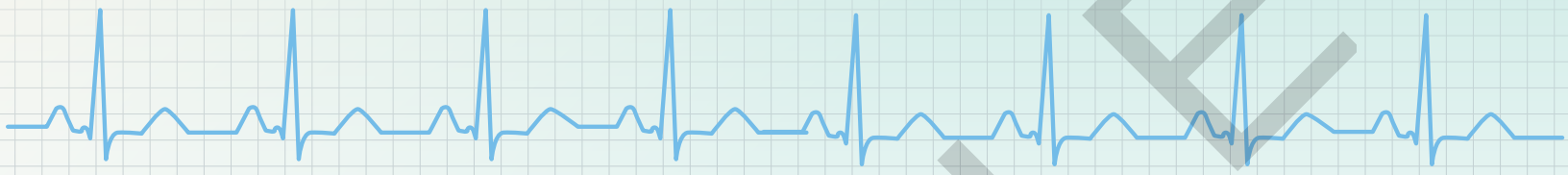
Chapter 5

Infection Control



READING AND NOTETAKING

Write the Learning Outcomes for each lesson on a piece of paper. Then, beneath each outcome, rewrite it as a question. While reading each lesson, take detailed notes about information relating to these outcomes. After reading, refer to your notes and write two or three sentences answering each outcome's question.

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HOSA EVENT PREP

Public Health

Public health focuses on how to improve health for the public. While you might think that public health primarily works with communicable diseases, that is just part of the job. Public health professionals also study socioeconomics and how poverty affects health and access to care. They may study chronic diseases and how they relate to the public—for example, the number of people newly diagnosed with diabetes in a community and trends among them. Many times, public health involves educating the general public on prevention and ensuring all have adequate medical care. HOSA—Future Health Professionals has a team event called *Public Health*. Each year, HOSA provides a topic for teams to develop and share a presentation.

Go to the HOSA website to learn more about the HOSA *Public Health* event. Find out the purpose of the event, what is involved in the event, and what knowledge is demonstrated in the event.

As you prepare for HOSA competitive events, be sure to check the website and talk with your HOSA advisor for the most up-to-date guidelines and procedures. Once you have learned about the *Public Health* event, answer the following questions:

1. How might participating in this event benefit you personally and your future career? Explain.
2. Are you interested in participating in this event? Why or why not?

LESSON
5.1

Microorganisms and Types of Infection

ESSENTIAL QUESTION

How does learning about the different types of microorganisms aid in infection control?

Learning Outcomes

After studying this lesson, you will be able to

- **5.1–1** Discuss the importance of infection control in a healthcare facility.
- **5.1–2** Identify microorganisms that can cause illness, including bacteria, viruses, fungi, protozoa, rickettsiae, and helminths.
- **5.1–3** Explain why the overuse of antibiotics can result in resistant organisms.
- **5.1–4** Identify different types of infections.

Terms to Know

aerobe
anaerobe
bacteria
fungi
healthcare-associated infections (HAI)
helminths
infection control
morphology
parasites
protozoa
rickettsiae
viruses

Healthcare facilities battle continuously to prevent the spread of microorganisms that can cause infectious disease. These microorganisms, known as *pathogens,* can result in infections both for patients and employees. Today, most healthcare facilities have a separate department devoted exclusively to **infection control**. Many facilities call this the *Department of Hospital Epidemiology and Infection Control (HEIC).* In this chapter, you will learn basic information about pathogens and the standard procedures for preventing them from spreading.

infection control
all efforts made to prevent the spread of infection

5.1–1 Introduction to Microorganisms

Microorganisms such as **bacteria**, **viruses**, **fungi**, **protozoa**, and **helminths** are everywhere in our environment—in the air, on our skin, in food, and on everything that we touch. You cannot see bacteria without a microscope. Viruses, which are much smaller than bacteria or fungi, cannot even be seen using a standard microscope.

Not all microorganisms cause illness. Microorganisms that do not cause illness are called *nonpathogenic* microorganisms. Nonpathogenic microorganisms, such as the bacteria in our intestines, do not cause health problems; instead, they contribute to good health by helping to break down waste and nutrients.

Under normal circumstances, nonpathogenic microorganisms do not cause disease, but there are exceptions to this rule. For example, in some circumstances, such as surgery that perforates (punctures) the bowel, the bacteria in the colon can spill into the body cavity and cause serious infection. In addition, people who have compromised immune systems are susceptible to infections and may become ill from microorganisms that do not usually affect individuals with healthy immune systems. Nonpathogenic microorganisms can become pathogens to such patients.

For microorganisms to live and thrive, they require certain elements in their environment. For example, **aerobes** are microorganisms that require oxygen to live. **Anaerobes** are microorganisms that live in an environment with little or no oxygen.

5.1–2 Bacteria

Bacteria are initially classified by their **morphology** (form and structure) as seen under a microscope. After observing bacteria under the microscope, a clinical microbiologist identifies the actual family of the bacteria through testing.

The basic forms of bacteria are spherical (*coccus*) and rod-like shapes (*bacilli*). **Figure 5.1** illustrates several shapes of bacteria, including those that appear as twisted cylinders (*spirochetes*), spherically-shaped cocci arranged in clusters (*Staphylococcus*), cocci forming chains (*Streptococcus*), and cocci in pairs (*Diplococcus*).

The following are examples of how bacteria can cause major illness in our bodies.

- Hospital stays can be prolonged by the bacterium *Staphylococcus aureus* (*S. aureus*). The infections caused by these bacteria are commonly called *staph infections*.
- The Black Death that killed approximately 25 million people in fourteenth-century Europe was a plague caused by the rod-shaped bacterium, *Yersinia pestis*. Today, *Yersinia pestis* is easily treated with antibiotics.
- Syphilis is a bacterial infection caused by a spiral bacterium called a *spirochete*.

Bacterial infections are treated with antibiotics—drugs that kill the disease-inducing microorganism. However, the overuse and misuse of antibiotics has caused some bacteria to become resistant to antibiotics. The types of bacteria resistant to antibiotics are those that cause skin and urinary

THINK CRITICALLY

Why is it important for healthcare providers to understand the difference between different microorganisms?

bacteria
small, one-celled microorganisms that cannot be seen by the naked eye; can be pathogenic (cause disease)

viruses
pathogenic microorganisms, much smaller than bacteria, that depend on a living cell to survive; cause many serious diseases and illnesses

fungi
parasitic organisms that live in the soil or on plants; includes disease-causing microorganisms such as yeasts and molds

protozoa
microorganisms that depend on a host cell to survive and replicate; can cause serious illness

helminths
large multicellular parasites that can cause serious illness in humans as well as animals; commonly known as *parasitic worms*

aerobe
an organism that requires oxygen to live

anaerobe
an organism that requires little or no oxygen to live

morphology
the science or study of the form and structure of organisms

tract infections, meningitis, sexually transmitted diseases, and respiratory tract infections such as pneumonia. Antibiotic-resistant bacteria are difficult to treat and cause increased hospital stays for patients. This in turn affects the cost of healthcare. The FDA has encouraged the development of new antibiotics, vaccines to prevent the diseases that may require antibiotics, and improved diagnostic tests for infectious diseases.

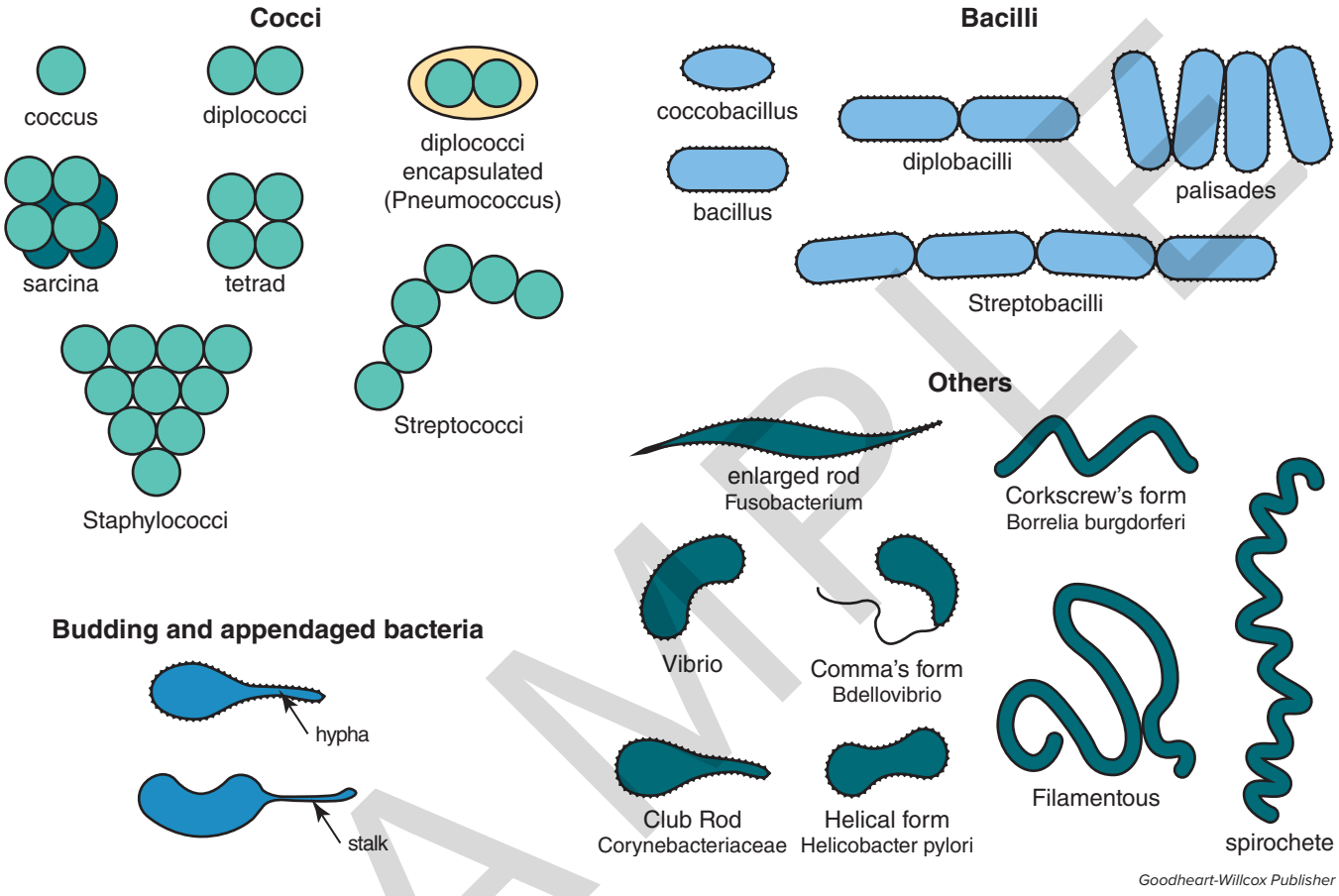

Figure 5.1 These illustrations show a few simple representations of the many different shapes and sizes of bacteria. *Which bacteria names do you recognize?*

Real Life Scenario

Overuse of Antibiotics

Antonio has an opportunity to go on vacation with his best friend's family. Antonio has been coughing quite a bit the last few days, keeping him up at night. His nose is running, and his parents think he shouldn't go on the trip. Antonio's family doctor says he probably has a cold and doesn't need antibiotics. However, Antonio thinks antibiotics would make him well. After all, he takes antibiotics every time he has an ear infection, and the infection clears up right away. He has some leftover antibiotic pills prescribed for his ears and decides to take them so he can go on vacation.

Apply It

1. Why didn't the doctor give Antonio antibiotics in case it could help?
2. Why does Antonio have leftover antibiotics from his ear infection? Should he? Will the pills cure his problem?
3. Should Antonio go on the trip?

5.1–2, 5.1–3 Viruses

Much smaller than bacteria, viruses depend on a living cell to survive because they cannot reproduce on their own. They need to be inside another living cell. Viruses are the cause of the common cold, smallpox, chicken pox, shingles, measles, influenza, polio, human papillomavirus (HPV), herpes simplex, and AIDS. Another example is SARS-COV-2, which is the virus that causes COVID-19 (CO = corona, VI = virus, and D = disease). This is a novel virus that has not been seen before in humans.

According to the CDC and the World Health Organization (WHO), COVID-19 spreads when a person who is infected coughs, sneezes, sings, talks, or breathes. Particles are inhaled into the nose, mouth, airways, and lungs of other people, causing the infection. These particles can travel distances of 6 feet (2 arm lengths) and beyond and can remain in the air for a long time. They can also land on surfaces or objects and stay there for hours, causing possible transfer when other people touch those surfaces or objects and then touch their mouth, nose, or eyes. COVID-19 seems to spread easily in communities; people who live in the same area become infected with the virus through a process called community spread.

Many more illnesses are caused by viruses.

Viruses that infect animals can also mutate to infect humans, including

- West Nile virus, a mosquito-borne virus that first infected birds but now infects humans;
- monkeypox, a virus that affects monkeys, primates, and rodents that has mutated to infect humans;

Extend Your Knowledge

Bioterrorism

Bioterrorism agents are living organisms—such as bacteria, viruses, or fungi—or toxins that are deliberately used to sicken and kill. They may be used by terrorists because of their psychological impact on the public and because they can be deadly, are easy to distribute, are a relatively inexpensive weapon, and are difficult to detect.

A bioterrorism agent that has been in recent news is *anthrax*, an infectious disease caused by spores of bacteria called *Bacillus anthracis*. Some bacteria form spores that are resistant to physical and chemical influences. More than 45 percent of people who inhale anthrax spores will die.

Other bioterrorism agents include smallpox, plague, botulism, and hemorrhagic fever. Other pathogenic microorganisms can be used in an attack.

In 2002, Congress signed into law the Bioterrorism Act. This act requires the development of a comprehensive plan against bioterrorism to increase the security of the United States.

Apply It

1. Research one of the bioterrorism agents listed above. What were the circumstances that caused this agent's use? What were the effects on the people or communities involved?
2. How can you be better informed about the use of bioterrorism agents?

- Ebola, a virus first seen in primates that has spread to humans; and
- H1N1, also known as swine flu, a virus with most cases resulting from contact with infected hogs.

Antibiotics do not kill viruses. Usually, time and rest are necessary to let most of these illnesses run their course. Doctors will advise patients to stay home, take non-aspirin pain relievers, and get plenty of rest. However, vaccines have been developed against many viral diseases. A vaccine introduces small amounts of the microorganism into the system in an effort to boost the immune system against the microorganism. An increasing number of antiviral remedies are being developed. These remedies prevent the virus from replicating or reproducing itself.

The following are three viruses that are of major concern to healthcare facilities and providers.

- Hepatitis viruses are transmitted by blood, serum, and other body secretions. Hepatitis B (HBV), also called serum hepatitis, affects the liver, leading to destruction of liver cells. A vaccine has been developed to protect people from this virus. Under federal law, employers are required to provide vaccination to workers, including three or more injections for HBV.
- Hepatitis C (HCV) can have no symptoms but can cause serious liver damage. New medications have been developed to cure this virus. Hepatitis viruses can remain active for several days in dried blood, so healthcare providers are responsible for taking precautions to prevent the spread of these viruses.
- Acquired immunodeficiency syndrome (AIDS) is caused by human immunodeficiency virus (HIV). HIV suppresses the immune system, making it difficult for a person with HIV to fight off many infections that would not affect a healthy person. There is no cure and no vaccine at present. It is critical for the healthcare provider to take precautions to prevent the spread of this disease (**Figure 5.2**).

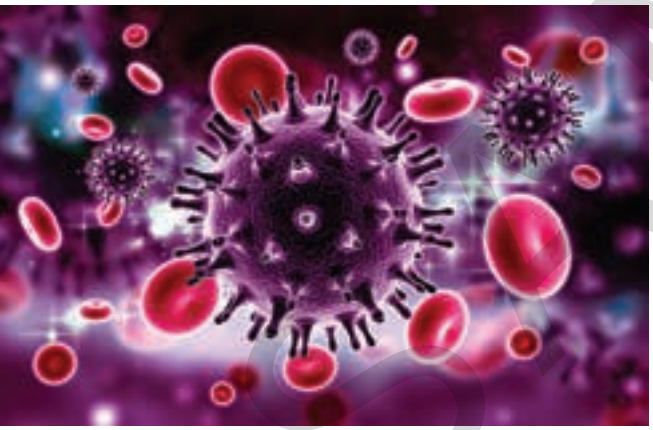

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Figure 5.2 HIV virus in the bloodstream, seen with the aid of an electron microscope.

5.1–2 Fungi

Microscopic fungi include yeasts and molds. Some fungi can cause disease, especially if the immune system has already been compromised by a different disease or disorder.

Examples of fungal infections include athlete's foot, thrush (an infection of the mouth or throat caused by the fungus *Candida albicans*), vaginitis, and certain lung diseases (**Figure 5.3**). Fungal infections are treated with topical, oral, or injectable medications.

5.1–2 Protozoa

Although they are larger than viruses, protozoa or *parasites* depend on a host cell to survive and replicate. Protozoa are found in water and soil and cause amoebic dysentery, an inflammation of the colon that results in fever,

abdominal pain, and severe diarrhea. They also cause amoebiasis, trichomoniasis, and malaria (a disease contracted when bitten by an infected mosquito). In a malaria patient, the protozoan lives in red blood cells. Protozoal infections are treated with oral and injectable anti-protozoal medications.

5.1–2 Rickettsiae

Rickettsiae are also **parasites**, or organisms that live in or on another organism. Parasites such as **rickettsiae** normally choose fleas, lice, ticks, or mites as their host organism. If one of these creatures bites a human, that human's body becomes the parasite's host. Rickettsiae cause Rocky Mountain spotted fever and types of typhus, both of which are severe infections that have been known to cause serious epidemics. Rickettsiae are treated with appropriate antibiotics.

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Figure 5.3 The fungus *Candida albicans* causes a tongue infection called thrush.

parasites
organisms that live in or on another organism

rickettsiae
parasites that normally choose fleas, lice, ticks, or mites as their host organisms; can cause severe infections

Extend Your Knowledge

Super Bugs

In the news today, you hear a great deal about antibiotic-resistant bacteria, or *super bugs*. Over the years, certain bacteria have developed a resistance to antibiotics. This resistance makes some infections difficult to treat.

Some bacteria are resistant to most antibiotics. This resistance can develop when antibiotics are used improperly, such as when

- patients do not take all of their prescribed antibiotics (the bacteria may not be completely killed, which will cause further illness or even drug resistance);
- antibiotics are prescribed when not needed or indicated (antibiotics will not be effective against the flu, which is caused by a virus);
- antibacterial substances are contained in cleaning products;
- antibiotics are found in animals consumed as food; or
- genetic mutation of bacteria has occurred.

Some bacteria that have become resistant to antibiotics include *Mycobacterium tuberculosis*, *Streptococcus*, *Klebsiella*, *Acinetobacter*, *Pseudomonas*, *Clostridium difficile*, vancomycin-resistant *Enterococcus*, and *Enterobacter*. One of the most highly publicized bacterium in this category is *Methicillin-resistant Staphylococcus aureus (MRSA)*. MRSA is responsible for a difficult-to-treat infection. MRSA is prevalent in hospitals, prisons, schools, and nursing homes, where residents with open wounds and weakened immune systems are confined in close quarters. These patients are at greater risk of infection than the general public.

Careful monitoring of antibiotic use is necessary to prevent the development of antibiotic resistance and to reduce the spread of antibiotic-resistant bacteria.

Apply It

1. Have there been incidences of antibiotic-resistant bacteria at one of your local healthcare facilities?
2. After completing this chapter, identify the infection control procedures that you believe should be followed when antibiotic-resistant bacteria are involved.

5.1–2 Helminths

Helminths, also commonly known as *parasitic worms*, are large multicellular parasites which can generally be seen with the naked eye when they are mature. They are often referred to as intestinal worms even though not all helminths live in the intestines. Three types of helminths are flukes, tapeworms, or roundworms. Humans can become infected with helminths by eating the eggs or larvae found in raw or undercooked contaminated food, such as pork, beef or fish, or being bitten by infected insects. Some worms can also penetrate the skin in order to enter the body.

Common worms that can infect humans include the following:

- **Hookworms**—These worms attach to the small intestines and can infect the heart and lungs.
- **Ascariasis**—The ascariasis worm lives in the small intestine and can cause obstruction (Figure 5.4).
- **Trichinella spiralis**—This worm can be contracted most commonly by eating raw or inadequately cooked pork.
- **Enterobiasis**—This worm is commonly called pinworm, mainly affecting young children. The pinworm lives in the rectum and causes anal itching.

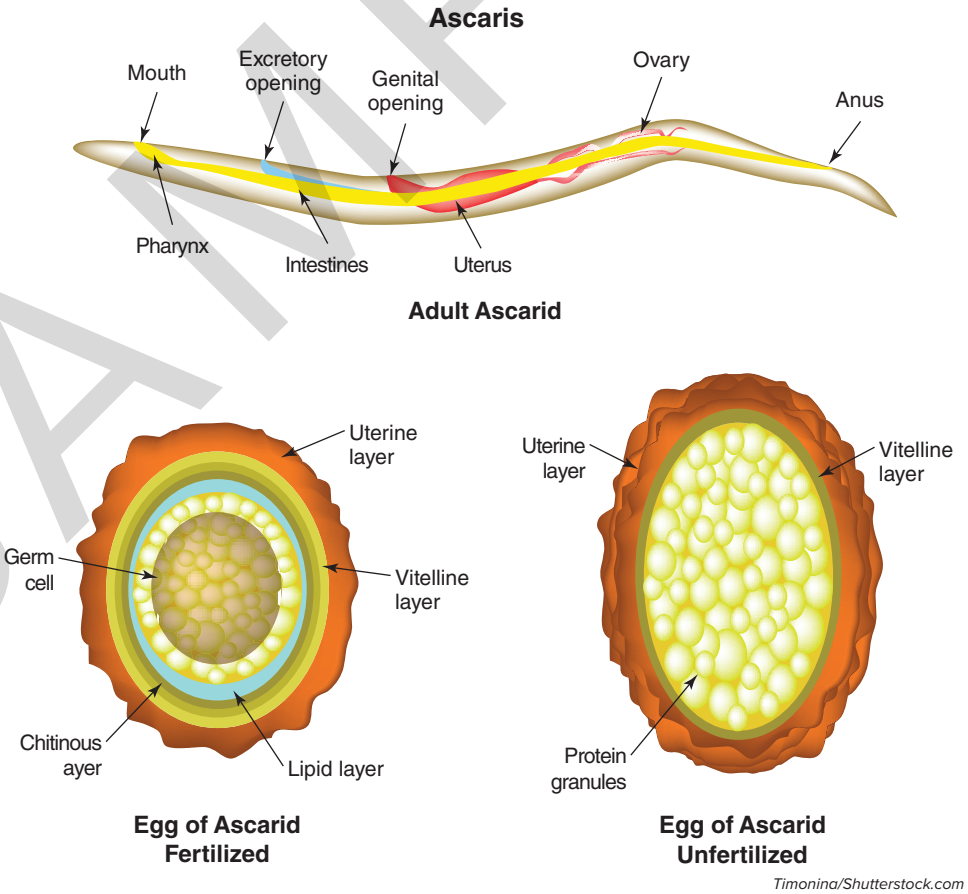

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Figure 5.4 The ascariasis worm is a type of helminth that lives in the small intestine and can cause obstruction. *What are other types of helminths?*

5.1–4 Types of Infection

Organisms that cause infection in the human body act in different ways. Some pathogens produce *toxins*, a type of poison that can harm the body. The bacterium that causes tetanus produces a toxin that affects the nervous system. Other pathogens can produce an allergic reaction. Malaria attacks red blood cells, causing them to rupture.

Infections can be classified as *endogenous* (originates inside the body, like tumors or infections caused by microorganisms inside the body). *Exogenous* infections originate outside the body (such as radiation, trauma, electric shock, and invading pathogenic organisms). **Healthcare-associated infections (HAI)** originate from a healthcare facility. *Opportunistic* infections occur in individuals who have a weakened immune system.

THINK CRITICALLY

Choose two types of infection described in this section. What could you do as a healthcare provider to prevent each infection?

healthcare-associated infections (HAIs) infections acquired in hospitals and other healthcare facilities; also known as healthcare-acquired infections

LESSON 5.1 REVIEW

Multiple Choice

Select the letter that corresponds to the correct answer.

1. Today, most healthcare facilities have a separate department devoted exclusively to _____. (5.1–1)
   A. identifying pathogens
   B. disinfection
   C. infection control
   D. sanitization
2. _____ are parasites that normally choose fleas, lice, ticks, or mites as their host organisms. (5.1–2)
   A. Rickettsiae
   B. Viruses
   C. Fungi
   D. Helminths
3. Smallpox, polio, and Ebola are all caused by _____. (5.1–2)
   A. Helminths
   B. Bacteria
   C. Protozoa
   D. Viruses
4. Which of the following is *not* a type of infection? (5.1–3)
   A. endogenous
   B. optimistic
   C. exogenous
   D. healthcare-associated
5. Bacteria can become resistant to antibiotics when _____. (5.1–4)
   A. patients do not take all of their prescribed antibiotics
   B. genetic mutation of bacteria has occurred
   C. antibiotics are prescribed when not needed or indicated
   D. All are correct.

LESSON
5.2

The Chain of Infection

ESSENTIAL QUESTION

How does breaking the chain of infection help to prevent the spread of infection in healthcare facilities?

Learning Outcomes

After studying this lesson, you will be able to

- **5.2–1** List the components of the chain of infection and explain how to break the chain.
- **5.2–2** Discuss the importance of proper hand washing and using a hand sanitizer.
- **5.2–3** Identify three levels of cleaning necessary in a healthcare facility.

Terms to Know

antisepsis
asepsis
autoclave
chain of infection
direct contact
disinfection
hand hygiene
indirect contact
sanitization
sterilization
vectors

THINK CRITICALLY

How does knowing the chain of infection help to prevent the spread of infection in healthcare facilities?

direct contact
a type of infection transmission in which the pathogen travels directly from one host to another, such as in person-to-person transmission

5.2–1 Infection Transmission

During a hospital stay, a patient does not expect to acquire an infection. Unfortunately, patients often do acquire new infections while in the hospital. Hospital-acquired infections are called *healthcare-associated infections*. These infections can cause pneumonia and infections of the bloodstream, the urinary tract, and other parts of the body. The reduced infection resistance of hospitalized patients contributes to the rate of these infections. Learning the various aspects of infection transmission can help you prevent healthcare-associated infections.

There are many modes of transmission of infection. As a healthcare provider, make sure you are familiar with all of them. One mode is **direct contact**, such as person-to-person contact or contact with infectious body

secretions (contamination by another person's blood on your hands). Another is **indirect contact**, in which a pathogen comes from food, air, soil, feces, instruments, equipment, clothing, and so on. **Vectors**, such as insects, rodents, or other small animals, can spread pathogens by biting a host.

As part of a team working continually to prevent the spread of infection, it is critical that you understand the various ways that infection can be transmitted from person to person. The **chain of infection** is used to visualize the sequence of events that allows infection to invade the human body. This sequence consists of an infectious agent, reservoir or host, portal of exit, mode of transmission, portal of entry, and susceptible host (Figure 5.5).

indirect contact
a type of infection transmission in which the pathogen takes an indirect path—such as through food, air, or clothing—to its next host

vectors
carriers—such as insects, rodents, or other small animals—that spread pathogens from host to host

chain of infection
the sequence of events that allows infection to move from one source or host to another

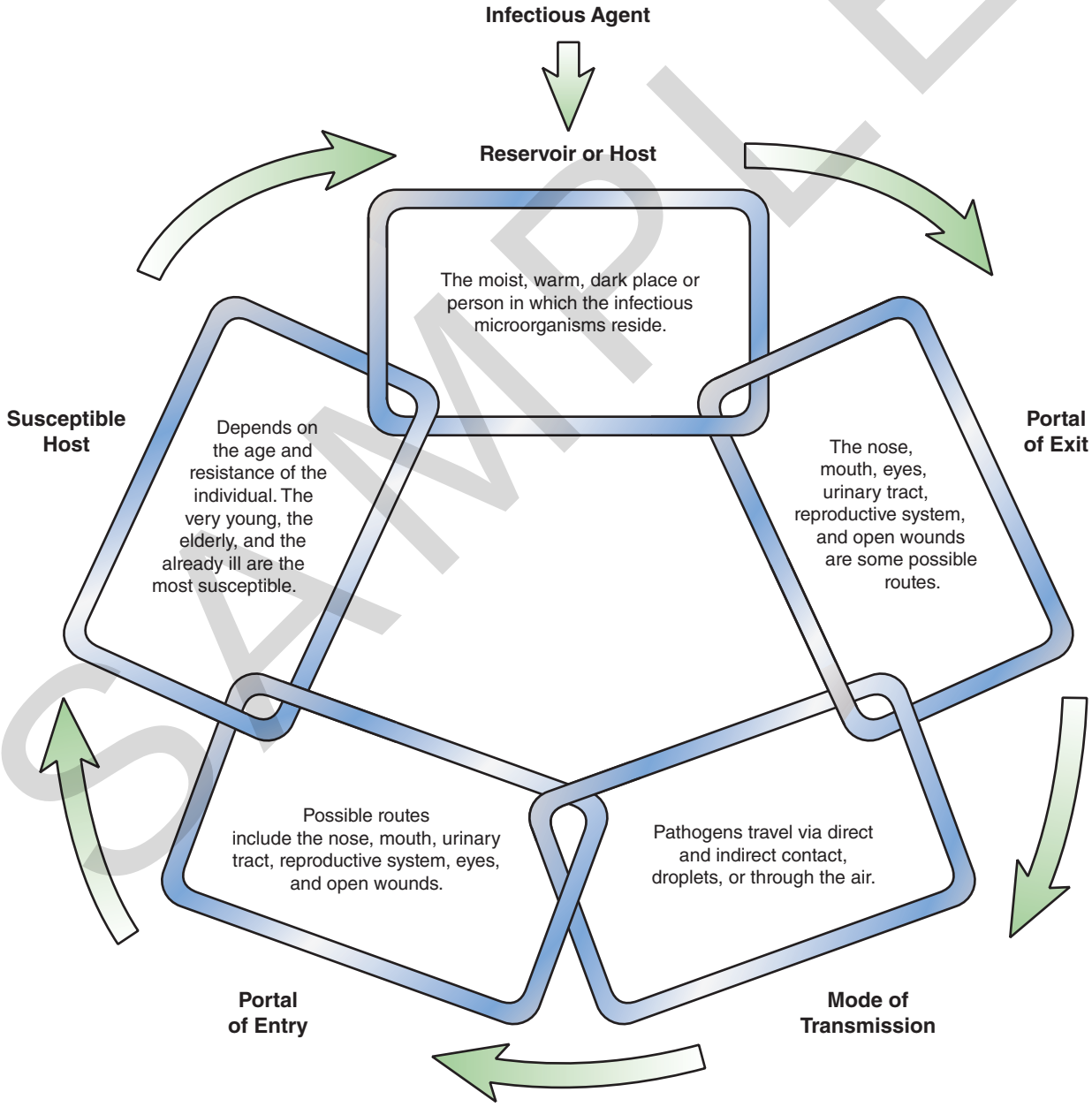

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Figure 5.5 The chain of infection is a sequence of events allowing infection to invade the human body. *Including the infectious agent, how many steps are there in a chain of infection? How many of these steps need to be eliminated to stop the spread of the infection?*

The infection control department of a healthcare facility focuses on interrupting the chain of infection before the infection spreads throughout the hospital. Once it becomes clear that an infection has developed, the clinical laboratory is responsible for identifying the infectious agent as soon as possible. It is essential that appropriate treatment be started immediately.

Several methods are used to control the spread of infection. The remaining sections of the lesson examine the most common and important methods.

THINK CRITICALLY

As a healthcare provider, when would you be expected to practice hand washing? Do you follow these guidelines in your everyday life as well?

5.2–2 Hand Hygiene

Employees are expected to maintain excellent hygiene, which includes **hand hygiene**. Hand hygiene is considered the single most important way to prevent the spread of infection. It can be accomplished through hand washing with a detergent or antimicrobial soap and water, or by applying an alcohol-based hand rub. Hand sanitizers do not kill the microorganisms that cause severe gastrointestinal infections such as *Clostridium difficile* (or *C. difficile*) or the Norovirus. Alcohol-based hand wipes have been found to be useless against any viruses not coated in lipid envelopes.

hand hygiene
hand washing with a detergent or antimicrobial soap and water, or by applying an alcohol-based hand rub; considered the single most important way to prevent the spread of infection

In an effort to prevent the spread of infection, the CDC has issued hand hygiene guidelines for healthcare providers. These guidelines require that hands be washed

- before and after eating;
- after the restroom has been used; and
- when dirt or body fluids such as blood, mucus, urine, and feces are visible on the hands.

It takes at least twenty seconds to wash your hands properly. Twenty seconds is about how long it takes to sing "Happy Birthday to You" twice.

The use of alcohol-based hand products is acceptable throughout the day, except under the previously stated circumstances. Alcohol-based hand rubs have become popular today because they do not dry out the skin as much as hand washing. As a result, alcohol-based hand rubs are widely used in healthcare facilities.

In addition to practicing good hand hygiene, hospital employees and healthcare providers cannot come to work when sick with a contagious disease.

Procedure 5.1 Hand Washing

Rationale

Standard precautions require routine and proper hand washing to remove and prevent the spread of microorganisms.

Preparation

1. Locate a sink near the place you will give care. There must be:
   - a sufficient supply of antimicrobial soap
   - a sink with warm, running water
   - clean paper towels in a dispenser
   - an appropriate waste container nearby
2. If your sleeves are long, use a clean, dry paper towel to push them up your arms until they are close to your elbows.
3. Remove any watches or rings. If you cannot remove a watch, use a clean, dry paper towel to push it up your arm away from your hand. If you cannot remove your rings, you will have to lather (spread) soap underneath them.
   Best Practice: The sink is always contaminated. Stand far enough away from the sink that your clothing does not touch it (**Figure 5.6**). Do not touch the inside of the sink at any time. Always rewash your hands if they touch the sink at any time.

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Figure 5.6

The Procedure

1. Using a clean, dry paper towel, turn on the faucet. Do not turn on the faucet with your bare hands. Adjust the water temperature until the water is warm. Be sure the water does not splash on your scrubs.
2. Thoroughly wet your hands, wrists, and the skin 1–2 inches above your wrists.
3. Remove your hands from the water. Apply enough soap and work it into a thick lather over your hands, wrists, and the skin at least 1–2 inches above your wrists (**Figure 5.7**). If you have not removed your rings, lather soap underneath them.

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Figure 5.7

Best Practice: When washing your hands, keep your hands and forearms below your elbows. Water should flow down off your fingertips, never up your arms.

4. Rub your palms together in a circular, counterclockwise motion.
5. Push the fingers of the right hand between the fingers of the left hand and rub up and down.
6. Push the fingers of the left hand between the fingers of the right hand and rub up and down.
7. With fingers interlaced, rub the palms together from side to side.

8. Bend your fingers and interlock them. The backs of your fingers should touch the opposite palm. Rub from side to side (**Figure 5.8**). Clean under your fingernails by rubbing them against the other palm and forcing soap underneath them. Continue rubbing to clean around the tops of your nails. Reverse hands and repeat this step.

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Figure 5.8

9. Hold the left thumb in the palm of the right hand. Rub in a circular, counterclockwise motion.
10. Hold the right thumb in the palm of the left hand. Rub in a circular, counterclockwise motion.
11. Hold the fingers of the right hand together and place them in the middle of the left palm. Rub in a circular, counterclockwise motion.
12. Hold the fingers of the left hand together and place them in the middle of the right palm. Rub in a circular, counterclockwise motion.
    Best Practice: Work up a good foam as you wash over every part of your hands and wrists.
13. Wash your hands for a minimum of 20 seconds. You can use different methods to be sure you reach the 20-second minimum. For example, you could sing the "Happy Birthday" song twice from beginning to end.
14. Hold your hands under the running water with your fingers pointing downward (**Figure 5.9**). Rinse your wrists and hands thoroughly.

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Figure 5.9

15. Using a clean, dry paper towel, dry your hands and then your wrists, moving from your clean hand up toward the dirty forearm. Grab only one paper towel from the dispenser. Do not touch the dispenser and do not shake water from your hands.
16. Drop the used paper towel into the waste container. If another paper towel is needed, use the same procedure. Never touch the waste container.

Follow-up

1. Use a clean, dry paper towel to turn off the sink faucet (**Figure 5.10**). Your bare hand should not touch the sink faucet. The faucet is always considered contaminated.

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Figure 5.10

2. Discard the paper towel into the waste container. Never touch the waste container.

Reporting and Documentation

This is an accepted, standard procedure. It does not need to be reported or documented.

Procedure 5.2 Using Hand Sanitizer

Rationale

Standard precautions require routine and proper hand hygiene. Using an alcohol-based hand sanitizer can help remove and prevent the spread of microorganisms.

Preparation

1. Locate the nearest hand sanitizer dispenser.
2. If your sleeves are long, use a clean, dry paper towel to push them up your arms until they are close to your elbows.
3. Remove any watches or rings. If you cannot remove a watch, use a clean, dry paper towel to push it up your arm away from your hand. If you cannot remove your rings, you will have to cover the rings with hand sanitizer.

The Procedure

1. Squeeze hand sanitizer from the dispenser into the cupped palm of one hand. Use enough hand sanitizer, usually one full pump, to cover the surfaces of the palms and fingers and perform the entire procedure.
   Best Practice: This procedure will take at least 20 seconds. Add more hand sanitizer to your hands, if needed.
2. Rub your palms together in a circular, counterclockwise motion (**Figure 5.11**).

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Figure 5.11

3. Push the fingers of the right hand between the fingers of the left hand and rub up and down (**Figure 5 12**).

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Figure 5.12

4. Push the fingers of the left hand between the fingers of the right hand and rub up and down.
5. With fingers interlaced, rub the palms together from side to side (**Figure 5.13**).

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Figure 5.13

6. Bend your fingers and interlock them. The backs of your fingers should touch the opposite palm (**Figure 5.14**). Rub from side to side. Reverse hands and repeat this step.

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Figure 5.14

7. Hold the left thumb in the palm of the right hand. Rub in a circular, counterclockwise motion (**Figure 5.15**).

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Figure 5.15

8. Hold the right thumb in the palm of the left hand. Rub in a circular, counterclockwise motion.
9. Hold the fingers of the right hand together and place them in the middle of the left palm. Rub in a circular, counterclockwise motion (**Figure 5.16**).

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Figure 5.16

10. Hold the fingers of the left hand together and place them in the middle of the right palm. Rub in a circular, counterclockwise motion.
11. Continue to rub your hands for the full 20 seconds. *Best Practice:* Creating friction is just as important when using hand sanitizer as it is when washing the hands.

Follow-Up

1. When the hands feel dry, the procedure is complete.

Reporting and Documentation

This is an accepted, standard procedure. It does not need to be reported or documented.

Did You Know?

What's the Most Hygienic?

Scientists at the University of Westminster in London performed a study to measure what was most hygienic—drying freshly washed hands with paper towels or using an electric hand dryer. Their study measured the number of bacteria on subjects' hands before washing and after drying them. Three different drying methods were used: paper towels, the warm air dryer, and a high-speed jet air dryer.

Paper towels were found to be clearly superior to the other methods, resulting in a 76 percent decrease in bacteria on the finger pads and a 77 percent decrease on the palms. In contrast, warm air dryers caused bacteria counts to increase by 194 percent on the finger pads and up to 254 percent on the palms. The jet air dryers increased the bacteria on the finger pads by 42 percent and by 15 percent on the palms.

Additionally, the warm air dryers had a potential for cross contamination of other bathroom users. The jet air dryers could potentially contaminate other users up to 7 feet away. The warm air dryers had the potential contamination range of about 10 inches.

In a hospital, the Central Services Department handles sterilization procedures. Autoclaves are widely used in doctors' offices, but many supplies used in patient care are prepackaged and sterilized by the manufacturer and are disposable. As a result, the use of an autoclave has declined somewhat in the healthcare facility.

5.2–3 Cleaning the Healthcare Facility

The absence of bacteria, viruses, and other microorganisms is called **asepsis**. In some facilities, the terms *medical asepsis* and *surgical asepsis* are used. Medical asepsis, or *clean technique*, includes procedures used to reduce the number of organisms present and prevent the transfer of organisms. Surgical asepsis, or *sterile technique*, prevents contamination of an open wound, serves to isolate the operative area from the unsterile environment, and maintains a sterile field for surgery.

The term **antisepsis** refers to using an antiseptic to prevent or inhibit growth of pathogenic organisms. Antiseptics (alcohols and iodine, for example) are not effective against bacterial spores, which can only be removed through sterilization.

At least three levels of cleaning take place in healthcare facilities to prevent the spread of pathogens: sanitization, disinfection, and sterilization.

Sanitization is defined as the use of antimicrobial agents on objects, surfaces, or living tissue to reduce the number of disease-causing microorganisms to nonthreatening levels. An example of sanitization is cleaning tables in a hospital cafeteria before disinfection.

Disinfection involves the use of antimicrobial agents on nonliving objects or surfaces to destroy or deactivate microorganisms. Disinfectants are applied and allowed to dry according to the directions of the chemical manufacturer. High-touch areas such as bedrails, bedside tables, transport equipment, and floors are usually disinfected daily. A more thorough cleaning of a hospital room, for example, is part of terminal cleaning upon a patient discharge or transfer.

Disinfecting an object does not mean that all the bacteria, viruses, and fungi have been removed. Some microorganisms form thick walls around themselves to protect themselves from harsh environments. This makes it difficult for disinfectants to remove the microorganisms completely.

THINK CRITICALLY

Why do you think there are multiple levels of cleaning that take place in healthcare facilities? When would only one level of cleaning be enough?

asepsis
the absence of bacteria, viruses, and other microorganisms

antisepsis
the process of using an antiseptic to prevent or inhibit the growth of pathogenic organisms

sanitization
the use of antimicrobial agents on objects, surfaces, or living tissue to reduce the number of disease-causing microorganisms

disinfection
the use of antimicrobial agents on nonliving objects or surfaces to destroy or deactivate microorganisms

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Figure 5.17 Autoclaves, such as the one shown here, are used to sterilize medical equipment and instruments. *What does it mean to sterilize something?*

To kill all microorganisms on a surface, the surface is sterilized. The most common method of **sterilization** in many healthcare facilities is the use of the **autoclave**. An autoclave is a machine that employs hot, pressurized steam for cleaning purposes. The steam's high temperature kills all microorganisms and their spores (Figure 5.17). Other methods of sterilization include dry heat, gas, ionized radiation, and specialized chemicals designed for the purpose of sterilization.

sterilization
the act of killing all microorganisms and their spores on a surface; methods of sterilization in a healthcare facility may include hot pressurized steam, dry heat, and gas

autoclave
a machine used frequently in healthcare facilities to kill all microorganisms and their spores on a surface

LESSON 5.2 REVIEW

Multiple Choice

Select the letter that corresponds to the correct answer.

1. All of the following are components of the chain of infection *except* _____. (5.2–1)
   A. infectious agent
   B. noninfectious agent
   C. portal of exit
   D. mode of transmission

2. When do the CDC hand hygiene guidelines require hands to be washed? (5.2–2)
   A. before and after eating
   B. after the restroom is used
   C. before and after handling sharps
   D. Both A and B are correct.

3. Which of the following is acceptable to use when practicing hand hygiene in a healthcare facility? (5.2–2)
   A. alcohol-based hand rubs
   B. hand sanitizers
   C. alcohol-based hand wipes
   D. scented soap

4. A(n) _____ is a machine used frequently in healthcare facilities to kill all microorganisms and their spores on a surface. (5.2–3)
   A. microscope
   B. vector
   C. autoclave
   D. biohazard sharps container

5. Which of the following is *not* a level of cleaning that takes place in healthcare facilities? (5.2–3)
   A. antisepsis
   B. disinfection
   C. sterilization
   D. sanitization

LESSON 5.3

Preventing the Spread of Bloodborne Pathogens

ESSENTIAL QUESTION

What safety precautions need to be taken to prevent the spread of bloodborne pathogens?

Learning Outcomes

After studying this lesson, you will be able to

- **5.3–1** Explain why it is important to prevent the spread of bloodborne pathogens in the healthcare facility.
- **5.3–2** Discuss the need for isolation procedures and how the procedures differ.
- **5.3–3** Identify three types of personal protective equipment and how to use them properly.
- **5.3–4** Explain how to prevent needlesticks and other sharps-related injuries in the healthcare facility.
- **5.3–5** Discuss the protocol for the disposal of hazardous and nonhazardous materials.

Terms to Know

biohazard sharps container
biopsy
bloodborne pathogens
isolation rooms
Needlestick Safety and Prevention Act
needlesticks
OSHA Bloodborne Pathogens Standard
personal protective equipment (PPE)
potentially infectious materials (PIM)
sharps
standard precautions

THINK CRITICALLY

What would happen if potentially infected materials were not disposed of properly in a healthcare facility?

5.3–1 Preventing the Spread of Bloodborne Pathogens

To avoid exposure to potentially harmful substances, employees are required to strictly follow instructions stated by the **OSHA Bloodborne Pathogens Standard**. This standard went into effect in the United States in 1992. It was designed to reduce the risk of transmitting bloodborne pathogens within the healthcare facility.

Bloodborne pathogens are infectious microorganisms found in human blood that can cause disease in humans. Examples of these pathogens include, but are not limited to, hepatitis B (HBV), hepatitis C (HCV), and human immunodeficiency virus (HIV).

The rules set forth by the OSHA Bloodborne Pathogens Standard apply to all patients receiving care in any healthcare facility, regardless of their diagnosis or infection status. The standard lists **potentially infectious materials (PIM)**, which include a range of body fluids. To protect themselves and their patients, healthcare providers are expected to always proceed as if these body fluids are infectious. Several body fluids have the potential to transmit harmful pathogens, including

- human blood and its components (plasma, serum, platelets, and immunoglobulin);
- semen and vaginal secretions;
- body fluids such as cerebrospinal, synovial (joint), pleural (lung), pericardial (heart), peritoneal (abdominal cavity), and amniotic (surrounding unborn baby) fluids;
- body fluids visibly contaminated with blood or other unidentified substances (such as saliva in dental procedures);
- human tissue such as tissue removed during a **biopsy** (procedure to obtain tissue for examination and diagnosis); and
- any bodily substance from a patient known to be infected with HIV.

In addition to practicing good hand hygiene and cleaning contaminated surfaces, employees are required to dispose of all potentially infected materials in a biohazard receptacle.

Gloves are not always worn when giving patient care, but they are required to be worn when there is the possibility of an employee being exposed to blood and body fluids. Healthcare providers are expected to always wash their hands before putting on gloves and again after removing their gloves between patients. Used gloves that are visibly contaminated with blood or other body fluids are to be disposed of in a biohazard receptacle.

OSHA Bloodborne Pathogens Standard
guidelines developed by the Occupational Safety and Health Administration (OSHA) that list potentially infectious materials and mandate all healthcare providers to proceed at all times as if the materials are infectious

bloodborne pathogens
infectious microorganisms in human blood that can cause disease

potentially infectious materials (PIM)
substances designated by OSHA that require healthcare providers to proceed as if they are infectious

biopsy
a piece of tissue removed from the body for examination; the process of removing tissue for examination

THINK CRITICALLY

Why do you think isolation procedures differ depending on the mode of transmission?

5.3–2 Patient Isolation

The purpose of isolation is to separate patients with certain infections from other patients to prevent the transmission of pathogenic microorganisms in hospitals. Reverse isolation, also called *protective isolation*, protects susceptible patients from contagious diseases by isolating them from others. Guidelines for patient isolation have been identified by the Centers for Disease Control and Prevention (CDC) and the Hospital Infection Control

Practice Advisory Committee (HICPAC). Isolation is different from quarantine. As you learned in Chapter 1, quarantine is an action taken to separate and restrict the movement of people believed to be exposed to a disease that may be spread from those who have it to those who have not been exposed. This is done to prevent the spread of the disease.

Healthcare facilities often have special **isolation rooms**. Signs are placed on the doors of these rooms to signal the type of isolation in place. Standard precautions are always used, with great attention paid to hand hygiene.

isolation rooms
rooms in a healthcare facility used to prevent the spread of infections, either by containing patients who have contagious diseases or by protecting patients with compromised immune systems from infectious diseases

Protective gloves, masks, and face shields serve as barriers against infection. Various types of gowns are worn to prevent contamination of clothing and to protect the skin from blood and other body fluids. Impermeable gown, leg, and shoe covers are available when greater protection is required. Special cleaning and disposing of patient supplies and equipment is important. Disposable dishes and other items are often used. Thorough cleaning and disinfection of the room and equipment is done regularly and upon patient discharge.

Patients in isolation should be moved outside of the room as little as possible. When it is necessary for an isolated patient to be transported in the hospital and airborne or droplet precautions are in place, the patient should wear a mask. It is critical for caregivers to remember that the patient in isolation is especially in need of compassionate care and understanding so that the patient does not feel unnecessarily shut off from the world.

Healthcare facilities use a variety of isolation practices. Many facilities divide these practices into two levels of isolation precautions: standard precautions and transmission-based precautions.

Profile: Medical Professionals Today

Deborah Yokoe

Dr. Yokoe is the Medical Director for Hospital Epidemiology and Infection Prevention for adult services, as well as an attending physician on the Transplant Infectious Diseases consultation service. Dr. Yokoe has served as the co-chair of the U.S. Department of Health and Human Services' Healthcare Infection Control Practices Advisory Committee (HICPAC), which advises the Centers for Disease Control and Prevention on infection prevention and control issues. She is also a member of the Society for Healthcare Epidemiology of America (SHEA) Board of Trustees and now serves as SHEA's President-Elect. Her research has focused on the development of streamlined and reliable methods for performing surveillance for healthcare-associated infections, and the evaluation of such methods. She has been an investigator in the CDC's Prevention Epicenters research program. In addition, she has participated in CDC and NIH-funded research. She has authored or co-authored over 100 publications since 1994.

Standard Precautions

standard precautions
a set of basic practices intended to prevent transmission of infectious diseases from one person to another

Standard precautions apply to all patients, regardless of their diagnosis. **Standard precautions** are a set of basic infection prevention practices intended to prevent transmission of infectious diseases from one person to another. These precautions include guidelines for hand hygiene, personal protective equipment, respiratory hygiene, needlestick and sharps injury prevention, cleaning and disinfection, waste disposal, and safe injection practices.

Because we do not always know if a patient has an infectious disease, standard precautions are applied to *every person*, *every time* to be sure that transmission of disease does not occur. These precautions were formerly known as *universal precautions*. These precautions apply to all body fluids and any secretions or excretions (except perspiration), whether they contain visible blood or not. These also apply to non-intact skin and mucous membranes.

Transmission-Based Precautions

Transmission-based precautions are designed for patients with highly transmissible infections. Transmission-based precautions are used in addition to standard precautions. Transmission-based precautions are divided into three categories—airborne precautions, droplet precautions, and contact precautions—based on how the infections are transmitted.

Airborne Precautions

Airborne precautions are used to prevent the spread of diseases, such as tuberculosis, that are transmitted by tiny, airborne droplet residue or dust particles containing microorganisms. Airborne precautions require that the patient be placed in a private room or with another patient who has the same disease. The door to the room must be kept closed and the room must have special ventilation.

Respiratory protection in the form of an N95 respirator is required to be worn when giving patient care. An N95 respirator is a respiratory protective device designed to achieve a very close facial fit and very efficient filtration of airborne particles. N95 respirators are not designed for children or people with facial hair. Because a proper fit cannot be achieved on children and people with facial hair, the N95 respirator may not provide full protection for these individuals. Some facilities require respirators certified by the National Institute of Occupational Safety and Health (NIOSH).

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Figure 5.18 This healthcare provider is wearing a mask to prevent the spread of an infection through droplets, which can occur during coughing or sneezing.

Droplet Precautions

Droplet precautions are used to prevent infection spread through large droplet transmission. In these cases, disease transmission occurs through coughing, talking, and sneezing. People within a six-foot radius are susceptible. Patients are placed in a private room. Masks are required to be worn within six feet of the patient (**Figure 5.18**). When following droplet precautions, a face mask or respirator is required before entering the

room. Your facility may also require you to wear a face shield and goggles. Influenza, COVID-19, and *Bordetella pertussis* (whooping cough) are examples of infectious diseases requiring droplet precautions.

Contact Precautions

Contact precautions are designed to reduce the risk of transmission of certain infectious microorganisms through direct or indirect contact. Direct contact transmission occurs when a patient is touched by a healthcare provider during care. Indirect contact transmission occurs when pathogens are transferred from a contaminated object or surface to a susceptible host. Contact precautions require that gloves and a gown be worn upon entering a room and when coming into contact with patients, surfaces, or objects in the room. Contact precautions also require that reusable items be cleaned or disinfected and that nonreusable items be discarded immediately after use. Hepatitis A and impetigo are examples of infectious diseases requiring contact precautions.

5.3–3 Personal Protective Equipment

OSHA requires that all workers be provided with the appropriate **personal protective equipment (PPE)** for their position (Figure 5.19). PPE protects workers from serious workplace injuries or illnesses resulting from contact with hazards of a microbial, chemical, radiological, physical, electrical, or mechanical nature. The protective equipment can include face shields, safety glasses, goggles, gowns, gloves, and face masks.

If your patient has a respiratory infection and is coughing and sneezing, wear a face mask. In a doctor's office, wear a face mask if you have a cold or if you are going to be exposed to a patient with a cold.

THINK CRITICALLY

Why is wearing proper PPE so important?

personal protective equipment (PPE)
equipment worn by workers to protect them from serious workplace injuries or illnesses

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Figure 5.19 Healthcare personnel wearing appropriate personal protective equipment for surgery.

Procedure 5.3

PPE: Putting on and Removing Disposable Gloves

Rationale

Standard and transmission-based precautions require the use of disposable, nonsterile gloves for a variety of procedures. Putting on and removing gloves properly helps ensure infection prevention and control.

Preparation

1. Locate a pair of new disposable gloves in the correct size. Find, at minimum, one extra pair of gloves in case they are needed.
2. Before putting on the gloves, inspect (check) them for cracks, holes, tears, or any discoloration. Rings and fingernails may puncture (poke a hole in) gloves; avoid these to protect yourself and the patient. Discard damaged gloves.
3. If a gown is required, put on the gown before putting on the gloves.

The Procedure: Putting on Disposable Gloves

1. Wash your hands or use hand sanitizer to ensure infection control.
2. Your hands should be dry. Gloves are easier to put on dry hands.
3. Pick up one glove by its cuff (**Figure 5.20**).

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Figure 5.20

4. Pull the glove onto your hand (**Figure 5.21**). The outside of a nonsterile glove is always considered contaminated, so keep your gloved hands away from your clothing and other areas.

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Figure 5.21

5. Repeat steps 6 and 7 with the glove for your other hand.
6. Interlace your fingers to adjust the gloves on your hands.
7. If you are wearing a gown, pull the cuffs of the gloves up over the sleeves of the gown (**Figure 5.22**).

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Figure 5.22

Best Practice: Always remove gloves if they become torn or soiled during a procedure. Then wash your hands or use hand sanitizer to ensure infection control and put on another pair of gloves using the same procedure.

The Procedure: Removing Disposable Gloves

1. To remove your gloves, use the gloved fingers of one hand to grasp the glove on the other gloved hand just below the cuff.
2. Pull the cuff of the glove down, drawing it over your hand and turning it inside out (**Figure 5.23**).

© Tori Soper Photography

Figure 5.23

3. Pull the glove off your hand and hold it in the palm of the other gloved hand (**Figure 5.24**).

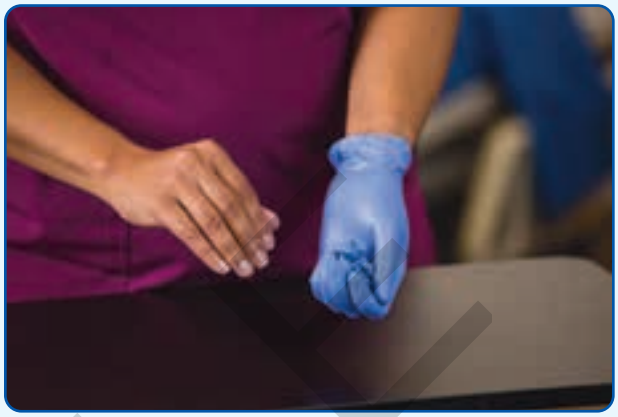

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Figure 5.24

4. Insert the fingers of the ungloved hand under the cuff of the remaining glove on the other hand.
5. Slowly pull the glove off, turning it inside out and drawing it over the first glove.
6. Drop both gloves into the appropriate waste container.
   Best Practice: Never wash or reuse disposable gloves.

Follow-up

1. Wash your hands to ensure infection control.

Reporting and Documentation

This is an accepted, standard procedure. It does not need to be reported or documented.

Procedure 5.4

PPE: Putting on and Removing Gowns

Rationale

Standard and transmission-based precautions require that healthcare staff members wear gowns during procedures in which they might be exposed to or transmit microorganisms. Gowns create barriers that protect healthcare staff and patients. In some situations, such as caring for patients in isolation, gowning must occur before entering the room.

Preparation

1. Select the appropriate gown.
2. Remove any watches or jewelry.
3. If wearing long sleeves, roll them up above your elbows.
   Best Practice: As often as possible, carry out all procedures that require a gown at one time. This avoids regowning for multiple entries into and exits from the same room.

The Procedure: Putting on a Gown

1. Wash your hands or use hand sanitizer to ensure infection control.
2. Hold gown by the shoulders out in front of you. The back of the gown should face you.
3. Unfold the gown carefully. Do not shake it open.
4. Slide your hands and arms into each of the sleeves of the gown (**Figure 5.25**).

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Figure 5.25

5. Pull the top of the gown around your neck to cover your scrubs.
6. Reach behind the gown and tie the neck ties using a simple shoelace bow.
7. Reach behind the gown again. Grab the open edges of the gown and pull them together so they overlap. Your clothing should be covered completely.
8. Tie the waist ties in the back using a simple shoelace bow (**Figure 5.26**).

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Figure 5.26

9. Put on disposable gloves. Always put on gloves after putting on a gown. Pull the gloves up over the cuffs of the gown sleeves.

The Procedure: Removing a Gown

1. Before removing your gown, first remove and discard your gloves. Be careful not to contaminate yourself.
   Best Practice: Do not touch the outside of the gown as you remove it.
2. Reach behind the gown and untie both the neck and waist ties.
3. Slide your hands back into the sleeves of the gown. Using one hand (still inside the sleeve), hold the cuff of the opposite sleeve and begin pulling your arm out of that sleeve (**Figure 5.27**). Be careful not to touch the outside of the gown.

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Figure 5.27

4. Repeat step 15 to begin pulling the other arm out of its sleeve. Do not to touch the outside of the gown with your hands as you pull the gown down off your shoulders and arms.
5. Turn the gown inside out as you remove it (**Figure 5.28**).

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Figure 5.28

6. Hold the gown, turned inside out, away from your clothing.
7. Roll the gown so the contaminated outside faces inward toward the gown (**Figure 5.29**).

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Figure 5.29

8. The gown is now considered infectious waste. Dispose of the gown in the appropriate waste container before leaving the room. Do not wear the gown again. If the gown is a reusable cloth gown, it should be worn only once and should be handled as contaminated linen according to facility policy.

Follow-up

1. Wash your hands to ensure infection control.

Reporting and Documentation

This is an accepted, standard procedure. It does not need to be reported or documented.

5.3–4 Needlesticks and Other Sharps-Related Injuries

Needles and other **sharps** (any objects that could puncture or cut the skin) are a hazard in the healthcare environment. Injuries related to **needlesticks** (any accidental punctures of the skin) or other sharps-related injuries can be both painful and dangerous.

In the healthcare environment, all needles are considered sharps, including needles with syringes and attached tubing, or needles from vacutainers (devices that enable phlebotomists to draw several blood tubes at one time). Sharps also include blades such as razors, scalpels, and lancets. These items are placed in a **biohazard sharps container** whether or not they are contaminated with biohazardous waste (**Figure 5.30**).

Any object that has been contaminated with biohazardous waste and has the potential to puncture a garbage bag is required to be placed in the biohazard sharps container. Such items might include broken glassware, glassware with sharp edges or points, pipettes, or glass slides. If these items

THINK CRITICALLY

Have you ever experienced a sharps-related injury in your everyday life? How did you address the injury?

sharps
needles or any other objects that could puncture or cut the skin

needlesticks
any accidental punctures of the skin by needles; can be dangerous in a healthcare setting because the puncture can cause a potentially serious infection

biohazard sharps container
a puncture-resistant container used for disposing of waste-contaminated sharps, including needles, scalpels, glass slides, and broken glassware

Thom Hanssen Images/Shutterstock.com

Figure 5.30 As a healthcare provider, you will develop the habit of putting used sharps into the proper disposable containers. Any object that is contaminated with biohazard waste and can puncture through a garbage bag needs to be placed in a biohazard sharps container.

are *not* contaminated with biohazardous waste, they may be placed in a rigid container and marked with the words "broken glassware."

Preventing Infections

A needlestick or other sharps-related injury immediately opens the skin to the potential of being infected by bloodborne disease and other pathogens. Any skin abrasion, including acne, presents an opening for pathogens to enter your body. Be sure to bandage any cuts or breaks in the skin and keep your hands away from your eyes and face to avoid infection.

Nurses, EMTs, paramedics, phlebotomists, clinical medical assistants, housekeeping personnel, and other healthcare providers may be at risk of exposure to bloodborne pathogens. A highly effective hepatitis B vaccine is available. Employers are required to offer this injection if their employees are at risk of being exposed to bloodborne pathogens. There is no vaccine for HIV or hepatitis C, but much research is being conducted in an attempt to find vaccines for these viral illnesses.

Needlestick Safety and Prevention Act

Needlestick Safety and Prevention Act
a law enacted in 2000 requiring employers to identify, evaluate, and introduce safer medical devices to avoid needlesticks

The **Needlestick Safety and Prevention Act** was signed into law on November 6, 2000. Under this act, OSHA requires employers to identify, evaluate, and introduce safe medical devices. Devices are available to shield a needle as soon as it is withdrawn from the patient. Do not re-cap a needle after use. OSHA requires that safety-engineered needles be used, such as those that have needle shields. Immediately after use, place needles in a puncture-resistant biohazard sharps container to prevent accidental exposure to a needlestick.

If you are stuck by a needle or another sharp object, or get blood or potentially infectious materials in your eyes, nose, mouth, or on broken skin, immediately flood the exposed area with water. Clean all wounds with soap and water or a skin antiseptic, if available. Immediately report the incident to your employer and seek medical attention. Your facility safety manual will clearly explain how to proceed after such an exposure.

The OSHA Standard requires the following:

- Sanitize your hands after direct contact with each of your patients.
- Use protective barriers such as gloves when working with blood and other potentially infectious body fluids. In addition, gowns, aprons, masks, and goggles are required when there is a danger of being splashed or sprayed with body fluids. Remember, gloves that are worn when giving patient care are not puncture-proof.

Real Life Scenario

Needlestick Incidents

Zuri just started her job as a phlebotomist at Eastridge Hospital. It is her first week drawing blood, and her supervisor is very strict about procedures. Zuri already feels that her supervisor does not have much faith in her abilities.

Zuri's next patient is a male adult who admits to being afraid of needles, increasing Zuri's anxiety. Zuri's hands are shaking, and she worries that her supervisor will come into the room to watch, so she hurries through the blood draw. She is able to draw the blood quickly, but in her haste to put away the needle she sticks herself with it. Zuri immediately decides that she won't tell anyone about the needlestick for fear of getting in trouble, or possibly fired.

Apply It

1. What could be the possible consequences of Zuri's failure to report this incident?
2. Do you think her supervisor should fire her?
3. What could happen if her patient has a bloodborne disease?
4. What would you do in Zuri's position?

- Collect and properly dispose of needles and other sharps in a biohazard sharps container.
- Do not re-cap needles.
- Cover all of your cuts and broken skin with a waterproof dressing before putting on gloves and handling blood or other potentially infectious body fluids.
- Promptly and carefully clean up spills of blood and other body fluids as directed by your facility safety manual.
- Facilities are required to use a safe system for healthcare waste management and disposal.

5.3–5 Protocol for Disposal of Hazardous Materials

THINK CRITICALLY

How does following proper protocol when disposing of hazardous and nonhazardous materials help to prevent the spread of pathogens?

The Joint Commission requires hospitals to have hazardous-materials and waste-management plans or protocols describing how the facility will safely control hazardous materials and waste. Infectious materials are considered hazardous.

According to OSHA, all healthcare facilities are required to create written orientation and education programs to train all personnel who come into contact with hazardous materials and waste. These programs address

- proper precautions in selection, handling, storage, and disposal of hazardous materials and waste;
- proper emergency procedures for spills and exposures; and
- orientation and education about incident reporting.

Procedure 5.5

Double-Bagging Infectious Waste

Rationale

The proper removal and disposal of infectious waste from an isolation room protects healthcare staff and prevents contamination of the environment.

Preparation

1. This procedure requires two healthcare staff members. One staff member should stand inside the isolation room, and the other should stand outside the room. The procedure requires:
   - disposable gloves for staff outside the isolation room
   - appropriate PPE for staff inside the isolation room
   - 2 leakproof, plastic biohazard waste bags (**Figure 5.31**)

Timothy OLeary/Shutterstock.com

Figure 5.31

The Procedure: Inside the Isolation Room

1. Wearing disposable gloves and other appropriate PPE, stand in the room by the doorway with the full bag of waste. Be sure the contaminated biohazard waste bag is closed tightly.
2. Wait until the staff member outside the room folds the top of a clean biohazard waste bag into a cuff.
3. Place the contaminated biohazard waste bag inside the clean biohazard waste bag (**Figure 5.32**). *Best Practice:* Do not touch the outside of the clean biohazard waste bag when placing the contaminated biohazard waste bag inside.

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Figure 5.32

The Procedure: Outside the Isolation Room

1. Wearing disposable gloves, stand outside the doorway with a clean biohazard waste bag.
2. Fold the top of the clean biohazard waste bag into a cuff. The cuff protects your hands from contamination.
3. Hold the clean biohazard waste bag wide open.
4. Remain standing outside the doorway while the staff member inside the room places the contaminated biohazard waste bag inside the clean biohazard waste bag.
5. Tie the clean biohazard waste bag with the biohazard waste and take it to the appropriate department for disposal, disinfection, or sterilization.

Follow-Up: Inside the Isolation Room

1. Remove your PPE before leaving the room.
2. Wash your hands to ensure infection control.

Follow-Up: Outside the Isolation Room

1. Remove and discard your gloves.
2. Wash your hands to ensure infection control.

Reporting and Documentation

This is an accepted, standard procedure. It does not need to be reported or documented.

Recycling and Waste Reduction

Most of the waste generated in a healthcare facility is nonhazardous. This means that you will not need to follow the protocols for disposal of hazardous materials for most waste materials. However, you will use recycling procedures when disposing of nonhazardous materials. Recycling practices save money for the facility and help protect the environment.

Of the total amount of waste generated by healthcare activities, about 85 percent is general, non-hazardous waste. This may include paper, plastics, food waste, and disposable linens. Whenever possible, make an effort to purchase products made from recycled materials.

LESSON 5.3 REVIEW

Multiple Choice

Select the letter that corresponds to the correct answer.

1. _____ are infectious microorganisms in human blood that can cause disease. (5.3–1)
   A. Airborne pathogens
   B. Bloodborne pathogens
   C. Viruses
   D. Fungi
2. Transmission-based precautions include which of the following? (5.3–2)
   A. contact precautions
   B. airborne precautions
   C. droplet precautions
   D. All are correct.
3. Which of the following is *not* a type of personal protective equipment? (5.3–3)
   A. lab coats
   B. gloves
   C. gowns
   D. face masks
4. The _____ is a law enacted in 2000 requiring employers to identify, evaluate, and introduce safer medical devices to avoid needlesticks. (5.3–4)
   A. Bioterrorism Act
   B. Needlestick Safety and Prevention Act
   C. OSHA Bloodborne Pathogens Standard
   D. OSHA Hazard Communication Standard
5. Healthcare facilities are required to create training programs that address _____. (5.3–5)
   A. proper precautions in disposal of hazardous materials and waste
   B. orientation and education about incident reporting
   C. proper emergency procedures for spills and exposures
   D. All are correct.

Chapter 5

Review and Assessment

Summary

Lesson 5.1 Microorganisms and Types of Infection

5.1–1 Infection control is a constant challenge in healthcare facilities.

5.1–2 Bacteria, viruses, fungi, protozoa, rickettsiae, and helminths can cause serious illnesses in humans.

5.1–3 Infections can be classified as endogenous, exogenous, healthcare-associated (HAI), or opportunistic.

5.1–4 Some bacteria have become antibiotic-resistant due to the overuse and misuse of antibiotics. Antibiotic-resistant bacteria are difficult to treat and can cause increased hospital stays for patients.

Lesson 5.2 The Chain of Infection

5.2–1 The chain of infection consists of an infectious agent, reservoir or host, portal of exit, mode of transmission, portal of entry, and susceptible host. It may be interrupted using strategies such as observing proper hand hygiene, wearing appropriate personal protective equipment, and properly disposing of all potentially infectious materials.

5.2–2 Proper hand hygiene can be accomplished through hand washing or by applying an alcohol-based hand rub. It is considered the single most important way to prevent the spread of infection.

5.2–3 At least three levels of cleaning take place in a healthcare facility to prevent the spread of infection: sanitation, disinfection, and sterilization.

Lesson 5.3 Preventing the Spread of Bloodborne Pathogens

5.3–1 Healthcare employees are required to strictly follow instructions stated by the OSHA Bloodborne Pathogens Standard, which was designed to reduce the risk of transmitting bloodborne pathogens within the healthcare facility. Bloodborne pathogens are infectious microorganisms found in human blood that can cause disease in humans.

5.3–2 Patient isolation separates patients with certain infections from other patients to avoid transmission of pathogenic organisms. Transmission-based precautions are designed for patients with highly transmissible infections.

5.3–3 Needles and other sharps are prevalent in the healthcare environment. Accidental needlesticks are dangerous and must be avoided.

5.3–4 Used needles and other sharps should be placed in a puncture-resistant biohazard sharps container.

Career Exploration

Infection Control Coordinator

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The infection control coordinator monitors and investigates known or suspected sources of infection. The coordinator determines the source and identifies control measures. This person reviews sterilization and disinfection techniques and recommends changes as needed. The coordinator provides related education to staff and may provide cultures of suspected pathogens in the environment for identification and study.

In many states, to qualify as an Infection Control Coordinator, applicants are required to have an associate's degree in nursing and some experience working in infection control. Salary varies from state to state.

Further Research

1. Research this career or one related to it using the *Occupational Outlook Handbook* and other reliable internet sources. Is the outlook for infection control careers positive?
2. What educational requirements are there for this career? Do they vary from state to state? How would you prepare to pursue this career?
3. What is the salary range for this job?
4. What would attract you to this career? What would be a downside for you? Are you interested in related careers?

Related Careers

Director, Infection Protection and Control

Infection Control Nurse

Infection Control Educator

Hospital Infection Control Practitioner (advanced nursing degree)

Infection Control Nurse/Educator

Review Questions

Answer the following questions using what you have learned in this chapter.

Multiple Choice

Select the letter that corresponds to the correct answer.

1. _____ is an example of a helminth. (5.1–2)
   A. HIV
   B. *Staphylococcus*
   C. Hookworm
   D. Chicken pox
2. Which of the following is a correct procedure for infection control? (5.1–1)
   A. Use a puncture-proof biohazard container to dispose of needles and other sharps.
   B. Follow proper hand hygiene procedures between contact with each patient.
   C. Use protective barriers when in direct contact with blood.
   D. All are correct.
3. Antibiotic resistance can be caused by _____. (5.1–4)
   A. not taking the full prescription of antibiotics
   B. prescribing antibiotics when not needed
   C. antibacterials contained in cleaning products
   D. All are correct.
4. All of the following are basic forms of bacteria *except* _____. (5.1–2)
   A. *coccus*
   B. rods
   C. squares
   D. *spirochete*

5. Which of the following is true of anaerobic organisms?
   A. They are not pathogenic.
   B. They need little or no oxygen.
   C. They do not require gloves when handling.
   D. They are people who are exercising.
6. It takes at least _____ seconds to wash your hands properly. (5.2–2)
   A. 25 C. 20
   B. 30 D. 15
7. Which of the following statements about viruses is *not* true? (5.1–2)
   A. Viruses can reproduce by themselves.
   B. Viruses that infect animals can mutate and infect humans.
   C. Polio is caused by a virus.
   D. Viruses are smaller than bacteria.
8. The chain of infection sequence includes a(n) _____. (5.2–1)
   A. host C. portal of exit
   B. infectious agent D. All are correct.
9. Transmission-based precautions include all of the following *except* _____. (5.3–2)
   A. airborne C. oral
   B. droplet D. contact
10. The steps for putting on disposable gloves include _____. (5.3–3)
    A. inspecting gloves for tears
    B. observing gloves for discoloration
    C. keeping nails short
    D. All are correct.
11. Pathogens act in different ways to cause infection in the human body, such as producing an allergic reaction, affecting the nervous system, or producing _____, a type of poison that can harm the body. (5.1–3)
    A. viruses C. antibiotics
    B. toxins D. fungi
12. _____ is the use of antimicrobial agents on nonliving objects or surfaces to destroy or deactivate microorganisms. (5.2–3)
    A. disinfection C. sterilization
    B. sanitization D. hand hygiene
13. Which of the following does the OSHA Bloodborne Pathogens Standard designate as a potentially infectious material? (5.3–1)
    A. human blood and its components
    B. human tissue removed during a biopsy
    C. body fluids such as cerebrospinal fluid
    D. All are correct.
14. Healthcare providers are required to do all of the following when working with needles and other sharps *except* _____. (5.3–4)
    A. sanitize their hands after direct contact with a patient
    B. properly dispose of needles and other sharps in a biohazard sharps container
    C. re-cap needles after use
    D. use protective barriers such as gloves when working with blood
15. When disposing of nonhazardous materials, use _____. (5.3–5)
    A. recycling procedures
    B. standard precautions
    C. biohazard sharps container
    D. personal protective equipment

Short Answer

Answer the following questions using what you have learned in this chapter.

1. What is a healthcare-associated infection? (5.1–3)
2. What is a biohazard sharps container and why is it used? (5.3–5)
3. What is an autoclave? (5.2–3)
4. What is a bloodborne pathogen? (5.3–1)
5. What items go into a biohazard sharps container? (5.3–4)
6. What is meant by the chain of infection? Name six parts of the chain. (5.2–1)
7. Name at least three types of microorganisms. (5.1–1)
8. What is meant by hand hygiene? (5.2–2)
9. Describe the procedure that must be followed after sticking yourself with a contaminated needle or other sharp object. (5.3–4)

Critical Thinking Exercises

Answer the following questions to assess your knowledge of what you learned in this chapter.

1. Develop a plan to support recycling and waste management in a facility such as your school or a local hospital. Explain how your plan would contribute to both cost containment and environmental protection. (5.3–5)
2. What are the differences between bacterial and viral infections? What treatments are available for both infections? (5.1–2)
3. Sanitization, disinfection, and sterilization are three levels of cleaning that take place in the healthcare environment. Explain the significance and use of each level. (5.2–3)

4. Research three illnesses that the Centers for Disease Control consider threats to the health of our country.

Math Skills

Tuberculosis (TB) is an infectious disease caused by *Mycobacterium tuberculosis* bacteria. Tuberculosis generally affects the lungs, but it can also affect other parts of the body. It is spread through the air when an infected individual coughs, spits, speaks, or sneezes. Using the information provided in the table, answer the following questions.

Incidence of Tuberculosis (TB) in the United States, 2010–2020

Year	Total Cases
2010	11,076
2011	10,480
2012	9,925
2013	9,545
2014	9,383
2015	9,536
2016	9,242
2017	9,071
2018	9,006
2019	8,904
2020	7,174

Courtesy of the Centers for Disease Control and Prevention

1. Did the number of cases of tuberculosis increase or decrease from 2010 to 2020?
2. What is the difference in the number of cases between 2010 and 2020?
3. Why do you think these changes occurred from 2010 to 2020?
4. What is the difference in case numbers between 2014 and 2015? Did the cases increase or decrease in this time? Why could this have happened?

Language Skills

Reading and Writing

Read about the following diseases that have greatly affected the world in the last several centuries. Be able to identify what caused these illnesses and what has controlled or eliminated them.

- polio
- malaria
- HIV
- Black Plague

Then, choose one of the four diseases and write about what you discovered. Answer the following questions in your paper using complete sentences.

1. How did humans become infected by the disease?
2. What organism caused the infection?
3. How does the disease affect the human body?
4. Is there a vaccination for the disease? If so, when and how was the vaccination discovered?
5. Where is the disease still active?
6. What steps can be taken to eradicate the disease?

HOSA Event Prep—Public Health

Complete the following activity to practice your skills related to healthcare.

Case Study

Read the following Case Study. Then complete the activities that follow.

Tim is a public health nurse who works in a local community that has seen an increase in type 2 diabetes among young adults. He has also noticed an increase in hypertension and early heart disease. Many people in the population are on food stamps. When considering ways to help with lifestyle changes and nutrition classes, Tim assesses the neighborhood. The nearest grocery store is 10 miles away, and many rely on public transportation. In the immediate area, there are many fast-food restaurants and a few gas stations. There is a community center with a big, open lot. Tim schedules weekly nutrition classes and gets people together on Saturday to grow a garden. During weekly classes, Tim gives heart-healthy food demonstrations and talks about healthier habits. He also sets up weekly blood pressure checks. Within a month, many have improved their blood sugar and blood pressures.

Activity

Answer the following questions pertaining to the Case Study. Use the information you have learned in this chapter.

Think About It

1. List the steps Tim took to address the health needs in this population. Why did Tim take each step? Why would each step be effective?
2. Imagine you are a public health nurse like Tim. Using reliable and valid online resources, research your responsibilities and what skills you would need to meet the needs of a population.
3. What qualities do you think are most important in a public health professional? Why?
4. Is public health a career that interests you? Why or why not?