CHAPTER 1

Principles of Asepsis

MEDICAL ASSISTING COMPETENCIES

CAAHEP

I. C (6) Identify common pathology related to each body system

III. C (1) Describe the infection cycle, including the infectious agent, reservoir, susceptible host, means of transmission, portals of entry, and portals of exit

III. C (5) List major types of infectious agents

III. C (6) Compare different methods of controlling the growth of microorganisms

ABHES

2. Anatomy and Physiology

b. Identify and apply the knowledge of all body systems, their structure and functions, and their common diseases, symptoms, and etiologies.

9. Medical Office Clinical Procedures

b. Apply principles of aseptic techniques and infection control

LEARNING OUTCOMES

After completing Chapter 1, you will be able to:

1.1 Explain the historical background of infectious disease prevention.

1.2 Identify the types of microorganisms that cause disease.

1.3 Distinguish some infectious diseases, and identify their signs and symptoms.

1.4 Describe the importance of preventing antibiotic resistance in a health-care setting.

1.5 Describe ways you can help prevent antibiotic resistance in health-care settings.

1.6 Explain the disease process.

1.7 Explain how the body's defenses protect against infection.

1.8 Describe the cycle of infection.

1.9 Identify and describe the various methods of disease transmission.

1.10 Explain how you can help break the cycle of infection.

MEDICAL ASSISTING MEDIA

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KEY TERMS

antibodies
antigen
asepsis
carrier
endogenous infection
exogenous infection
fomite
immunity
induration
macrophage
microorganism
monocyte
opportunistic infection
pathogen
phagocyte
reservoir host
resident normal flora
subclinical case
susceptible host
vector
virulence

CHAPTER OUTLINE

- History of Infectious Disease Prevention
- Microorganisms and Disease
- Infectious Diseases
- Drug-Resistant Microorganisms
- The Disease Process
- The Body's Defenses
- The Cycle of Infection
- Breaking the Cycle

PREPARATION FOR CERTIFICATION

RMA (AMT) Exam

- Asepsis
  - Medical terminology

CMA (AAMA) Exam

- Principles of infection control
- Principles of asepsis

CMAS Exam

- Basic clinical medical office assisting
- Asepsis in the medical office
  - Understand concepts of asepsis, sanitization, disinfection, and sterilization
  - Understand prevention of disease transmission
  - Observe Standard Precautions

Introduction

Our bodies are amazing structures that defend us against infections under normal circumstances. As you read this chapter, you will learn about disease-causing microorganisms, how the body defends itself against infections, and ways that infections might occur. You will also learn about antibiotic-resistant organisms and the importance of educating patients regarding the proper use of antibiotics. The chapter focuses on the history of disease prevention, disease processes, the body's defenses, and the cycle of infection.

CASE STUDY

A 14-year-old girl comes to your office with symptoms of diarrhea, flatulence, greasy stools, stomach cramps, and nausea. In the past 2 weeks, the patient has lost 10 pounds. During the patient interview, you find out from her mother that the family went camping about 3 weeks earlier. You also discover that the patient drank from a stream while on a hike. The patient shares with you that she saw beavers in the stream during the hike. No other family members are exhibiting any symptoms. After several laboratory tests, the patient is diagnosed with giardiasis, a parasitic infection often carried by beavers. The incubation period for Giardia is 1 to 2 weeks; however, adults do not always show signs of the infection. Risk factors for infection with Giardia include children in child care settings, people in close contact with infected persons, people who drink or swim in contaminated water, and people who have contact with infected animals. The patient is placed on antimicrobial therapy.

As you read this chapter, consider the following questions:

1. What part of the cycle of infection caused the problem for the patient?
2. How could the patient have avoided this infection?
3. Why are the other family members not showing symptoms of the infection?
4. Should the patient's family members be tested for the infection?

History of Infectious Disease Prevention

Throughout history, doctors have tried to solve the problem of infection: what causes it, how it spreads, how to prevent it, and how to treat it. Some infections, such as the plague in the Middle Ages, have changed the course of history. Table 1-1 briefly describes some of the scientists who made early contributions in the prevention of infectious disease.

During the past century, remarkable advances have taken place in knowledge regarding the causes, prevention, and treatment of infectious disease. The threat of infection, however, is as great as it has ever been. Medical science still wrestles with relatively new infectious diseases, such as acquired immunodeficiency syndrome (AIDS) and Ebola virus disease. In addition, some established diseases continue to challenge researchers because they have become resistant to antibiotics used to treat them. Some examples of established diseases that have become resistant to antibiotics are methicillin-resistant *Staphylococcus aureus* (MRSA), vancomycin-resistant *Staphylococcus aureus* (VRSA), and multidrug-resistant tuberculosis. As a medical assistant, you need to understand how to perform specific tasks to control infection and prevent disease transmission. Prior to this, you need to understand the disease process and spread of infection.

TABLE 1-1 A Brief History of Infectious Disease Prevention

Scientist	Contribution
Edward Jenner (1749–1823)	Developed first effective vaccine Used cowpox to vaccinate against smallpox
Ignaz Semmelweis (1818–1865) and Oliver Wendell Holmes (1809–1894)	Promoted hand washing as a means of reducing the spread of puerperal fever to women in childbirth
Louis Pasteur (1822–1895)	Helped develop the germ theory of infectious disease, stating that disease is caused by microorganisms
Joseph Lister (1827–1912)	Helped develop the germ theory Introduced aseptic techniques in medicine through the use of antiseptics on wounds, surgical sites, and surgical instruments
Robert Koch (1843–1910)	Developed a set of proofs, known as Koch's Postulates, that microbes caused disease
Sir Alexander Fleming (1881–1955)	Discovered penicillin

TABLE 1-2 Microbial Pathogens and Their Characteristics			
Classification	**Characteristics**	**Example**	**Disease**
Prions*	• Infectious particle made of protein • Very small • No nucleic acid • Reproduction unknown	Pr P	Creutzfeldt-Jakob disease (CJD) Bovine spongiform encephalopathy (BSE) (Mad Cow Disease)
Viruses	• DNA or RNA surrounded by protein coat • Reproduced in living cells only • Very small • Acellular	varicella-zoster virus	Chickenpox
Bacteria	• Single celled • Reproduce quickly • Mostly asexual reproduction	*Vibrio cholerae*	Cholera
Protozoans	• Single celled • Reproduction mostly asexual	*Entamoeba hystolytica*	Amebic dysentery
Fungi	• Multicellular • Reproduction is sexual & asexual	*Candida albicans*	Candidiasis
Helminths	• Multicellular • Parasitic • Contain specialized organs • Reproduction is sexual	*Enterobius vermicularis*	Pinworms

*Although there is evidence that prions are directly responsible for several diseases that cause progressive brain degeneration, such as spongiform encephalopathies, there are scientists who believe that prions merely aid another unknown infectious agent in causing disease. Prion research is ongoing.

Microorganisms and Disease

Microorganisms live all around us. They are found in and on our bodies, in the air we breathe, in the water we drink, and on almost every surface we touch. There is great variety in the types of pathogenic microorganisms. Successful **pathogens** (microorganisms capable of causing disease) have developed ways to evade the host defenses. There are pathogens in each classification of microorganism. Some examples of these are given in Table 1-2. Additional discussion about microorganisms and disease will be covered later in this chapter and later in the textbook (see Chapter 15).

Although everyone is surrounded by microorganisms, people are able to avoid infection most of the time for the following three reasons:

1. The majority of microorganisms are either beneficial or harmless. Pathogens, microorganisms capable of causing disease, comprise only a small portion of the total number of microorganisms that exist in a given environment.
2. The human body has a wide variety of defenses that allow people to resist infection.
3. Conditions must be favorable for a pathogen to grow and to be transmitted to a person who is susceptible (sensitive) to infection.

Infectious Diseases

Identifying the signs and symptoms of some infectious diseases can help protect health-care workers and patients from exposure to pathogens. It is important that you become familiar with some of the more common infectious diseases, including common signs and symptoms.

Chickenpox (Varicella)

Chickenpox, or varicella, is a contagious viral infection with an incubation period of 7 to 21 days. Patients with chickenpox experience an itchy rash that begins as tiny, red bumps and eventually becomes fluid-filled blisters. The blisters break and dry into scabs, usually within a few days. The rash may cover most of the body. Patients also may run a slight fever, have a headache, and experience general malaise. The infection is spread through direct or indirect transmission as well as by droplets, or airborne secretions. Patients should be isolated for about a week following the initial eruption of the rash, until all the blisters have scabbed over. In 1996 the Food and Drug Administration (FDA) approved a live vaccine for chickenpox, and it was recently added to the immunization schedule for children. Many states require reporting chickenpox cases to the state or county department of health, although there are no national requirements for reporting them.

Common Cold

Common colds are viral infections of the upper respiratory tract. They are transmitted from person to person through direct or indirect contact. The patient does not have to be isolated. It is important, however, that commonsense precautions be taken to avoid spreading the infection to others. For example, advise the patient to use tissues when coughing or sneezing, and have the patient and family wash their hands frequently and, if possible, use disposable dishware while the patient is ill. Incubation normally lasts for 2 to 3 days.

Croup

Croup is a condition characterized by a harsh, barking cough, difficulty breathing, hoarseness, and low-grade fever. The leading cause of croup is Human parainfluenza virus I, but it also may be caused by an allergy, a foreign body, or a new growth obstructing the upper airway. Croup is most common in infants and young children. Symptoms of croup may be lessened by humidifying the air in the child's room, encouraging rest, and giving clear, warm fluids. If croup accompanies a bacterial respiratory infection, the doctor may prescribe antibiotics. As with the common cold, have the patient and family take commonsense precautions to prevent spreading the respiratory infection to others.

Diphtheria

Diphtheria is a bacterial infection, primarily of the nose, throat, and larynx. The patient may experience pain, fever, and respiratory obstruction. Untreated, diphtheria is generally fatal. The incubation period is between 2 and 5 days. The patient must be isolated from others and undergo antibiotic therapy until tissue cells taken from the nose and the throat show negative results. Once a leading cause of death among young children, diphtheria is now rare in the United States because of widespread immunization. Cases of diphtheria must be reported to the state or county health department.

Epstein-Barr Virus

Epstein-Barr virus is a common human virus. The CDC estimates that nearly 95% of adults in the United States have, at some time, been infected with the virus. Thirty-five percent to 50% of adolescents who become infected develop infectious mononucleosis. The symptoms of infectious mononucleosis are fever, sore throat, swollen lymph nodes, and, occasionally, spleen and liver involvement. Recovery from the symptoms of infectious mononucleosis usually occurs within two months. However, the virus remains dormant in the person's throat for life. Occasionally, the virus reactivates and is associated with two types of tumors: Burkitt's lymphoma and carcinoma of the nasopharynx.

Haemophilus Influenzae Type B

Haemophilus influenzae type B (Hib) is a frequent cause of bacterial infections—including blood infections, epiglottitis, and pneumonia—in infants and young children in the United States. It is spread through direct, indirect, and droplet transmission. The incubation period is approximately 3 days. The patient may experience upper respiratory symptoms, fever, drowsiness, body aches, and diminished appetite. The infection also can cause bacterial meningitis (a swelling or inflammation of the tissue covering the spinal cord and brain) and should be carefully monitored.

Hepatitis

Hepatitis is a viral infection of the liver. There are several different viruses that cause hepatitis. Depending on the virus, transmission can be spread either through the blood or through the fecal-oral route. Hepatitis will be covered in greater detail in a later chapter (see Chapter 2).

HIV/AIDS

Human immunodeficiency virus (HIV) is the virus implicated as the cause of acquired immune deficiency syndrome (AIDS). HIV/AIDS will be covered in greater detail in a later chapter (see Chapter 3).

Influenza (Flu)

Nearly everyone has experienced symptoms of influenza, or the flu: fever, chills, headaches, body aches, and upper respiratory congestion. Isolation and other commonsense precautions can greatly reduce transmission of this viral infection. In addition, two types of vaccines are available to help prevent the flu. A live, attenuated (weakened) virus is given as a nasal spray and is approved for healthy individuals aged 5 through 49. This type of vaccine is not recommended for pregnant women. An inactivated (dead) virus is given as an intramuscular injection. This type of vaccine is approved for healthy individuals older than 6 months of age and people with chronic medical conditions.

The CDC recommends that the following people receive a yearly flu vaccination:

- People with an increased risk of flu complications
- Individuals older than age 50
- Anyone in close contact with people at risk for complications

Measles (Rubeola)

Measles, also called rubeola, is an infectious viral disease spread through droplets or direct transmission. Normally, the disease requires 8 to 13 days for the initial symptom of fever to appear. The characteristic itchy rash appears 14 days after exposure. Patients should follow isolation procedures for 7 days after the rash first appears. Children younger than the age of 3 are especially at risk for contagion and should be kept apart from family members who have contracted the disease. The CDC requires reporting measles to the state or county health department.

Meningitis

Meningitis is an inflammation and infection of the protective coverings of the brain and spinal cord, and the fluid that surrounds these tissues. Meningitis is caused by an infection with a virus or bacteria. Viral meningitis is usually milder than bacterial meningitis. It clears up in a week or two without specific treatment. Viral meningitis is also called aseptic meningitis.

Bacterial meningitis is a serious, life-threatening condition that requires immediate medical treatment. Severe bacterial meningitis can result in brain damage and even death. It affects more men than women. At highest risk are the elderly, children younger than 5, and people with chronic illnesses. Risk groups include children in daycare or schools, military recruits, anyone with a damaged spleen, and college students living in dorms or other close environments. The Centers for Disease Control and Prevention (CDC) recommend everyone in these risk groups receive meningococcal vaccination.

Between 5% and 20% of the population normally carry the bacteria that cause meningitis. These bacteria are commonly found in the nose and throat. Occasionally, a person who carries these bacteria develops meningitis. A person with an ear or sinus infection is at greater risk for meningitis. In addition, persons who have certain types of skull fractures also have a higher risk for developing meningitis.

For patients older than age 2, symptoms may include the following:

- A red, blotchy rash
- Confusion and delirium (delusions or hallucinations)
- Coma (in severe cases)
- Discomfort looking into bright lights
- Headache
- High fever and chills
- Nausea and vomiting
- Pain in the arms, legs, and abdomen
- Sleepiness
- A stiff neck and back

The classic symptoms of fever, headache, and neck stiffness may be absent or difficult to detect in newborns and small infants. The infant may only appear slow or inactive, be irritable, have vomiting, or be feeding poorly.

Some forms of bacterial meningitis are contagious. The bacteria are spread through the exchange of respiratory and throat secretions (for example, coughing, kissing, laughing, or sneezing). It also can be spread to individuals who have had close or prolonged contact with an infectious patient who has meningitis caused by *Neisseria meningitidis* (also called meningococcal meningitis) or Hib. Any health-care worker who has had direct contact with an infectious patient's oral secretions would be considered at increased risk of acquiring the infection. The CDC requires reporting meningitis to the state or county health department.

Mumps

Mumps is a viral infection that primarily affects the salivary glands. The incubation period lasts from 2 to 3 weeks. The patient may experience pain, especially related to parotitis (inflammation of the parotid gland near the ear), and fever. Isolation procedures should be followed until glandular swelling stops. You must report all cases of mumps to the state or county health department.

Pertussis (Whooping Cough)

Pertussis, or whooping cough, is an acute, highly contagious bacterial infection of the respiratory tract. Symptoms include slight fever, sneezing, runny nose, and quick, short coughs. The characteristic "whoop" occurs during the inhaled breath that follows a severe coughing fit. The patient should be isolated for 3 weeks after the onset of the spasmodic coughs. Whooping cough cases must be reported to the state or county health department.

Poliomyelitis (Polio)

Poliomyelitis, more commonly called polio, is an acute viral disease involving the gray matter of the spinal cord. It is caused by any of three related viruses, and it occurs in three different forms:

1. Inapparent, in which a patient may experience fever, sore throat, headache, and vomiting
2. Nonparalytic, in which a patient experiences the same symptoms as the inapparent type but in a more severe form, and in which pain and stiffness occur in the neck, back, and legs
3. Paralytic, in which a patient has the same symptoms as the nonparalytic form, followed by recovery and then signs of central nervous system paralysis

Although polio outbreaks occur worldwide, polio's current incidence in the United States is rare. Since the 1950s, the incidence of polio has decreased as a result of the routine immunization of most children. In the United States, vaccinations are generally administered by injection to protect against all three types of polio viruses. There is no drug treatment once the disease begins. Report all cases of polio to the state or county health department.

Roseola

Roseola is a rose-colored rash caused by a human herpes virus. The disease affects infants and young children. Its incubation period lasts between 5 and 15 days. Symptoms include sudden, high fever; sore throat; swollen lymph nodes; and after several days, a rash. Although seizures may sometimes accompany cases involving a very high fever, the disease is usually not serious.

Rubella (German Measles)

Rubella, or German measles, is a highly contagious viral disease. It is transmitted through direct or droplet transmission, and incubation normally occurs in 16 to 18 days, although periods as long as 23 days have been recorded. Symptoms are mild and include fever and an itchy rash. Because of effective vaccination programs, the occurrence of rubella is diminishing. Fetuses of pregnant women who are not immune to rubella are at the greatest risk because the disease can cause birth defects in a fetus during the first trimester of pregnancy. Report rubella to the state or county department of health.

Streptococcal Pharyngitis

Streptococcal pharyngitis (strep throat) is a bacterial infection of the throat. It is a common infection among children and adolescents. Patients experience severe throat pain with redness and swelling of the pharyngeal mucosa. They also may have fever, headache, nausea, and abdominal pain. Streptococcal pharyngitis is treated with antibiotics. Occasionally, complications occur due to strep infection. These include scarlet fever (scarlatina), rheumatic fever, and acute post-streptococcal glomerulonephritis.

Scarlet Fever (Scarlatina). Scarlet fever, also known as scarlatina, commonly accompanies strep throat. It occurs when the bacteria causing strep throat become systemic. In addition to the symptoms of strep throat (fever, sore throat, and swollen glands), the patient experiences the characteristic "strawberry rash" (tiny, bright red spots) that progresses from the trunk and neck to the face and extremities, along with nausea and vomiting. Incubation occurs in 1 to 3 days, and the patient may be kept isolated for 7 days. A shorter isolation period may be allowed if symptoms indicate the infection is not severe.

Rheumatic Fever. Rheumatic fever can occur several weeks after the patient's apparent recovery from strep throat. It is thought to be an autoimmune disorder. Research suggests that **antibodies** made by the body against streptococci cross react with heart tissues. Antibodies are highly specific proteins that attach themselves to foreign substances. The heart valves are especially prone to damage by these antibodies, resulting in the need for valve replacement later in life. The signs and symptoms of rheumatic fever are carditis (inflammation of the heart), electrocardiogram changes, joint pain and inflammation, and fever.

Acute Post-Streptococcal Glomerulonephritis. Acute post-streptococcal glomerulonephritis, a complication of strep throat, is an inflammation of part of the filtering unit of the kidney (glomerulus). Damage to the glomerulus causes inadequate filtering of the blood. Signs of acute glomerulonephritis include swelling in the hands and feet, decreased urine output, hypertension, and increased protein in the urine.

Tetanus

Tetanus is an acute, often fatal infectious bacterial disease. The infection follows the introduction of pathogenic spores, which enter the body through a contaminated puncture wound. If the disease process is not halted, the patient can experience lockjaw (a motor disturbance resulting in difficulty opening the mouth) and, eventually, paralysis. Incubation of the disease is normally 3 to 21 days. Patients with tetanus do not need to be isolated, but you must report cases to the state or county health department.

Tuberculosis

Tuberculosis, also called TB, is an infectious bacterial disease that mainly affects the lungs but also can involve other organs. TB is a leading infectious killer of adults worldwide. A patient infected with tuberculosis may not have any symptoms. The body's immune system often destroys the bacteria, leaving only a scar or spot on the lungs. Sometimes, however, the infection spreads, and the patient exhibits these symptoms:

- Night sweats
- Productive and prolonged cough
- Fever
- Chills
- Fatigue
- Unexplained weight loss
- Diminished appetite
- Bloody sputum

Incidence of Tuberculosis. Since 1992, the incidence in the United States has been declining. Incidence remains high or on the increase in many states, however, particularly in some urban centers. You may encounter patients with tuberculosis, and you can never relax your vigilance when working in environments where there is any risk of infection.

Many factors contribute to the continued high incidence of tuberculosis. You may work with patients who are affected by some or all of these factors:

- Infection with HIV increases the risk for developing tuberculosis after exposure to the pathogen
- The population of the United States is shifting to include a larger percentage of people from countries where there is a higher incidence of tuberculosis

- The number of people living in environments known to pose increased risk, such as long-term institutional settings, homeless centers, and medically underserved neighborhoods, has increased
- The public health-care system is unable to meet the needs of its constituents, resulting in patients who remain untreated
- New drug-resistant strains of the tuberculosis pathogen are appearing, requiring longer and more potent therapy regimens, which are harder to enforce and with which many patients do not comply

Understanding how tuberculosis is transmitted and managed will help you apply the principles of infection control.

Transmission of Tuberculosis. *Mycobacterium tuberculosis,* the microorganism responsible for tuberculosis infection, is spread through droplet transmission. The bacteria can spread through the air near an infected person when the person breathes, coughs, sneezes, or talks.

When another person inhales the bacteria, they travel through that person's respiratory system to lodge in the alveoli. From there, the bacteria can eventually spread throughout the body.

The most effective way to break the growth cycle of the tuberculosis pathogen is to contain the bacteria at the source. Containing the pathogen at this point prevents its entrance into another host. Containment measures are discussed in the Points on Practice box.

Increasing Resistance to Tuberculosis. Another way to break the pathogenic growth cycle is to decrease the susceptibility of the host. Early diagnosis, prompt treatment, and compliance with the treatment regimen have a positive impact on the outcome of tuberculosis. Risk factors for infection include the following:

- HIV infection or any disease state that weakens the immune system
- Intravenous drug use
- Previous tuberculosis infection
- Diabetes mellitus, a disorder characterized by a deficiency of the hormone insulin
- End-stage renal disease, a type of kidney disease
- Low body weight

Preventing Tuberculosis. A vaccine is available for the prevention of TB. Bacille Calmette-Guérin (BCG) is used in countries with a high rate of tuberculosis. BCG is not commonly used in the United States because it is not especially effective in adults. It also interferes with the tuberculin skin test by causing a false-positive result.

The CDC recommends vaccinating children who are continually exposed to TB and cannot be removed from the source of the exposure. They also recommend vaccinating certain health-care workers who work with patients with a high percentage of TB infection.

Points on Practice

Preventing the Spread of Tuberculosis

Containing the tuberculosis bacteria is the single best means of preventing the spread of the disease. There are specific measures that should be taken by the patient and the office personnel. Containment measures include the following:

Patient Measures

- Instruct patients in the correct procedure for covering the mouth when sneezing, coughing, laughing, or yawning. Explain that patients should properly dispose of tissues or other materials that have been used to block a sneeze or a cough and should thoroughly wash their hands afterward.
- Instruct patients that they should always take their tuberculosis medication as directed. If they miss a dose or are having problems taking the medicine, they should call the office.
- Have patients avoid close contact with other people. They should avoid going to school, work, or any public place until instructed to do so by the doctor.
- Patients should air out their room as often as possible, even in the winter. Moving air to the outside reduces the number of tuberculosis bacteria in the room.

Office Measures

- When you must perform a procedure that induces coughing, conduct the procedure in an area with negative air pressure, such as inside a protective booth. Negative air pressure acts to draw contaminated air out of the immediate area and into a filtration system.
- When you work with a patient who is infectious, wear a personal respirator to prevent inhalation of the bacteria. Be sure also to apply standard sanitization, disinfection, and sterilization techniques to instruments and equipment.

Treating Tuberculosis. Tuberculosis infection must be confirmed by a Mantoux tuberculin skin test, in which you administer tuberculin intradermally with a needle and syringe. If the test results are positive, the skin area turns red and becomes raised and hard, which is termed **induration.** A positive test result reveals that a patient has had previous exposure to tuberculosis, either from immunization (common outside the United States) or from coming in contact with the tuberculosis bacteria. If a patient tests positive for tuberculin sensitivity, further tests, including chest x-rays and sputum examination, are performed.

The specific treatment of a patient with active tuberculosis depends on the part of the body affected and the type of tuberculosis involved. In all cases, however, drug therapy must be begun immediately. Emphasize to patients the importance of completing the entire course of treatment (12 to 18 months on medication). As a medical assistant, you can help patients comply with the treatment by providing education about the following:

- The disease
- The expected course of treatment
- The anticipated outcome
- Measures patients can take to prevent the spread of the disease

Patients with active pulmonary tuberculosis should be hospitalized in a facility approved for treating the disease. They also should be placed in an isolation room with negative air pressure. Visitors should be kept to a minimum. Patients may be discharged to their homes after starting TB therapy, even though they may still be infectious. Transmission is less likely to occur after treatment has begun.

Drug-Resistant Microorganisms

Resistance to antimicrobial agents is a severe problem. Drug-resistant pathogens are the cause of many infections. It is the responsibility of physicians, medical staff, and patients to use antibiotics wisely. Bacteria and other microorganisms that have developed resistance to antimicrobial drugs include the following:

- MRSA—methicillin/oxacillin-resistant *S. aureus*
- VRE—vancomycin-resistant enterococci
- VISA—vancomycin-intermediate *S. aureus*
- VRSA—vancomycin-resistant *S. aureus*
- ESBLs—extended-spectrum beta-lactamases, which are resistant to cephalosporins and monobactams
- PRSP—penicillin-resistant *Streptococcus pneumoniae*

MRSA and VRE are the most common multidrug-resistant organisms in patients who reside in nonhospital health-care facilities (for example, nursing homes and other long-term-care facilities). Persons outside of health-care facilities are increasingly at risk for becoming colonized with MRSA. Community-associated MRSA, an infection found in otherwise healthy individuals, is on the rise in the United States. PRSP are more common in patients seeking care in physicians' offices and clinics, especially in pediatric settings.

Risk Factors

There are a number of risk factors for both the development of and infection with drug-resistant organisms. These risk factors include the following:

- Advanced age
- Invasive procedures, which include dialysis, the presence of invasive devices, and urinary catheterization
- Previous use of antimicrobial agents
- Repeated contact with the health-care system
- Severity of the illness
- Underlying diseases or conditions, especially chronic renal disease, insulin-dependent diabetes mellitus, peripheral vascular disease, and dermatitis or skin lesions.

Preventing Antibiotic Resistance in Health-Care Settings

In response to a growing concern over the emergence of antibiotic-resistant infections, the CDC began the Campaign to Prevent Antimicrobial Resistance in Healthcare Settings. This campaign has four strategies to reduce the incidence of antibiotic-resistant microorganisms:

1. Prevent infection
2. Diagnose and treat infection appropriately
3. Use antibiotics carefully
4. Prevent transmission of infections

The Disease Process

Many types of diseases affect humans. An infectious disease is one that is caused by the action of a microorganism. An infection begins when the microorganism finds a human host, that is, a body in which it can survive, multiply, and thrive. To grow, a microorganism requires specific conditions, which include three things: (1) the proper temperature, (2) pH (a measure of the body's acid-base balance), and (3) moisture level. The temperature within the human body (98.6°F, or 37°C), the body's neutral pH, and the body's dark, moist environment are prime conditions for the growth of microorganisms.

Some pathogens nearly always cause disease, whereas others cause disease less often or only under certain circumstances. A microorganism's disease-producing power is called **virulence.** When microorganisms damage the body, they do so in many ways:

- By depleting nutrients or other materials needed by the cells and tissues they invade
- By reproducing themselves within body cells

- By making body cells the targets of the body's own defenses
- By producing toxins, or poisons, that damage cells and tissues

Once exposed to a pathogenic organism, the body goes through 4 stages of illness:

1. Incubation period. This period begins at the first exposure and ends when the first symptoms appear.
2. Prodromal stage. This stage begins with the first onset of symptoms. This stage is generally short, lasting only from one to two days.
3. Invasion period. During this stage, the numbers of organisms are greatest and symptoms are most pronounced.
4. Convalescent period. During this time, the patient regains his or her normal health status.

Patients can be contagious during any of these stages, though patients are generally most contagious during the invasion period.

The Body's Defenses

People are constantly exposed to multitudes of pathogens, but the bodies of healthy individuals have built-in defenses against them. The condition of being resistant to pathogens and the diseases they cause is called **immunity.**

The body has several first lines of defense. These serve as nonspecific physical or chemical barriers to any invader. They include

- Skin—a strong mechanical barrier that resists penetration
- Sweat glands—structures that mechanically flush microbes from skin surfaces
- Mucous membranes—mechanical barriers that prevent microbe adherence
- Cilia—structures that line the respiratory tract; they act as "brooms" to remove substances trapped in mucus (Figure 1-1)
- Lacrimal glands—structures that produce tears to mechanically flush the eyes
- Saliva—a substance that mechanically pushes microorganisms to the stomach
- Hydrochloric acid—an acid found in the stomach that acts as a chemical barrier to ingested microbes
- Lysozyme—an enzyme found in tears and saliva that acts as a chemical barrier for the eyes and mouth

In addition to the first lines of defense, other factors help to protect the body. **Resident normal flora** are microorganisms found in the body. They consist of bacteria, fungi, and protozoa that have taken up residence either in or on the human body. Some of these organisms neither help nor harm the host and some are beneficial, creating a barrier against pathogens. Resident normal flora produce substances that can harm invaders or simply starve them by using up the resources pathogens need to live. The skin, nose, mouth, vagina, rectum, and intestines are all colonized by resident normal flora. Table 1-3 summarizes the anatomic sites colonized and gives examples of organisms found at those sites. These organisms live in balance most of the time, dependent on the health of the host. They can become pathogenic when they enter tissues normally not populated by them or when the host's defenses are compromised.

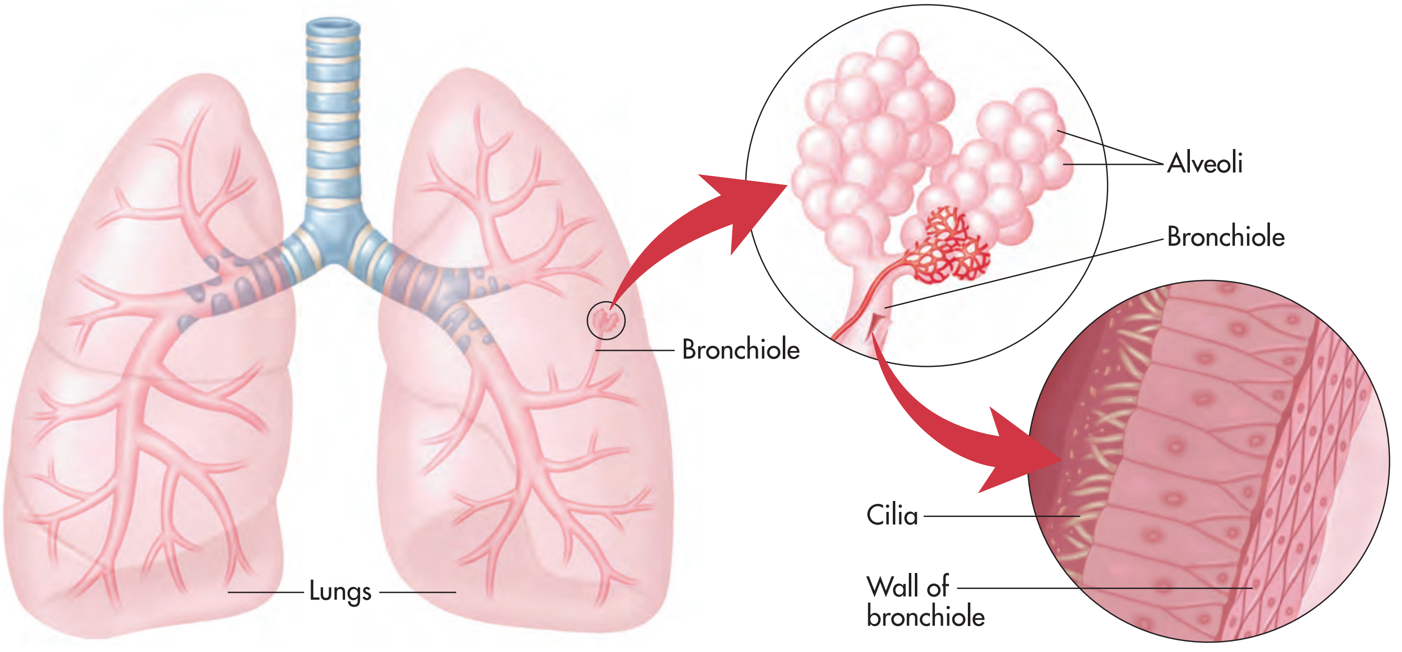

Figure 1-1. The sweeping motion of cilia that line the respiratory tract helps rid the body of foreign particles and some microorganisms.

TABLE 1-3 Sites Containing Well-Established Flora and Representative Examples

Anatomic Sites	Common Organisms	Characteristics
Skin	Bacteria: *Staphlococcus, Micrococcus, Corynebacterium,*	Microbes live only in upper dead layers of epidermis, glands, and follicles; dermis and layers below are sterile
	Fungi: *Malassezia yeast*	Dependent on skin lipids for growth
	Arthropods: *Demodix mite*	Present in sebaceous glands and hair follicles
Gastrointestinal tract Oral cavity	Bacteria: *Streptococcus, Neisseria, Staphylococcus, Lactobacillus,*	
	Fungi: *Candida* species	Can cause thrush
	Protozoa: *Trichomonas tenax, Entamoeba gingivalis*	Frequent the gingiva of persons with poor oral hygiene Colononize the epidermal layer of cheeks, gingiva, pharynx; surface of teeth; found in saliva in huge numbers
Large intestine and rectum	Bacteria: *Bacteroides, Clostridium,* fecal streptococci, *Lactobacillus,* coliforms (*Esherichia, Enterobacter*)	Sites of lower gastrointestinal tract other than large intestine and rectum have sparse or nonexistent flora Flora consists predominantly of strict anaerobes; other microbes are aerotolerant or facultative
	Fungi: *Candida*	
	Protozoa: *Entamoeba coli, Trichomonas hominis*	Feed on waste materials in the large intestine
Upper respiratory tract	Microbial population exists in the nasal passages, throat, and pharynx; owing to proximity, flora is similar to that of oral cavity	Trachea and bronchi have a sparse population; smaller breathing tubes and alveoli have no normal flora and are essentially sterile
Genital tract	Bacteria: *Lactobacillus, Streptococcus, Corynebacterium, Escherichia,*	In females, flora occupies the external genitalia and vaginal and cervical surfaces; internal reproductive structures normally remain sterile. Flora responds to hormonal changes during life.
Urinary tract	Bacteria: *Staphlylococcus, Streptococcus,* coliforms	In females, flora exists only in the first portion of the urethral mucosa; the remainder of the tract is sterile. In males, the entire reproductive and urinary tract is sterile except for a short portion of the anterior urethra.
	Fungi: *Candida*	Cause of yeast infections

A person's defenses may be compromised by poor health, inadequate nutrition, or poor hygiene. A break in the skin caused by injury can leave a person especially vulnerable to microorganisms. This type of opening in the body provides the organisms with an unprotected point of entry. Drugs also can weaken the body's ability to fight infection. For example, anticancer drugs may kill healthy cells along with cancer cells. Disorders of the immune system, such as AIDS, interfere with the body's natural ability to fight infection. Because people are constantly surrounded by pathogens, the body's natural defenses against pathogens are crucial to survival. If people do not have these defenses, they are potentially vulnerable to infection by every microorganism they encounter, including the body's resident normal flora.

Infections by microorganisms that can cause disease only when a host's resistance is low are called **opportunistic infections.** Examples of opportunistic infections are pneumonia caused by *Pneumocystis carinii* (a protozoan) and oral candidiasis, which is caused by *Candida* (a fungus found commonly in the mouth, intestinal tract, and vagina). Both of these infections are common in AIDS patients.

In most cases, when microorganisms successfully evade the body's first lines of defense and invade body tissues, the immune system begins to neutralize and destroy them. The immune system includes nonspecific defenses, humoral defenses (fluid mechanisms), and cell-mediated defenses. The immune system also involves the spleen, lymph nodes, tonsils, thymus, lungs, liver, and kidneys, all of which contain lymphatic tissue. Lymphatic tissue is a filtering network of connective tissue containing large numbers of lymphocytes. Lymphocytes are specialized white blood cells that combat infectious agents.

Nonspecific Defense

A microorganism that invades the human body is subjected to a variety of host defenses. Initially, the defense mechanisms are nonspecific. These nonspecific defenses include inflammation and phagocytosis.

Inflammation. Following an injury or invasion by a pathogen, the body begins a response known as inflammation. Signs of inflammation include redness, localized heat, swelling, and pain. The purposes of inflammation are to

1. Summon immunologic agents to the site
2. Begin tissue repair
3. Destroy invading microorganisms

This "call to action" by the body includes the following steps:

1. Initial constriction of blood vessels followed very shortly by dilation of blood vessels, causing redness and heat
2. Fluid leakage from local vessels, resulting in local swelling
3. Scar tissue formation, at which point the inflammatory response decreases

Inflammation is a useful initial tool for fighting foreign invaders. However, when inflammation becomes chronic, it can create new problems in the body. Chronic inflammation can damage tissues, resulting in a permanent loss of function. An example of the damage chronic inflammation can do is seen in rheumatoid arthritis.

Phagocytosis. Another type of nonspecific defense is the process known as phagocytosis. This process occurs when special white blood cells called **phagocytes** engulf and digest pathogens. (Figure 1-2 shows how a phagocyte "swallows" a pathogen.) A pouch forms around the pathogen as it is engulfed. The phagocyte secretes enzymes and metabolites into the pouch, destroying the trapped material.

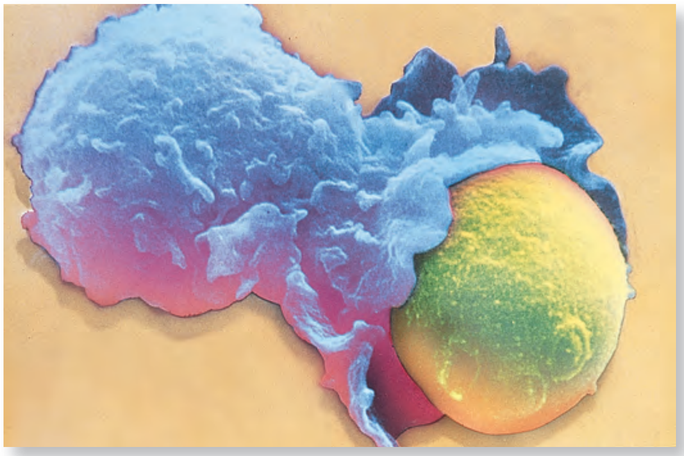

Figure 1-2. Phagocytes protect the body from infection by finding, surrounding, and digesting intruding microorganisms.

Phagocytes constantly search for and destroy foreign invaders. There are three main types of phagocytes: neutrophils, **monocytes,** and **macrophages.** Neutrophils are important in the inflammatory response. When tissues are injured, neutrophils travel to the site of injury and begin engulfing bacteria. Pus contains large numbers of neutrophils. Monocytes are phagocytes that are formed in bone marrow and circulate throughout the blood for a very short period of time. They then migrate to specific tissues and are called macrophages. Macrophages are slightly larger and more specialized than monocytes. Macrophages are found in the lymph nodes, liver, spleen, lungs, bone marrow, and connective tissue. Macrophages play several roles in humoral and cell-mediated immunity, including delivering **antigens** (foreign substances) to the lymphocytes involved in these defenses.

Humoral Immunity

One type of humoral protection is provided by antibodies. This defense involves two types of lymphocytes: B cells (also called B lymphocytes) and T cells (also known as T lymphocytes). When the body is invaded by antigens, helper T cells activate B cells to produce antibodies, which combine with the antigens to neutralize them. Although the initial response to a major invasion by an antigen may not be a highly effective defense, memory B cells are produced for the appropriate antibody. A later invasion by the same antigen will be quickly and effectively countered. Specific antibodies are produced in response to specific antigens. These antibodies act as a

TABLE 1-4 Types of Immunity

Immunity to a disease can be acquired in a variety of ways: naturally, artificially, actively, and passively.

Active Immunity Body produces its own antibodies; provides long-term immunity	**Passive Immunity** Antibodies produced outside of the body are introduced into the body; provides only temporary immunity
Natural Active Immunity Results from exposure to disease-causing organism	**Natural Passive Immunity** Results when antibodies from the mother cross the placenta to the fetus
Artificial Active Immunity Results from administration of a vaccine with killed or weakened organisms	**Artificial Passive Immunity** Results from immunization with antibodies to a disease-causing organism

homing device to attract phagocytes, which then engulf and destroy the antigen.

The formation of antibodies gives the body immunity from a particular disease. Immunity can be active or passive, natural or artificial (Table 1-4).

- Active immunity is a long-term immunity in which the body produces its own antibodies. Active immunity can be natural or artificial.
- Passive immunity results when antibodies produced outside the body enter the body. Passive immunity can be natural or artificial.
- Natural active immunity results from exposure to organisms that cause a disease, such as mumps. Although the person becomes sick with the disease, the body produces antibodies that prevent the individual from having the disease again if re-exposed. A fetus acquires natural passive immunity when the mother's antibodies move across the placenta. Natural passive immunity lasts only a short time, usually a few weeks after birth.
- Artificial active immunity results from the administration of an immunization or a vaccine. There are several types of vaccines available. Some vaccines are made from whole organisms that have been either killed or altered in a way that makes them unable to cause disease. Examples of vaccines produced from whole organisms are the influenza vaccines. Both live and dead virus influenza vaccines are available. Vaccines also can be made from purified substances found on or in a pathogen. More recently, vaccine research is studying the use of DNA techniques to produce vaccines. New DNA vaccines for West Nile Virus and HIV are on the horizon. All of these methods of immunization induce the formation of antibodies without causing disease.
- Natural passive immunity occurs when the mother transfers immunity to her unborn fetus through the placenta or to the newborn through breast milk. This type of immunity is temporary.
- Artificial passive immunity occurs as a result of injecting premade antibodies that provide temporary protection for people who have been exposed to serious disease, such as hepatitis and tetanus. Artificial passive immunity lasts only a short time, usually a few weeks.

The other type of humoral defense is called complement. Complement is a group of proteins that circulates in the blood and body fluids. It is always present in low amounts. When activated by antibodies, however, complement can multiply rapidly and destroy pathogens. It helps the white blood cells ingest microorganisms, sometimes making a hole in the microorganisms' cells that causes the cells to rupture and be destroyed. The main reason that most bacteria do not cause disease is that complement proteins destroy many species of bacteria.

Cell-Mediated Immunity

In addition to their role in humoral immunity, T cells are instrumental in cell-mediated immunity. Cell-mediated immunity differs from humoral immunity in that T cells do not form antibodies to combat antigens. Instead, they directly attack the invader. Several different types of T cells are involved in the attack process. Helper T cells activate the killer T cells, which bind with the antigen and kill it. Suppressor T cells slow down or stop the attack after the antigen is destroyed. Memory T cells are formed and will respond quickly to another attack by the same antigen.

Cell-mediated defenses against infection often result in inflammation of the affected area. Inflammation occurs when phagocytes enter the area, stick to the lining of the blood vessels, and come out of the vessels to attack the infecting agent. Small blood vessels then dilate and leak fluid, resulting in swelling, redness, and warmth. This process often causes fever, which is a common response to many infections and may play a part in fighting infection. The fever results when endogenous pyrogen, a product of phagocytic cells, acts on the area of the brain that controls the body's temperature.

The Cycle of Infection

Five elements make up the cycle of infection (Figure 1-3). These five parts must all be present for infection to occur:

1. Reservoir host
2. Means of exit
3. Means of transmission
4. Means of entrance
5. Susceptible host

Reservoir Host

The infection cycle begins when the pathogen invades the reservoir host. The **reservoir host** is an animal, insect, or human whose body is capable of sustaining growth of a pathogen. Many pathogens require a reservoir host to provide nutrition and a place to multiply.

The presence of the pathogen in the reservoir host may cause an infection in the host. At times, however, the host avoids full infection. A human **carrier** is a reservoir host who is unaware of the presence of the pathogen and so spreads the disease. The carrier exhibits no symptoms of infection. A human host also may have a **subclinical case,** which is a manifestation of the infection that is so slight that it is unnoticeable. The host experiences only some of the symptoms of the infection or milder symptoms than in a full case. A wide range of diseases can be manifested subclinically.

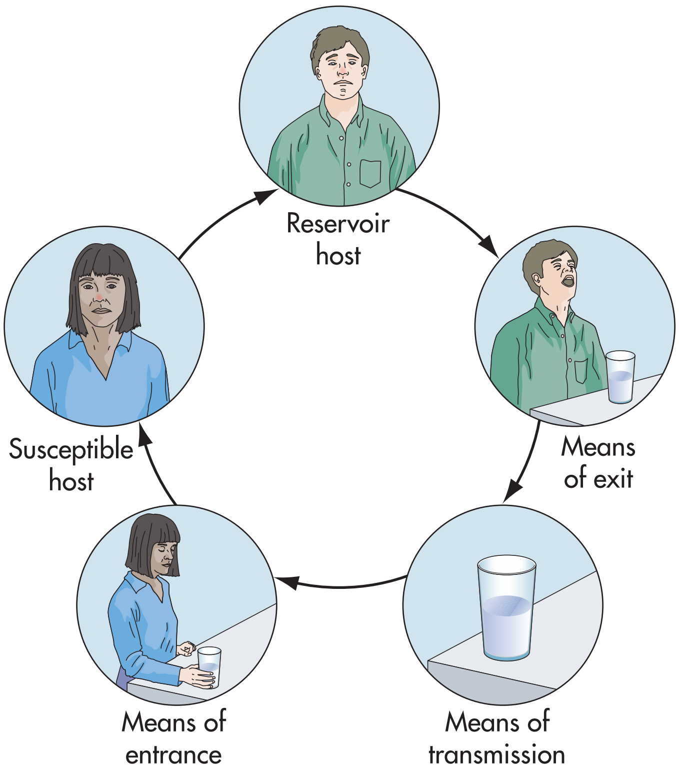

Figure 1-3. The cycle of infection must be broken at some point to prevent the spread of disease.

An infection in the reservoir host may be either endogenous or exogenous. An **endogenous infection** is one in which an abnormality or malfunction in routine body processes has caused normally beneficial or harmless microorganisms to become pathogenic. An **exogenous infection** is one that is caused by the introduction of a pathogen from outside the body.

Means of Exit

The next step in the cycle of infection is the pathogen's exiting from the reservoir host. Common routes of exit include the following:

- Through the nose, mouth, eyes, or ears
- In feces or urine
- In semen, vaginal fluid, or other discharge through the reproductive tract
- In blood or blood products from open wounds

Means of Transmission

To reproduce after it has exited from the reservoir host, the pathogen must spread to another host by some means of transmission. The means may be direct or indirect. Direct transmission occurs when the pathogen moves immediately from one host to another. This type of transmission may happen through contact with the infected person or with the discharges of the infected person, such as saliva or blood.

Indirect transmission is possible only if the pathogen is capable of existing independently of the reservoir host. In this case, the pathogen survives until a new host encounters it and the pathogen takes up residence in that new host.

Airborne Transmission. Pathogens can be transmitted to a new host through the air. For example, microorganisms may enter the respiratory tract of a new host by inhalation. Respiratory diseases such as influenza, or flu, are often transmitted this way.

Pathogens may be inhaled from a variety of sources, such as soil particles or secretion droplets. When people inhale contaminated soil particles, fungal diseases may be contracted. If contaminated droplets are inhaled, diseases including influenza, chickenpox, and tuberculosis may be contracted. Because pathogens can spread relatively rapidly through airborne transmission, they may cause large epidemics among susceptible people.

Bloodborne Transmission. Pathogens also can enter a new host through contact with blood or blood products. Bloodborne pathogens (discussed in greater detail in Chapter 3) may be transmitted in a variety of ways:

- Indirectly, as when pathogens are transferred through blood transfusions, needlesticks, or improperly sterilized dental equipment
- Directly, as when the contaminated blood of one person comes into contact with another person's broken skin or mucous membrane, or when a pregnant woman transmits a disease to her fetus across the placenta

Transmission During Pregnancy or Birth. If a mother becomes infected during her pregnancy, she can pass on pathogens to the fetus. An infection may be transmitted while the fetus is in the mother's uterus, which may result in damage to the fetus. This transmission is a form of bloodborne transmission.

Some bloodborne infections that produce only mild symptoms in the mother may be devastating to the fetus (for example, rubella). Other infections, such as herpes, gonorrhea, syphilis, or streptococcal infections, may infect the baby during passage through the birth canal. An infection that is present in a child at the time of birth is said to be congenital.

Foodborne Transmission. A new host may be exposed to pathogens by ingesting contaminated food or liquids. Food can become contaminated when it is handled by an infected person who has poor hygiene habits, such as a customer at a self-service salad bar who did not wash his hands. The amount of contamination needed in a food to make someone ill varies. People who produce less stomach acid may become infected with a smaller dose of pathogens than those with higher acid production because stomach acid kills many microorganisms. An example of a pathogen transmitted by ingestion is a strain of *Escherichia coli* bacteria, commonly known as E. coli, which can cause severe food poisoning.

Vector-Borne Transmission. A living organism that carries microorganisms from an infected person to another person is known as a **vector.** The most common carriers are insects such fleas, flies, mosquitoes, and ticks.

- Fleas carry the organism responsible for plague. Though the number of cases in the United States is very low, plague has been identified as a possible bioterrorism agent.
- Common houseflies carry pathogens from garbage and feces on their bodies and feet. When they land on food, they mechanically transfer these microorganisms to the food.
- Mosquitoes are carriers of several diseases of importance in the United States. They carry the organisms responsible for West Nile Virus and malaria.
- Ticks carry the microorganisms responsible for Lyme disease and Rocky Mountain spotted fever.

Transmission by Touching. Direct or indirect contact through touch is another method of transmitting infection. Direct transmission occurs through contact with an infected person's mucous membranes. Sexually transmitted diseases are spread through the direct contact of one mucous membrane with another (in the penis, vagina, urethra, mouth, or anus) during sexual activity.

Indirect transmission occurs through contact with **fomites.** A fomite is any inanimate reservoir of pathogenic microorganisms. Any object that can be contaminated

Figure 1-4. Because many people touch stair railings, they are common fomites for disease transmission.

by an infected person and then can transmit the infective agent to a susceptible host is considered a fomite. These objects can include drinking glasses, door knobs, shopping cart handles, pencils, and almost any surface or object that can temporarily hold microorganisms (Figure 1-4).

Means of Entrance

Just as the pathogen needs a means of exit from the reservoir host, it also needs a means of entrance into the new host. Pathogens can enter a new host through any cavity lined with mucous membrane, such as the mouth, nose, throat, vagina, or rectum. They also can enter through the ears, eyes, intestinal tract, urinary tract, reproductive tract, or breaks in the skin. Most pathogens can take advantage of any means of exit and entry. For example, the droplets from an infected child's sneeze can land on a toy in a common play area. The next child to pick up the toy can transfer the infected droplets to his own nose, spreading the infection.

Susceptible Host

A final requirement must be met for the infection cycle to remain intact. The person into whom the pathogen has been transmitted must be an individual who has little or no immunity to infection by that organism. This individual is called a **susceptible host.**

Susceptibility is determined by a variety of factors. Some of these factors are related to the host, some to the pathogen, and some to the environment. Factors related to the host include the following:

- Age
- Genetic predisposition to certain illnesses
- Nutritional status
- Other disease processes
- Stress levels
- Hygiene habits
- General health

Factors related to the pathogen include the number and concentration of pathogens, the strength (virulence) of the pathogen, and the point of entry. Environmental factors, such as the living conditions of the host and the host's exposure to hazardous substances, also affect susceptibility.

Once a new host has been infected, the cycle can continue. This host becomes the reservoir host and eventually transmits the pathogen to yet another host.

Environmental Factors in Disease Transmission

The climate, food, water, animals, insects, and people in a community may greatly influence the types and courses of infection there. In a highly dense population, the infection rate may be higher than in a low-density population because pathogens spread more quickly from person to person when people are in closer proximity. Proximity is one reason for the increase in respiratory disease during seasons when people are indoors for long periods.

Animals can play a role in infection. Infections related to pathogens are found in domestic and wild animals. Unpasteurized milk from an infected cow may cause disease. Some pathogens can infect animals and people. Butchers, hunters, and people in occupations dealing with animals may be at greater risk than other individuals for infection by those pathogens.

The environment affects the incidence of diseases carried by insects. Whether a potentially disease-carrying insect is in a certain area depends on whether that area has the appropriate climate and environment the insect needs to live. For instance, in tropical regions, malaria is spread by the female *Anopheles* mosquito (Figure 1-5). In other areas, ticks may carry Rocky Mountain spotted fever or Lyme disease.

Economic and political factors influence the pattern of infection transmission. They help determine the cleanliness of an area, the availability of medical care, and people's knowledge about preventing infection. Other factors that influence infection transmission include the availability of transportation, urbanization, population growth rates, and sexual behavior.

Figure 1-5. The female *Anopheles* mosquito carries malaria-causing parasites, transmitting them to humans when it bites.

Breaking the Cycle

The principles of **asepsis** must be applied to break the cycle of infection and its spread. Asepsis is the condition in which pathogens are absent or controlled. In medical settings, where many people are hosts to pathogens and many others are susceptible, asepsis can break the cycle by preventing the transmission of pathogens.

Specific measures to help break the cycle of infection include

- Maintaining strict housekeeping standards to reduce the number of pathogens present
- Adhering to government guidelines to protect against diseases caused by pathogens
- Educating patients in hygiene, health promotion, and disease prevention

You will learn more about specific ways of promoting asepsis in Chapter 2.

Summary

1.1 Infection control has been a problem throughout history. Though there have been many advances, controlling infection continues to be a challenge for doctors.

1.2 There is great variety in the types of pathogenic organisms. Types of potentially infectious microorganisms include prions, viruses, bacteria, protozoans, fungi, and helminths.

1.3 It is important to be familiar with the diseases that infect people so that you can protect your patients, coworkers, and yourself. These diseases include but are not limited to chickenpox, croup, diphtheria, hepatitis, influenza, measles, mumps, and polio.

1.4 Antibiotic resistance of microbial pathogens is a growing problem. The number of infections for which there is little or no treatment is increasing. It is the responsibility of health-care workers to use antibiotics wisely.

1.5 The CDC began a campaign to prevent antimicrobial resistance. There are four strategies outlined in the campaign: (1) prevent infection, (2) diagnose and treat infection appropriately, (3) use antibiotics carefully, and (4) prevent transmission of infections.

1.6 There are numerous human pathogens. These pathogens cause disease by damaging the body in a number of ways including depleting nutrients needed by cells, reproducing themselves within body cells, making body cells the targets of the body's own defenses, and producing toxins that damage cells and tissues.

1.7 The body is able to protect itself from disease through the use of several lines of defense. These lines of defense may be nonspecific or specific.

1.8 In order for an infection to occur, five elements must be in place. There must be a reservoir host, a means of exit, a means of transmission, a means of entrance, and a susceptible host.

1.9 Direct disease transmission occurs when the pathogen moves immediately from one host to another. Indirect transmission is possible only if the pathogen is able to survive outside the host for some period of time.

1.10 The most effective means of breaking the cycle of infection is by using aseptic techniques. These includes maintaining strict housekeeping standards, adhering to government health guidelines, and educating patients in hygiene, health promotion, and disease prevention.

REVIEW

CHAPTER 1

CASE STUDY QUESTIONS

Now that you have completed this chapter, review the case study at the beginning of the chapter and answer the following questions:

1. What part of the cycle of infection caused the problem for the patient?
2. How could the patient have avoided this infection?
3. Why are the other family members not showing symptoms of the infection?
4. Should the patient's family members be tested for the infection?

Multiple-Choice Questions

1. Which of the following is a viral disease of the salivary glands?
   a. Whooping cough **c.** Croup
   b. Mumps **d.** Diphtheria
2. The stage of illness during which a person regains normal health status is the
   a. incubation period. **c.** invasion period.
   b. prodromal stage. **d.** convalescent period.
3. In order to grow, a microorganism needs the proper growth temperature, pH, and
   a. darkness. **c.** flora.
   b. immunity. **d.** moisture level.
4. Which of the following is the term meaning an area of the skin that is raised and hardened?
   a. Induration **c.** Scarlatina
   b. Prodromal **d.** Inflammation
5. Which of the following is an infection with symptoms that are slight and barely noticeable?
   a. Carrier **c.** Endogenous
   b. Subclinical **d.** Exogenous

Discussion Questions

1. Why would patients who reside in long-term care facilities be at greater risk for infection with a multi-drug resistant microorganism?
2. Differentiate active, passive, and natural active immunities.
3. Discuss ways in which vector-borne disease transmission can be controlled.

Critical Thinking Questions

1. Why are people, as a rule, able to avoid infections?
2. Why is the previous use of antibiotics a risk factor for the development of antibiotic-resistant microorganisms?

3. In order for a disease to be transmitted to a person, that person must be susceptible. Which susceptibility factors does a person have control over and how can he or she control these factors?

Application Activities

1. With another student, role-play a scenario involving a medical assistant and a patient with newly diagnosed tuberculosis. Include information about containing the spread of infection. Document this teaching in the patient's medical record.
2. Create a poster for your office describing the cycle of infection. You might choose a specific disease to illustrate the cycle.
3. With another student, role-play a scenario involving a medical assistant and a patient. The medical assistant should use various media to explain and teach the patient about a specific infectious disease.

Virtual Fieldtrip

Visit the McGraw-Hill Higher Education Medical Assisting website at http://www.mhhe.com/medicalassisting4e to complete the following activity:

Use the National Institutes of Health's website and search the term *influenza*. Keep a journal of your trip. Include the following information:

- Trail map (describe where your search led you)—this should include the URL of each link you found useful and a short synopsis of the information found at the link
- List of information useful to patients
- List of information useful to staff

Plan how you will use this information in a medical practice.

Open the CD and complete this chapter's practice activities, play the games, listen to the key terms, and test yourself with the interactive review. E-mail, print, and/or save your results to document your proficiency.