risk of needlestick injuries. (See Figure 1-2.)
- *Specimen containment.* Confine and transfer body fluids within closed containers whenever possible. Place specimens in well-constructed containers with secure lids to prevent leakage during mailing or transport. Do not contaminate either the laboratory request form or the outside of the container during collection.
- *Prevention of* **aerosolization.** When minute amounts of body fluids or bacterial cultures are sprayed or swept into the air by spillage, laboratory procedures, or wind currents within the room, aerosols are formed. Aerosol droplets cannot be seen by the naked eye, but they can carry disease and penetrate to the depths of the respiratory tract, causing infection of lab personnel. Avoid aerosolization of biohazards by covering all specimens. Cap or cover urine containers and tubes of blood when they are not undergoing actual testing.
- *Vented hoods or biohazard cabinets with filters.* Use this equipment when working with bacteria or hazardous material that may generate aerosols. Always inoculate microbiological specimens onto culture media and streak and isolate cultures inside a hood or biohazard cabinet because minute amounts of microscopic organisms may be infectious.
- *Safe use of centrifuges.* Stopper or cap specimens and centrifuge them with the lid closed. An open lid is unsafe because of occasional accidental breakage. Flying glass fragments and spattering or aerosolization of biological specimens can result in both cuts and contamination at once. Never stop centrifuges by hand or open them before spinning stops because these actions encourage spattering and aerosolization of contents.
- *Barriers between body fluids and laboratory technicians.* In addition to needle safety shields, other devices serve as barriers between laboratory personnel and the biohazard. Devices that remove test tube stoppers prevent aerosols from escaping and eliminate direct handling of contaminated stoppers. Plexiglass shields also can be placed as needed between the specimens and technicians. Figure 1-3 shows examples of barrier devices.

(a) (b) (c)

Figure 1-3 Examples of barrier devices: (a) capped specimen container; (b) safety shield; and (c) hood.

- *Safe pipetting.* Pipetting by mouth is unsafe because of the danger of aspirating contaminated body fluids and hazardous chemicals. Instead, use mechanical suction devices to uptake and release fluids from pipettes.
- *Disposable equipment.* The less often contaminated equipment is handled, the less likely there is exposure to disease organisms. Disposable equipment, which does not have to be washed and disinfected for reuse, provides a safer laboratory environment. Using disposables is also usually cheaper than cleaning and sterilizing used equipment. A wide variety of disposable products are available, including glassware, needles, lancets, and transfer pipettes.

Work-Practice Controls. Any technique or procedure that makes lab work safer falls into this category. Most **work-practice controls** are simple but proven methods of protecting oneself from disease. All require self-discipline if they are to be effective. To keep yourself as safe as possible in the lab, you should follow these important rules:

- *Wash your hands frequently with antimicrobial soap or an alcohol-based gel or foam.* The importance of hand hygiene cannot be overemphasized. Direct contact is the most common method for transmission of microorganisms that cause disease. Wash your hands using antimicrobial soap or an alcohol-based disinfectant gel or foam (see Figure 1-4). After drying your hands, apply lotion to prevent skin from cracking and leaving open wounds.
- *Avoid wearing false fingernails.* Many labs have rules regarding false fingernails, tips and overlays because they may harbor bacteria and they increase the puncture risk to gloves which could leave the skin exposed to biohazardous substances.

Figure 1-4 Wash your hands thoroughly between patients, after handling hazardous chemicals, between laboratory and nonlaboratory activities, and before and after using the restroom.

- *Keep objects away from your face.* The mouth is the entrance to the body's digestive and respiratory systems. The mucous membranes of the nose and eyes also are pathways for infection. Absentmindedly chewing on pencils or fingernails, rubbing your face, or putting on makeup in the lab can breach the barrier between pathogen and worker. In order to avoid possible contamination with biospecimens and chemicals, do not store or consume food and drink in the laboratory. Take coffee breaks and meals outside the laboratory after washing your hands.
- *Keep personal items in storage.* A closet or locker near the laboratory should house personal effects such as jewelry and purses or extra clothing worn to and from work. Carrying such personal items into and out of the lab increases the risk of spreading pathogens and other hazards outside the lab environment.

(a) (b)

Figure 1-5 (a) Clean up broken glass with care and place in proper container; (b) Freshly prepared solutions of 10% household bleach may be used to sanitize the area or commercially available spill kits may be used.

- *Clean up spills immediately.* In the event of potentially infectious spills, pour a 1:10 bleach solution liberally, cover the spill with paper towels to prevent spreading, and allow the spill to soak for 5 minutes before wiping it up. If glass is broken, never pick up the pieces by hand because of the danger of cuts. Instead, scoop broken glass into a dustpan or box and dispose of it in a puncture-proof container (see Figure 1-5). Dispose of items used in the wipe-up, including gloves, aprons, and other barrier items, in another plastic bag. Label these bags with a biohazard indicator. Always wash your hands after cleaning up a spill.
- *Decontaminate equipment.* Decontaminate equipment that comes into contact with blood or other body fluids on a daily basis with disinfectant, such as a bleach solution. Equipment that may corrode from daily wiping with a bleach solution may be wiped with alcohol.
- *Prevent splashing or spraying of materials.* Analyze all procedures for better ways to control mishaps that may contaminate equipment or the lab environment.

Personal Protective Equipment (PPE). PPE refers to specialized clothing and other gear that help shield laboratory personnel from contaminants. Examples include fluid repellant, high-collar laboratory jackets and coats, vinyl or latex disposable gloves (see Figure 1-6), fluid-proof aprons, enclosed shoes, face shields, masks, and goggles. PPE should be exchanged for street clothing before lab personnel leave the medical office and placed in a designated area for storage, laundry, decontamination, or disposal. OSHA stipulates that medical labs must provide these items and that the equipment must be replaced or repaired when necessary to maintain its effectiveness.

Figure 1-6 Laboratory personnel wearing proper PPE.

Always wearing disposable, protective gloves is especially important when working with biohazardous material. Wearing gloves helps prevent the entrance of pathogens into abrasions that may not be obvious if they are very small. Gloves used in venipuncture and laboratory procedures should be discarded after specimen processing. Gloves also should be changed after each patient contact, and hands should be washed with antimicrobial soap or sanitized with alcohol-based hand gel or foam between each glove change. Gloves should not be disinfected and reused because disinfected gloves may disintegrate and allow fluid to pass through undetected holes. At the end of the day,

gloves should be discarded and hands washed again before leaving the office. Note that frequent hand washing dries and cracks the skin. Always use a hand lotion after washing your hands to help maintain skin integrity.

To properly remove contaminated gloves, remove the first glove and hold it in your hand with the second glove while you pull down the second glove over the hand holding the first glove. The gloves are inside out, with contaminants inside. Discard the gloves in the biohazardous waste container.

Latex Allergy

The occurrence of allergic reactions to latex is increasing and health care facilities provide both latex and nonlatex gloves for personnel. Allergic reactions could be in the form of a simple rash or more serious reaction of anaphylaxis.

HBV Vaccination

Although there is no proven vaccine to prevent HIV or HCV infection, a safe and effective vaccine is available for the prevention of HBV infection. This vaccine is recommended for laboratory personnel who are at risk of HBV infection. It is offered free of charge on a voluntary basis by all employers and employees refusing the vaccine must sign a waiver.

Post-Exposure Evaluation and Follow-Up

Even when control measures are followed, exposure accidents sometimes occur. If you receive a needlestick or other exposure to potentially hazardous biomaterial, you should immediately wash or flush the area with water and then submit a written report of the incident to your employer. As a **post-exposure evaluation** and follow-up, your employer must then do the following:

- Track the exposure incident to blood or other potentially infectious material.
- Report the injury on the OSHA Occupational Injury and Illness Log if **post-exposure prophylaxis** (PEP) is prescribed and administered by licensed medical personnel. An injury report form can be found in Appendix C.
- Record HBV, HIV, or HCV exposure if the infection can be traced to an injury or other biohazard exposure incident.
- Make available to the exposed worker a confidential medical evaluation and follow-up.
- Document the route of exposure; the HBV, HCV, and HIV status of the source patient, if known; and the circumstances of the exposure.
- Notify the source patient of the incident and ask for consent to collect and test his or her blood for the presence of HIV, HBV, and HCV.
- Collect blood samples from the worker as soon as possible after exposure for HIV, HBV, and HCV testing.
- Repeat HIV testing for the exposed worker at 6 weeks, 12 weeks, and 6 months after the exposure. Extended HIV testing is recommended (12 months) for health care personnel who become infected with HCV following exposure to a source infected with both HIV and HCV.
- Provide counseling to the exposed worker and medical evaluation of any acute febrile illness occurring within 12 weeks after exposure.

This system of record keeping and data collection ensures that exposed workers receive the best possible treatment for potential health problems relating to the accident. OSHA requires employers to train employees in preventing possible exposure to diseases such as HIV, HBV, and HCV. OSHA compiles similar information on the incidence of chemical exposures and other laboratory accidents.

Disposal of Biohazardous Material

One of the most important aspects of safe handling of biohazardous material is appropriate decontamination and/or disposal of contaminated equipment, especially sharp instruments, and of used biospecimens and other contaminated waste. The laboratory waste-disposal system should provide safe, quick disposal of all items used in collecting and testing body specimens, following federal, state, and local regulations. The aim is to prevent contamination of the lab environment and possible infection of lab personnel.

Bagging, Tagging, and Labeling Biohazardous Materials. To protect from the possibility of infection, all lab personnel must be aware of the location of biohazardous materials—whether they are blood samples, dirty glassware, or used needles. To this end, it is crucial that biohazards be marked with the word *biohazard* or the red or orange biohazard symbol (see Figure 1-7), or simply color-coded red or orange. The identifying mark must be recognizable from a distance of 5 feet. If using identifying tags or labels, fasten them as closely as possible to

Figure 1-7 This symbol in orange or red permits quick identification of biohazardous material.

the hazard with string, wire, or adhesive to prevent their loss or unintentional removal. Before working in any lab, it is important to familiarize yourself with the location of all biohazardous materials. You must be constantly aware of biohazards as you work. In addition, maintenance crews and other nonmedical personnel should be instructed on proper safety and handling of lab wastes.

Cleaning or Disposal of Contaminated Equipment. Reusable pieces of equipment such as hemacytometers and pipettes should be placed immediately after use in a suitable disinfectant such as household bleach. This reduces risk of further **contamination** and makes the equipment easier to clean. Larger pieces of equipment should be washed by hand or in an automatic washer and then disinfected with bleach or sterilized in a drying oven. Contaminated disposable supplies like plastic tubing should be disinfected with germicide or bleach prior to disposal.

Disposal of Sharp Instruments. All disposable sharp instruments, including needles, lancets, and syringes with attached needles, should be placed in a sharps container immediately after use. The sharps container should be located where these items are most often used. The container should be disposed of when the fill line has been reached. (See Figure 1-8.)

You should be especially careful when discarding contaminated needles. A significant number of infections of lab personnel have been documented from needlesticks received while discarding needles.

Disposal of Biohazardous Waste. Discarded lab specimens, blood, and other contaminated waste must be placed in containers or bags that are sturdy and leak proof. They also must be labeled, tagged,

Figure 1-8 These laboratory safety devices are designed to help laboratory personnel avoid skin puncture from contaminated needles, lancets, and other sharp objects. Sharps containers accommodate different needs in the laboratory.

or color-coded so that the danger of their contents is apparent to anyone who may handle them. If the outside of the bag is contaminated with blood or other potentially infectious material, the waste must be double bagged—one bag inside another. Contaminated waste that will be placed in a landfill must be **autoclaved** or incinerated first.

Note

Under no circumstances should you recap, bend, break, or handle a needle in any unnecessary manner.

Housekeeping Practices

Safe medical laboratories have smooth, seamless surfaces on floors and countertops so that they are easily washed and disinfected. Floors should be covered with vinyl, not carpeting, to facilitate thorough cleaning and **disinfection.** The entire laboratory should be well lighted and well ventilated with adequate room for work areas and storage of supplies and equipment. Cleaning should be scheduled as often as necessary to maintain a sanitary workplace. When cleaning, workers should use appropriate PPE including gloves.

Disinfection. For general cleanup, an approved hospital disinfectant, a chemical germicide that is tuberculocidal, or a fresh bleach solution should be used each day on counters, work surfaces, and accessible machine parts that are subject to contamination. Because bleach solutions lose their potency over time, they should be prepared daily. A 1:10 dilution of household bleach, such as 5 percent sodium hypochlorite in water, is effective against HIV and other pathogens.

Laundry. Laundry that is contaminated with blood or other potentially infectious material should be treated as if it were HBV, HCV, or HIV infectious and handled as little as possible, with minimum agitation. It should be bagged at the location where it is used and transported in biohazard-identified bags. A solution of 1:10 to 1:100 bleach can be used to disinfect the garments before laundering. Many laboratories use disposable lab coats, but these are expensive.

Laboratory Personnel Education

Training and education of employees are required by law for everyone whose work exposes them to blood or other potentially infectious materials (OPIM). An education program should include maintenance crews who do general after-hours cleaning and/or repairs. The program must explain the following:

- epidemiology, transmission, and symptoms of HBV, HCV, and HIV
- effectiveness, safety, and benefits of HBV vaccination
- employer's **infection-control program (ICP),** including procedures to follow if an exposure incident occurs and labeling of biohazards
- methods of control that may prevent or reduce exposure to biohazards, including Standard Precautions, engineering controls, work-practice controls, and personal protective equipment

WORKING SAFELY WITH CHEMICAL HAZARDS

Safety in POLs requires knowledge of and respect for chemicals. The current trend is using very small amounts of premixed chemicals embedded in plastic or dissolved in some other medium in order to eliminate most mixing and handling of reagents. Test kits with these small amounts of chemicals are not hazardous if used correctly.

Unfortunately, hazardous chemicals cannot be eliminated entirely from medical labs. Chemicals such as methyl alcohol and acetone are required as preservatives, stains, drying agents, and cleaners. These and other lab chemicals may be flammable, caustic, carcinogenic, or **toxic** in other ways. This is true of their fumes as well as their liquid or solid forms. Therefore, it is important to be familiar with the rules of safety concerning lab chemicals.

Safety Tips for Using Lab Chemicals

Lab personnel should assume that all chemicals are harmful until they learn otherwise and should never taste or sniff an unknown chemical in order to identify it. OSHA maintains a **hazardous chemical list** used in medical labs that may be checked if there is any question about toxicity. OSHA also requires chemical manufacturers and distributors to furnish a **Material Safety Data Sheet (MSDS)** with all shipments of hazardous chemicals (see Figure 1-9). The MSDS provides usage precautions, among other information. For safety's sake, familiarize yourself with all precautions for chemicals that you use in the lab.

Right-to-Know

OSHA developed the Right-to-Know Law, which requires employers to make certain that all employees are informed of any possible chemical hazards in the workplace. This is accomplished by proper chemical container labeling, MSDS, and employee training.

When using hazardous chemicals, it is especially important to keep your workstation free of excess reagents and equipment. This will help prevent spills and mistakes. Manipulate chemicals that generate fumes or a cloud of powder under a vented hood. Avoid direct contact of lab chemicals with skin or clothes, and wash your hands after each use.

Always place covers from reagent containers top down on a clean counter to prevent contaminating both the counter and reagent container cover. Replace the cover and return the reagent to its storage place as soon as possible.

Most reagents may be safely flushed down the laboratory sink unless otherwise specified. Place these directly into the drain to prevent spattering and flush with plenty of water. Refer to MSDS for proper disposal.

MATERIAL SAFETY DATA SHEET **WAVICIDE-01** Date Issued:

SECTION 1 IDENTIFICATION

Manufacturers Name and Address: Wave Energy Systems, Inc. 25 Mansard Court Wayne, NJ 07470 Phone: 1-800-252-1125 Fax: (201) 633-1023

Hazardous Chemicals: Glutaraldehyde
Routes of entry: Inhalation ✓ Skin/Eye ✓ Ingestion ✓

Product Name: WAVICIDE-01 (2.5% aqueous glutaraldehyde solution)

Product Code: 0104 (case of 4 gallons) or 0112 (case of 12 quarts)

Product Type/General Information: Chemical Sterilant/Disinfectant

EPA Registration Number: 15136-1

Chemical Name: (active ingredient) 2.5% glutaraldehyde

PRECAUTIONARY LABELING
(HMIS Rating System)

Health	3
Flammability:	0
Reactivity:	0
Physical Hazard:	None

The New Jersey Poison Control Center has been provided information for use in medical emergencies involving this product. Call 1-800-962-1253.

SECTION 2 HAZARDOUS INGREDIENTS/IDENTITY INFORMATION

WAVICIDE-01 contains the following hazardous ingredients at concentrations greater than 1.0%:

CHEMICAL COMPONENTS	CAS%	% w/v	OSHA PEL	ACGIH TLV
Glutaraldehyde (active ingredient)	111-30-8	2.5	0.2 ppm[1]	0.2 ppm

WAVICIDE-01 contains no hazardous ingredients listed as carcinogens or potential carcinogens by the National Toxicology Program (NTP), International Agency on Cancer (IARC) or OSHA, and present at a concentration greater than 0.1%:

[1] The OSHA Permissible Exposure Level (PEL) for glutaraldehyde was invalidated in 1992 by court order. However, the PEL may remain valid in some OSHA approved state plans, and also can be enforced by federal OSHA under its General Duty Clause.

SECTION 3 PHYSICAL/CHEMICAL CHARACTERISTICS

Boiling Point:	100°C/212°F	**Evaporation Rate:**	0.81 (Butyl Acetate = 1)
Specific Gravity:	1.005 - 1.013	**Solubility (H_2O):**	Complete
Vapor Pressure:	16.9 mm Hg	**Appearance & Color:**	A clear, slightly yellow liquid with typical aldehyde odor and added lemon scent.
Melting point:	N/A	**pH:**	Approximately 6.30
Vapor Density:	1.1 (air = 1)	**Molecular Weight:**	100.11 (glutaraldehyde)
Freezing Point:	0°C/32°F (same as water)	**Odor Threshold:**	0.04 ppm, detectable (ACGIH)

SECTION 4 FIRE AND EXPLOSION HAZARD DATA

Flash Point (Test Method): None (Tag Closed Cup ASTM D 56)

Special Fire Fighting Procedures: Self-Contained Breathing Apparatus (SCBA) and protective clothing should be worn when fighting chemical fires.

Unusual Fire and Explosion Hazards: None known **Extinguishing Media:** Carbon dioxide, foam, dry chemical.

SECTION 5 REACTIVITY DATA

Stability: Unstable_____ Stable ✓ **Hazardous Polymerization:** May Occur_____ Will Not Occur ✓

Hazardous Decomposition Products: Thermal decomposition may produce carbon dioxide and or carbon monoxide.

Conditions and Materials to Avoid: Alkaline (pH > 10) and acidic (pH < 3) materials catalyze an aldol-type condensation (exothermic but not expected to be violent). Avoid High temperatures above 40°C/104°F and or evaporation of H_2O.

Date Issued:

SECTION 6 HEALTH HAZARD DATA

Routes of Entry: *Inhalation ✓ Skin ✓ Ingestion ✓ Eyes ✓*

Signs and Symptoms Associated With Overexposure (one-time or repeated):

Ingestion: May cause irritation and possibly chemical burns of the mouth, throat, stomach and esophagus. May produce discomfort in the mouth, throat, chest and abdomen, nausea, vomiting, diarrhea, dizziness, faintness, drowsiness, thirst and weakness.

Eyes: Solution contact may cause damage, including severe corneal injury, which could permanently impair vision if prompt first-aid and medical treatment are not obtained. Vapors may cause stinging sensation in the eye with excess tear production, blinking, and redness of the conjuntiva.

Skin: Direct solution contact may cause skin irritation or aggravation of an existing dermatitis. May also cause skin to turn a harmless yellow or brown color.

Inhalation: Vapor is irritating to the respiratory tract. May cause stinging sensations in the nose and throat, chest discomfort and tightening, difficulty with breathing and headache. May also aggravate pre-existing asthma and pulmonary disease.

Emergency and First Aid Procedure:

Ingestion: DO NOT INDUCE VOMITING. Drink large quantities of water and call a physician immediately
NOTE TO PHYSICIAN: Probable mucosal damage from oral exposure may contraindicate the use of gastric lavage.

Eyes: Immediately flush eyes with water and continue washing for at least 15 minutes. Obtain medical attention immediately, and follow up with an ophthalmologist.

Skin: Immediately remove contaminated clothing and flush skin with soap and water for a minimum of 15 minutes. If irritation persists, seek medical attention. Wash or discard contaminated clothing.

Inhalation: Remove to fresh air. Give artificial respiration if not breathing. If breathing is difficult, oxygen may be given by qualified personnel. If irritation persists, seek medical help.

Medical Conditions Generally Aggravated by Overexposure: See above.

SECTION 7 PRECAUTIONS FOR SAFE HANDLING AND USE

Steps to be Taken if Material is Released or Spilled: Wear suitable protective equipment, including nitrile gloves, chemically resistant gown or apron, and protective eyewear (safety glasses or shield). A full face respirator , or half-face respirator with gas proof goggles, both worn with organic vapor cartridges, is recommended for small spills. A respirator is essential for large spills, or if you experience discomfort watery eyes, nasal or respiratory irritation) due to inadequate ventilation. For small spills of 1 gallon or less, gather up a bucket, household ammonia, and a sponge or mop. Don protective equipment and mix approximately 1 cup of ammonia with 1 cup of water in the bucket. Mop or sponge the ammonia mixture into the spill until thoroughly combined (about 2 minutes). Wipe or mop up resulting mixture and discard down the drain with a copious amount of water. Rinse bucket, mop or sponge with water, and give spill area a final wipe or mop with fresh water. Re-rinse all equipment, and allow spill area to dry. For large spills of more than 1 gallon, remove people from immediate spill area, and isolate until cleaned up. Don protective equipment including a respirator with organic vapor cartridges. Contain spill with absorbent material, ie. towels. Add approximately 228 grams of sodium bisulfite powder per gallon of WAVICIDE-01 spilled (aqueous sodium hydroxide and ammonium will also neutralize glutaraldehyde). With a sponge, mix neutralizing chemical into spill, and allow 5 minutes for deactivation to occur. Discard resulting mixture according to your facility's waste disposal guidelines. Mop spill area with fresh water. Rinse out all equipment (bucket, mop, towels) with large amounts of water. If paper towels were used, dispose of in a tightly closed trash bag. Let spill area dry, and if possible increase ventilation. Once glutaraldehyde odor is below allowable levels (TLV), the area may be released from isolation.

Waste Disposal Method: Dispose of WAVICIDE-01 after 30 days of re-use, or the MEC Indicator shows the solution is below it's minimum effective concentration (1.7% w/v), which ever is sooner. This may be accomplished by pouring solution down drain in accordance with state and local regulations. Flush with a large quantity of water. Do not reuse empty containers. Rinse thoroughly with water and dispose of in trash.

Precautions to be Taken in Handling and Storing: WAVICIDE-01 should be stored in it's original sealed container at controlled room temperature (15°C/50°F to 30°C/85°F).

Precautionary Labeling: Avoid contact with eyes, prolonged and repeated contact with skin, and contamination with food.

SECTION 8 TRANSPORATATION DATA & ADDITIONAL INFORMATION

Proper Shipping Name: 2.5% Glutaraldehyde Solution **DOT (ground):** Not regulated **IATA (air):** Not Regulated **IMO (ocean):** Not Regulated

Hazard Class: None **Labels:** None needed **Packaging:** None **ID#:** None **Special Instructions:** None **Reportable Quantity:** None

SECTION 9 CONTROL MEASURES

Eye Protection: Safety glasses, goggles or face shield recommended when working with WAVICIDE-01. An eye wash, and full face respirator with organic vapor cartridges or half face respirator with gas proof goggles and organic vapor cartridges should be available for emergency situations.

Ventilation: WAVICIDE-01 should be used in closed containers with tight fitting lids. The working area should be large enough with ventilation necessary to keep the level of atmospheric glutaraldehyde below the Threshold Limit Value (TLV). If the solution vapors are irritating to eyes and nose, the TLV is probably being exceeded, and additional ventilation may be necessary. A fume hood or self contained fume absorber may be appropriate for this purpose. Any ventilation should pull fumes away from worker and towards the floor.

Skin Protection: Nitrile gloves and a chemical resistant gown or apron should be worn when working with WAVICIDE-01. Rubber boots may be needed to contain large spills.

Respiratory Protection: None required if glutaraldehyde vapor levels are below the TLV. A full face respirator with organic vapor cartridges or SCBA should be available for emergencies.

SECTION 10 SPECIAL REQUIREMENTS

None

Figure 1-9 An example of a Material Safety Data Sheet (MSDS) that includes proper handling, storage, and disposal of hazardous chemicals.

Figure 1-10 The NFPA "fire diamond" is used to identify a substance's level of hazard. The higher the number, the higher the risk.

Labeling and Storing Reagents

OSHA requires that all reagent containers be clearly and prominently labeled with the chemical's name and pertinent information about hazards, such as toxicity and flammability. The date of receipt or preparation of chemicals, their expiration date, and any special storage requirements also should be noted. Discard reagents with missing or unreadable labels to prevent potential misuse. As an extra safety measure, it is a good idea to label all caustic reagents with a brightly colored sticker or easily recognized symbol.

The National Fire Protection Association has standardized a method of labeling hazardous materials using colors and symbols to identify a substance's level of hazard. It is sometimes referred to as the "**NFPA diamond.**" The symbol is divided into four colored quadrants, each quadrant representing a hazard and level of that hazard. (See Figure 1-10.)

All reagents should be stored away from heat and sunlight in a dry location because heat, light, and moisture often cause chemicals to react. Reagents may be stored at room temperature unless storage directions indicate the need for refrigeration. Reagents that react together should be stored in isolation from one another in safety containers, and flammable reagents should be stored in a fireproof metal cabinet. The smallest amount of all necessary chemicals should be kept in stock to keep the potential for contamination and injury at a minimum.

Acids and Bases—Special Concerns

Two groups of chemicals requiring special caution are **acids** and **bases.** Both are **caustic,** generate heat when they come into contact with water, and react quickly with other chemicals and each other. Even the fumes of acids and bases react together. Acids and bases are prone to spattering and can cause serious burns to the eyes and skin. Protective eyewear is recommended when working with acids, bases, and other chemicals that may spatter.

Acids always should be added to water—not water to acids—because there is less chance of spattering and burns. When water is added to acid, it remains on top because it is less dense. There, it reacts and generates heat, potentially spattering the workstation and lab personnel.

Acids and bases neutralize each other; therefore, a base is used to neutralize acid spills and an acid to neutralize base spills. A large amount of a weak base will neutralize a strong acid as effectively as a smaller amount of a stronger base but in a safer manner. Similarly, a large amount of a weak acid is safer to neutralize a strong base than is a stronger acid.

First Aid for Chemical Spills

No matter how careful laboratory personnel are, the possibility of an accident with hazardous chemicals still exists. Therefore, every laboratory should have a designated sink where chemical spills can be washed off quickly. An eyewash station should be installed at a sink that is quickly accessible (see Figure 1-11). Check your lab's manual for more explicit procedures to follow when chemical spills occur.

Figure 1-11 An eyewash station is an instant source of water for a quick rinse when an accident occurs. A quick response can be crucial.

SAFETY FROM PHYSICAL HAZARDS

Physical hazards such as slippery floors and falling objects may present risks to workers in most workplaces, but are especially dangerous in laboratories where biohazardous materials are at hand. Good housekeeping and time management are important to help prevent accidents of this nature. The best way for lab personnel to avoid injury from physical hazards is to follow basic rules for physical safety. These are described next for electrical, fire, weather, and personal hazards.

Electrical Hazards

Always use common sense when using electricity. For example, always unplug electrical appliances before changing bulbs or servicing. Be careful to keep water and chemicals away from outlets and electrical equipment to avoid dangerous shorts that can start fires and cause electrocution.

The electrical wiring system of the laboratory should be adequate for the amount of electricity used—extension cords and multiple tap plugs are not safe and usually indicate an inadequate electrical wiring system. There should be safety devices such as three-prong grounded plugs, current breakers or fuses, and a master switch that is accessible in case of emergency.

Any malfunctioning electrical equipment should be checked by a professional. If the malfunction is major, unplug the machine until it can be repaired or replaced. Check cords periodically for breaks and frays.

Fire Hazards

Any situation that is a potential fire hazard should be remedied before an accident occurs. For example, long hair or loose clothing presents a fire hazard around open flames such as laboratory burners. Situations like this are easily avoided.

Even when precautions are taken to prevent fires, they may still occur. All lab personnel should know how to report a fire. Each lab should have a multiple-use fire extinguisher conveniently mounted on a wall ready for use. Know how to use it. The fire extinguisher should be in good condition and checked periodically. A fire blanket at a convenient location is essential to smother flames.

The POL manual should include a fire escape plan. Dual exits should be included in the plan in case one exit is blocked by fire. Exits to be used as fire escapes should be clearly marked and accessible at all times during work hours.

Weather Hazards

In some parts of the country, weather emergencies are relatively common. For example, hurricanes are a potential risk in the Southeast and tornadoes in the Midwest. The places to take cover in case of severe weather in your area should be described in the POL manual. Learn where they are.

Personal Hazards

Wherever you work, you should analyze your work environment for personal safety hazards such as theft and assault. To maximize your personal safety in the lab, in the parking lot, and on route to and from work, follow these safety tips recommended by police:

- When you arrive at work, park in a well-lighted area and lock your car.
- At work, keep your purse or other valuables out of sight, preferably in a locked place such as a desk or filing cabinet.
- Avoid working alone, especially at night.
- When you leave work, particularly after dark, stay alert, leave the building with coworkers, have your keys handy, and drive on well-lighted streets.

LABORATORY PERSONNEL CHARACTERISTICS AFFECTING LAB SAFETY

Safety rules and regulations and specialized equipment and gear cannot ensure lab safety unless personnel use care and common sense on the job everyday.

Personnel Attitudes

In POLs, as elsewhere, worker attitudes can contribute to an unsafe work environment. Workers who take shortcuts and are inconsiderate of others may undermine everyone's safety. Attitudes that may contribute to a safer laboratory, on the other hand, include awareness of potential danger, willingness to learn and use safe methods, and concern for the welfare of coworkers. Professionalism in medical laboratories is a combination of positive attitudes that put a high priority on personnel safety.

To ensure safety on the job, lab personnel should avoid taking unnecessary risks. Sometimes, even experienced workers take risks that can cause lab

accidents. Indeed, experienced workers sometimes take unnecessary risks because they have performed these tasks without incident so many times in the past. Other common reasons for lab accidents include

- hurrying to meet deadlines or goals
- carelessness and fatigue
- preoccupation with nonwork matters
- excessive stress

Keep in mind that working under these conditions may lead to accidents.

Chronic Injury to Muscles and Bones

Muscles and bones, if overused over a period of time, can develop chronic injuries classified as occupational diseases. Two examples are carpal tunnel syndrome of the wrist, which affects keyboard operators, and neck torsion disorder, which may occur from long periods of microscope use.

The following suggestions can help you prevent these injuries. Examine your work activities, furniture, and lighting for stressful elements. Use good posture; comfortable chairs; good lighting; large, padded grip and handle surfaces; and cushioned hand/wrist rests. Alternate between high- and low-risk activities and take brief breaks to stretch muscles during tedious tasks. Try to eliminate awkward or stressful motions such as extending beyond your usual reach. Use minimal, not excessive, force to operate keyboards and instruments. If the microscope is not at a comfortable height, try placing books under it to raise it to a level that does not require you to bend your neck tightly.

More About Stress

While some stress may be helpful in maintaining alertness, too much stress may cause work quality to deteriorate and lead to accidents on the job. Stress may originate off the job—a too busy lifestyle, for example—or work conditions may be the cause. It is not uncommon for lab personnel to feel pressure to work faster. Whatever the cause, excessive stress should be brought under control before injury or ill health results. Following are some ways to help control job-related stress:

- Prioritize your job tasks each day and schedule your work assignments by the day, week, and month. Work piling up on your desk may create job stress. If you develop a plan to deal with all of the work, you will feel less stressed.
- Try to resolve job-related stress by first discussing problems with your supervisor. For example, be realistic with your time. Tell your supervisor if you have more work than you can handle.
- Develop a personal wellness program—eat a well-balanced diet, get plenty of rest, and exercise regularly.

PROCEDURE 1-1

Hand Washing

Goal

After successfully completing this procedure, you will be able to wash your hands with soap and running water to sanitize your skin prior to gloving before hazardous laboratory procedures and also after completing such procedures.

Completion Time

2 minutes

Equipment and Supplies

- A sink with running water
- Liquid soap in a dispenser (preferably an antiseptic soap)
- Paper towels in a dispenser
- Hand lotion

Instructions

Read through the list of equipment and supplies you will need and the steps of the procedure. Be sure you understand each step correctly and in the proper order.

*Steps marked with (*) are critical and must have the maximum points to pass.

Performance Standards	Points Awarded	Maximum Points
1. Remove all jewelry such as rings (except for a plain gold band), bracelets, and your wristwatch because these may harbor microorganisms in the crevices. Wristwatches worn at work in the POL should be sanitized separately.		10
2. Turn on the faucet and regulate the water temperature to a desired warm temperature. Soap will suds better in warm water.		5
3. Wet your hands with water. Hold your hands lower than your elbows to prevent water running past your elbows. Microorganisms and debris will be washed away into the sink instead of traveling up your arms.		5
4. Apply approximately 2–4 mL of liquid soap to your hands and arms up to your mid forearm. Suds the soap with about 10 circular motions of your hands.		10
5. Use friction along with the circular motions to suds your palms, the backs of your hands, and your forearms.		10
6. Wash your fingers with 10 circular motions, interfacing your fingers and rubbing them back and forth with friction.		10
7. Rinse your hands well, making sure to hold your hands lower than your elbows. Then rinse your wrists and forearms until no soap remains.		10
8. Repeat the soaping and rinse process to be sure that your hands are clean.		5
9. Dry your hands gently and thoroughly with paper towels. Drying your hands well will help prevent chapping, which causes crevices and breaks in skin.		5
10. Turn off the water using a paper towel. The faucet handles are considered contaminated.		5
11. Inspect your hands for cuts and abrasions. Cover any hangnails or open wounds with bandages.		5
12. Put lotion on your hands.		5
13. If this is your last hand wash of the day before leaving work, clean your nails thoroughly with an orange stick. Nails harbor microorganisms in the debris lodged underneath them.		5
14. If work is to continue with hazardous material, put on nonsterile gloves.		5
15. Wipe the sink area with a paper towel to remove water and debris. Keep the paper towel between your hands and the sink. The sink is considered contaminated.		5
Total Points		**100**

Overall Procedural Evaluation

Student's Name _____

Signature of Instructor _____ Date _____

Comments _____

_____

PROCEDURE 1-2

Practicing Lab Safety

Goal

After successfully completing this procedure, you will be able to properly use equipment to safely handle and dispose of biohazardous materials in the laboratory.

Completion Time

45 minutes

Equipment and Supplies

- Disposable gloves
- Hand disinfectant
- Face shield or goggles
- Surface disinfectant
- Paper towels
- Biohazard container
- Sharps container
- Pipette and suction device
- Personal protective gear
- Bags and tags for biohazardous waste
- Needle and needle remover or forceps
- Tap water

Instructions

Read through the list of equipment and supplies you will need and the steps of the procedure. Be sure you understand each step before you begin. Then complete each step correctly and in the proper order. If your completion time is too long, repeat the procedure until you increase your speed.

Steps marked with (*) are critical and must have the maximum points to pass.

Performance Standards	Points Awarded	Maximum Points
1. Collect or locate the appropriate equipment.		10
2. Wash your hands thoroughly with hand disinfectant.		20
3. Dry your hands completely.		10
4. Put on disposable gloves.		5
5. Assemble and correctly put on a complete outfit of protective gear.		10
6. Remove all gear, except the gloves, and return to storage.		10
7. Use the pipette suction device to pipette a small amount of tap water into a disposable pipette.		10
8. Empty the pipette and repeat step 7.		5
9. Pour a small amount of tap water on the floor to simulate a biohazardous spill.		5
10. Pour surface disinfectant liberally on the spill. Cover the spill with paper towels to prevent spreading, and let the spill soak for 5 minutes.		10
11. Wipe up the spill thoroughly with paper towels.		5
12. Dispose of the paper towels in a plastic bag. Label the bag with a biohazard indicator.		10
13. *Remove your gloves, wash your hands with disinfectant, dry your hands, and put on clean gloves.		20
14. Thoroughly wipe a piece of equipment such as a centrifuge with disinfectant or alcohol and paper towels.		10
15. Dispose of the paper towels in a plastic bag and label the bag with a biohazard indicator.		10

16. *Remove your gloves, wash your hands with disinfectant, dry your hands, and put on clean gloves.		20
17. *Dispose of the needle and syringe safely in the sharps container.		20
18. Disinfect work counters and tables with surface disinfectant.		10
19. *Clean the work area following Standard Precautions.		20
20. *Remove your gloves, wash your hands with disinfectant, and dry them.		20
Total Points		**240**

Overall Procedural Evaluation

Student's Name _____

Signature of Instructor _____ Date _____

Comments _____

_____

chapter 1 REVIEW

Using Terminology

Define the following terms as they apply to laboratory safety.

1. Aerosolization _____
2. Biohazard _____
3. Exposure incident _____
4. Chain of transmission _____
5. Material Safety Data Sheet _____
6. Infection Control Program _____
7. Post-exposure prophylaxis _____
8. Universal Precautions _____

Match the following terms to the most appropriate meaning.

____ **9.** Biological specimen
____ **10.** Engineering control
____ **11.** HBV
____ **12.** HCV
____ **13.** HIV
____ **14.** PPE
____ **15.** OSHA
____ **16.** Vector

a. hepatitis B virus
b. federal agency that ensures safety and health of workers
c. virus that causes AIDS
d. an animal, such as an insect, that carries a pathogen
e. includes gloves, face shields, aprons, uniforms
f. lab samples originating from living organisms
g. safety devices used in the laboratory
h. hepatitis C virus

Acquiring Knowledge

Answer the following questions in the spaces provided.

17. How do the Universal Precautions protect laboratory personnel against infection?

18. List five medical problems or diseases that may be encountered in a laboratory.

19. Discuss appropriate ways to manage a high level of stress at work.

20. How should you apply the rule of placing a barrier between you and the possible source of contamination or disease in the laboratory? Give examples for

Pipetting

Disposing of used needles and lancets

Working with biohazards that may splatter

21. Why are biohazards labeled with an easily read label, whether they are test specimens or waste material?

22. Why do the Universal Precautions dictate that all biospecimens be regarded as hazardous?

23. Which of the following may transmit HIV?

_____ a. blood

_____ b. amniotic fluid

_____ c. semen

_____ d. synovial fluid

24. What protection against HBV is available to laboratory personnel?

25. What records are kept of reported laboratory accidents involving biohazards and toxic chemicals?

26. List seven ways to prevent exposure to toxic chemicals in the laboratory.

27. In a safety education program provided by the employer, what information should be provided to new lab personnel?

28. What are some physical hazards in the laboratory and how are they best controlled?

29. What is an acceptable dilution of household bleach prepared daily for the purpose of decontaminating counters, equipment, and floors?

30. What part does attitude play in laboratory safety?

31. When should laboratory personnel wash their hands?

32. What rule should laboratory personnel follow regarding facial contamination?

33. How should laboratory personnel dispose of waste contaminated with biohazards or chemicals?

34. Why should fire escape routes be posted and exits not blocked with supplies or furniture?

35. How can lab personnel avoid being exposed to needlesticks from contaminated needles?

36. When should lab personnel wear gloves in the laboratory?

Applying Knowledge—On the Job

Answer the following questions in the spaces provided.

37. Mary and Jane were working as a team in the POL. The schedule for that day was very busy. Mary had just drawn blood. As she attempted to dispose of the contaminated needle into the sharps container, Jane reached for a reagent and was accidentally stuck. Write the report that Jane must submit to her employer and list the post-exposure procedure steps that her employer must follow.

38. A patient infected with HIV is having a blood test in the POL. What precautions should you take when you draw his blood? When you perform the blood test?

39. Joseph, a student, is instructed to visit a lab to see how safety rules are being observed. Make a list of at least eight safety rules that Joseph could easily observe when he visits the lab.

_____

_____

_____

40. Anna, a lab technician, performs the following tasks in the following order. After which tasks should she wash her hands?

_____ a. entering the lab for her work shift

_____ b. putting on disposable gloves

_____ c. performing a test using a test tube of blood

_____ d. removing gloves

_____ e. taking the lab report to the receptionist

_____ f. putting on gloves

_____ g. drawing blood from a patient for a blood test

_____ h. performing the blood test

_____ i. removing the gloves

_____ j. putting the cover on the microscope

_____ k. making a phone call

_____ l. going to the waiting room to call a patient to come to the lab for a timed blood test

_____ m. verifying that the test request is for the right patient

41. A laboratory fails a fire safety inspection only because an exit in the lab is partially blocked. List three other safety requirements that it must have met.

_____

_____

_____

42. Web Research: Go to **www.cdc.gov/mmwr** and search for the updated U.S. Public Health Service Guidelines for the Management of Occupational Exposure to HBV, HCV, and HIV. Report to the class the recommendations for post-exposure prophylaxis for health care personnel to these three infections.