chapter 16

Infection Prevention and Control: Protective Mechanisms and Asepsis

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Objectives

Upon completing this chapter, you should be able to:

Theory

1. List the types of microorganisms that can cause infection in humans.
2. Discuss the links in the infection process and give an example of each.
3. Discuss factors that make the elderly more susceptible to infection.
4. Explain how the body's protective mechanisms work to prevent infection.
5. Explain how the inflammatory and immune responses protect the body.
6. Identify means for removal or destruction of microorganisms on animate and inanimate objects.
7. Compare and contrast medical asepsis and surgical asepsis.
8. Describe accepted methods of disinfection and sterilization.

Clinical Practice

1. Discuss the surveillance, prevention, and control of infections in hospitalized patients.
2. Demonstrate proper hand hygiene techniques.
3. Consistently demonstrate the application of Standard and Transmission-Based Precautions while caring for patients.
4. Prepare to teach a home care patient with a wound infection how to prevent spread of infection to family members.

Skills & Steps

Skill 16-1 Hand Hygiene
Skill 16-2 Using Personal Protective Equipment (PPE): Gown, Mask, Gloves, Eyewear

Steps 16-1 Removing Gloves

Key Terms

antibiotic (p. 209)
antimicrobial (ăn-tī-mī-KRŌ-bē-ăl, p. 209)
antiseptic (ăn-tĭ-SĔP-tĭk, p. 230)
asepsis (ā-SĔP-sĭs, p. 218)
aseptic (ā-SĔP-tĭk, p. 212)
bacteria (băk-TĒ-rē-ă, p. 208)
contaminated (p. 211)
debris (dĕ-BRĒ, p. 216)
disinfectants (dĭs-ĭn-FĔK-tănts, p. 230)
fungi (FŬN-jī, p. 210)
helminths (HĔL-mĭnths, p. 210)
immune response (ĭ-MŪN rē-SPŎNS, p. 216)
interferon (ĭn-tĕr-FĒR-ŏn, p. 216)
medical asepsis (p. 218)
microorganism (mī-krō-ŌR-găn-ĭz-ĕm, p. 208)
pathogens (PĂTH-ō-jĕnz, p. 208)
personal protective equipment (PPE) (p. 224)
prions (p. 209)
protozoa (prō-tō-ZŌ-ă, p. 210)
rickettsia (rĭ-KĔT-sē-ă, p. 210)
Standard Precautions (p. 224)
sterile (p. 212)
sterilization (stĕr-ĭ-lĭ-ZĀ-shŭn, p. 211)
surgical asepsis (p. 218)
viruses (p. 209)

Box 16-1 Vocabulary Related to Infection

Aerobic: Needs oxygen to live and grow
Anaerobic: Able to live and grow only in the absence of oxygen
Bactericidal: An agent that is able to kill or destroy bacteria
Colonization: Microorganisms take up residence and grow
Community-associated infection: An infection that was present or incubating before the patient came in contact with health care or had a medical procedure performed.
Cross-contamination: Transmission of infectious microorganisms from one person or object to another
Culture: Propagation of living organisms or tissue in special media conducive to their growth
Disinfectant: An agent that reduces the number of viable microorganisms
Endotoxin: A heat-stable toxin associated with the outer membranes of certain gram-negative bacteria that is released when the cells are disrupted
Exotoxin: An unstable, highly toxic by-product of select microorganisms that can be found in both gram-positive and gram-negative bacteria
Exudate: Fluid in or on tissue surfaces that has escaped from blood vessels in response to inflammation and that contains protein and cellular debris
Gram-negative: Bacteria that lose the stain in Gram's method of staining
Gram-positive: Bacteria that retain the stain in Gram's method of staining
Health care–associated infection: Infection that was not present or incubating on admission to a health care facility; acquired during hospitalization
Host: An animal or plant that harbors and provides sustenance for another organism (a parasite)
Infection: Invasion and multiplication in body tissues of microorganisms that cause cellular injury
Inflammation: Localized response caused by injury or destruction of tissues that serves to contain the injurious agent and injured tissue
Leukocytosis: Increase in the number of leukocytes in the blood, resulting from infection or other causes
Phagocytes: Cells (e.g., macrophages) capable of ingesting particulate matter
Phagocytosis: The engulfing of microorganisms and foreign particles by phagocytes
Spores: Oval bodies formed within bacteria as a resting stage during the life cycle of the cell; characterized by resistance to environmental changes (heat, humidity, or cold)
Toxin: A poison; a poisonous protein produced by certain bacteria
Vector: Carrier that transports an infective agent from one host to another, such as animals, insects, and rodents
Virulence: Degree to which a microorganism can cause infection in the host or invade the host

An **infection** is the entry of an infectious agent, a **microorganism** (organism only visible with a microscope), into the body that multiplies and causes tissue damage. Left untreated, an infection may result in illness and disease. Health care professionals work to eliminate infection from the body and to prevent its spread to others. Careful hand hygiene is essential to prevent **cross-contamination.** Box 16-1 presents vocabulary related to infection. Microorganisms capable of causing disease are called **pathogens** (Figure 16-1). Nonpathogenic organisms that are prevalent on and in the body are called **normal flora** (Table 16-1). Normal floras prevent more harmful microorganisms from colonizing and multiplying within the body. They do this by occupying receptor sites on cells, monopolizing the nutrients, and secreting substances that are toxic to other microorganisms. Some pathogenic microorganisms produce harmful **toxins,** and others release **endotoxins.** Endotoxins are responsible for the symptoms seen in botulism, tetanus, diphtheria, and *Escherichia coli* infection.

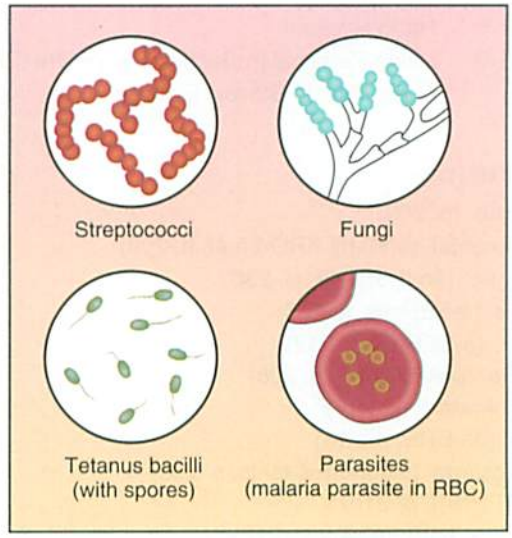


FIGURE 16-1 Pathogenic microorganisms. (Key: *RBC,* Red blood cell.)

INFECTIOUS AGENTS

BACTERIA

Bacteria are single-cell microorganisms lacking a nucleus that reproduce from every few minutes up to several weeks. Bacteria are classified according to their need for oxygen, their shape, and their Gram-staining properties. **Aerobic bacteria need oxygen to grow and thrive. Anaerobic bacteria grow only when oxygen is not present.** A laboratory technique called Gram staining is performed to help in classifying the bacteria's outer cell surface. This identification process also helps determine

Table 16-1 Normal Flora of the Body*

SITE	NORMAL FLORA
Upper respiratory tract (nose, mouth, throat)	*Corynebacterium* species *Enterobacter* species *Haemophilus* species *Klebsiella* species *Lactobacillus* species *Neisseria* species *Staphylococcus* species *Streptococcus* (*viridans* group) *Streptococcus pyogenes* (group A) Various types of anaerobes
Skin	*Acinetobacter* species *Corynebacterium* species *Staphylococcus aureus* *Staphylococcus epidermidis* Yeasts
Small bowel and colon	Anaerobes *Bacteroides* species *Clostridium perfringens* *Enterobacter* species (coliforms) *Streptococcus faecalis* (enterococci or group D)
Vagina	Alpha-hemolytic streptococci Enterobacteriaceae Enterococci *Lactobacillus* sp. Many types of anaerobes *Staphylococcus epidermidis*

*The lower respiratory tract, central nervous system, bladder, and upper urinary tract are normally sterile (no microorganisms present).

the most effective method to use in eliminating the microorganism. The specimen to be tested for bacteria is placed on a slide, stained, and then treated with a contrasting dye; those retaining the stain are **gram positive,** and those losing the stain and taking up the counterstain are **gram negative.** Many gram-negative bacteria are more dangerous than gram-positive bacteria because they may produce an endotoxin that can cause hemorrhagic shock and severe diarrhea and can alter resistance to other bacterial infection. Classification of bacteria according to their **morphology** (shape) places them into one of three main groups: **cocci** (round), **bacilli** (rod shaped), and **spirochetes** (spiral). Some grow in chains (streptococci), some in pairs (diplococci), and some in clusters (staphylococci).

Final identification involves chemical testing of the bacteria by performing a **culture.** To do this, the body secretion or specimen is transferred to a medium in which it can grow. Sensitivity tests are then performed to determine which **antibiotic** (chemical substance that can kill or alter the growth of bacterial microorganisms) is most effective against the bacteria. When culture results show that a drug-resistant organism is responsible for an infection, extreme care must be taken to prevent the spread of the organism. The four most common multidrug-resistant organisms are (1) methicillin-resistant *Staphylococcus aureus* (MRSA), (2) vancomycin-resistant *Enterococcus* (VRE), (3) extended-spectrum beta-lactamase–producing (ESBL) pneumonia *(Klebsiella pneumoniae* or *E. coli),* and (4) *Clostridium difficile (C. diff).* A new quick test, the BD GeneOhm StaphSR assay, identifies MRSA bacterium in 2 hours by testing a blood sample. Another example of a drug resistant organism is penicillin-resistant *Streptococcus pneumoniae,* which causes a form of pneumonia that can be difficult to treat.

These organisms, especially MRSA, are being contracted outside the hospitals now and are an increasing problem. Patients must be educated about the correct use and possible misuse of **antimicrobial** (killing or suppressing growth of microorganisms) agents. Encourage each patient to take the entire antimicrobial prescription as ordered by the heath care provider to ensure full treatment of the infection. Incomplete treatment allows some microorganisms to live, giving them a chance to mutate and develop drug resistance. Consistent use of Standard Precautions plus any Transmission-Based Precautions (e.g., Airborne Infection Isolation Precautions, Contact, or Droplet Precautions) is essential, especially when a drug-resistant organism is present.

Health Promotion

Preventing Spread of MRSA

To prevent the spread of methicillin-resistant Staphylococcus aureus *(MRSA) in your community:*

- Wash hands frequently; use an alcohol-based rub when soap and running water are unavailable.
- Keep cuts and abrasions clean and covered with a bandage until healed.
- Avoid sharing personal items such as razors, towels, and make-up.
- Avoid contact with other people's bandages or wounds.

PRIONS

Prions are protein particles that lack nucleic acids and are not inactivated by usual methods for destroying bacteria or viruses. They do not trigger an immune response, but cause degenerative neurologic disease such as variant Creutzfeldt-Jakob disease (mad cow disease).

VIRUSES

Viruses are extremely small and can be seen only with an electron microscope (Figure 16-2). They are composed of particles of nucleic acids, either DNA or RNA, with a protein coat and sometimes a membranous envelope. **Viruses can grow and replicate only within a living cell.** Once inside cells, viruses can trigger an

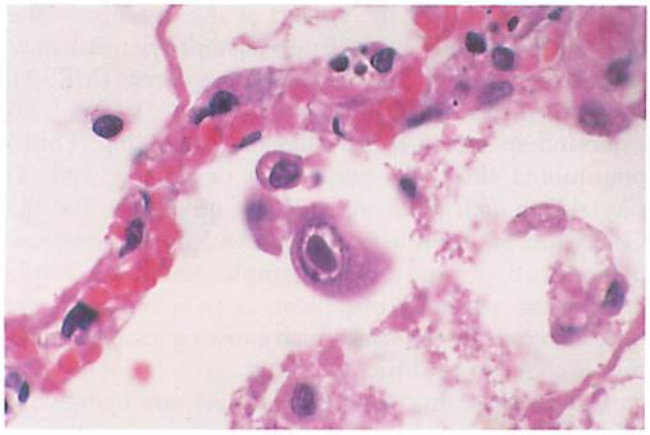


FIGURE 16-2 Electron microscope view of viruses.

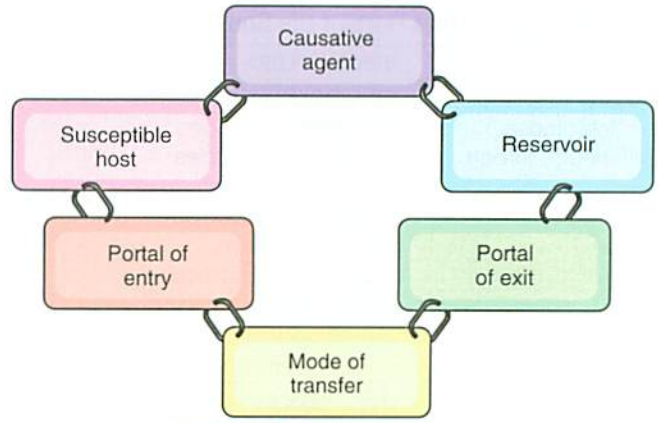


FIGURE 16-3 The infection chain.

immune reaction or damage cells in other ways. Their survival and multiplication depend on host tissue. Viruses are identified in the laboratory by fluorescent techniques, electron microscopy, and tissue culture.

PROTOZOA

Protozoa are one-celled microscopic organisms belonging to the animal kingdom. Protozoa that are pathogenic to humans include the *Plasmodium* species that causes malaria; *Entamoeba histolytica,* which causes amebic dysentery; and other strains capable of causing diarrhea.

RICKETTSIA

Rickettsia are small round or rod-shaped microorganisms that are transmitted by the bites of lice, ticks, fleas, and mites that act as **vectors.** They multiply only in host cells. Examples of rickettsial infection include Rocky Mountain spotted fever and typhus.

FUNGI

Fungi are tiny, primitive organisms of the plant kingdom that contain no chlorophyll. Examples include yeasts and molds. Fungi feed on living plants, animals, and decaying organic material. They thrive in warm, moist environments. Fungi reproduce by means of **spores.** In humans, fungal infections are called **mycoses.** When the balance of normal flora is altered by antimicrobial therapy, fungal infections such as vaginal candidiasis may occur.

HELMINTHS

Helminths are parasitic worms or flukes belonging to the animal kingdom. Pinworms, which mostly affect children, are the most common helminths worldwide. Roundworms and tapeworms are other helminths.

OTHER INFECTIOUS AGENTS

Several types of organisms differ enough in structure to fall outside the above classifications. Mycoplasmas are very small organisms without a cell wall. They cause infections of the respiratory or genital tract. *Mycoplasma pneumoniae* is an example. *Chlamydia,* another type of organism, affects the genitourinary and reproductive tracts and has become more common in the past 20 years. In countries where hygiene is poor, *Chlamydia trachomatis* is responsible for trachoma, an eye disease that can cause blindness. In the United States the same organism causes a significant amount of sexually transmitted infections (Table 16-2).

PROCESS OF INFECTION

The process by which an infection is spread from one person to another can be thought of as a continuous chain. Each link must be present in its proper order for the chain to remain intact and for the infection to spread. Figure 16-3 shows how the links of the chain connect and infection occurs. If just one link is broken, the transmission of the microorganism cannot occur.

CAUSATIVE AGENT (LINK ONE)

A causative agent is any microorganism or biologic agent capable of causing disease. These agents include bacteria, viruses, protozoa, prions, rickettsia, fungi, and helminths.

Some microorganisms are more virulent than others. Characteristics that affect **virulence** are ability to (1) adhere to mucosal surfaces or cell walls, (2) penetrate mucous membranes, (3) multiply in the body, (4) secrete harmful enzymes or toxins, (5) resist **phagocytosis** (destruction by white blood cells [WBCs]), and (6) bind with iron (essential to bacterial growth). Microorganisms differ in structure and characteristics (see Figure 16-1). If the pathogen is not contained, the patient may become ill. The four stages of the infection process are incubation, prodrome, illness and convalescence.

Table 16-2 Disease-Producing Organisms (presented in order of increasing complexity)

ORGANISM CLASS	COMMON EXAMPLES	COMMON DISEASE MANIFESTATIONS
Bacteria	*Staphylococcus* species	Superficial skin infections, osteomyelitis, pneumonia, bacteremia
	Streptococcus species	Pharyngitis, skin infections, pneumonia
	Neisseria meningitidis	Meningitis
	Escherichia coli	Urinary tract infection
	Pseudomonas aeruginosa	Skin infection, otitis, urinary tract infection
Prions		Bovine spongiform encephalitis (BSE)/Creutzfeldt-Jakob disease, kuru*
		Possible role in Alzheimer disease, Parkinson disease, and amyotrophic lateral sclerosis (ALS)†
Viruses	Poliovirus	Poliomyelitis
	Hepatitis A virus	Hepatitis
	Rhinovirus	Common cold
	Influenza A virus	Influenza
	Mumps virus	Mumps
Protozoa	*Entamoeba histolytica*	Diarrhea, colitis
	Plasmodium species	Malaria
	Leishmania species	Fever, weight loss, cutaneous lesions
	Toxoplasma gondii	Chorioretinitis, encephalitis
Rickettsia	*Rickettsia rickettsii*	Rocky Mountain spotted fever
	Rickettsia prowazekii	Typhus
	Coxiella burnetii	Q fever
Fungi	*Candida albicans*	Thrush, vaginitis
	Aspergillus species	Sinusitis, brain abscess
	Cryptococcus neoformans	Meningitis, pneumonia
	Histoplasma capsulatum	Pneumonia
	Coccidioides immitis	Pneumonia
	Pneumocystis jiroveci (formerly *carinii*)	Pneumonia
Helminths	*Ancylostoma duodenale* (hookworm)	Anemia
	Ascaris lumbricoides (roundworm)	Intestinal obstruction
	Enterobius vermicularis (pinworm)	Anal pruritus
	Schistosoma species (blood flukes)	Hydronephrosis
	Taenia solium (pork tapeworm)	Epilepsy from cysticercosis
Chlamydiae	*Chlamydia trachomatis*	Trachoma, lymphogranuloma venereum, conjunctivitis
	Chlamydia psittaci	Psittacosis (parrot fever)
Mycoplasmas	*Mycoplasma pneumoniae*	Pneumonia
	Ureaplasma urealyticum	Urethritis
	Mycoplasma hominis	Pyelonephritis, pelvic inflammatory disease

From Ignatavicius, D.D., & Workman, M.L. (2006). *Medical-Surgical Nursing: Patient-Centered Collaborative Care* (5th ed., p. 508). Philadelphia: Elsevier Saunders.
*Gambetti, P. (2007). Prion Diseases. *The Merck Manuals Online Medical Library*. Available from www.merckmanuals.com/home/sec06/ch090/ch090a.html.
†Cisse, M., & Mucke, L. (2009). Alzheimer's Disease: A Prior Protein Connection. *Nature*, 457:1090-1091.

Pathogenic microorganisms must be destroyed or rendered harmless to remove this link from the chain. Disinfection and **sterilization** are methods used in the process of destroying all microorganisms, pathogens, or pathogenic products. Procedures for disinfection should be used in all areas where patients are receiving treatment.

The most effective means for destroying viruses and all other kinds of microorganisms is to expose them to a high temperature for a specified amount of time; the temperature should be at least 250° F (121° C) for 20 to 30 minutes if using a steam sterilizer, and at least 320° F (160° C) for 90 minutes to 3 hours if using dry sterilization. This can be accomplished by using a special machine called an autoclave.

The Centers for Disease Control and Prevention (CDC), a government agency (www.cdc.gov), provides a wealth of information on all aspects of infectious diseases, including their prevention and control.

RESERVOIR (LINK TWO)

Reservoirs are places where microorganisms are found. Reservoirs can be infected wounds, human or animal waste, animals and insects, **contaminated**

(made unclean) food and water, or a person with an infection. Standard Precautions are used to prevent the spread of infection from the reservoir. Good hand hygiene is one of the most effective ways to prevent the spread of microorganisms. Using **sterile** (without pathologic organisms) technique is another effective method; for example, it is used to insert an indwelling urinary catheter to help prevent the transfer of normal flora from the skin and mucous membranes into the sterile bladder, where it could cause an infection.

PORTAL OF EXIT (LINK THREE)

The portal of exit is the route by which a pathogen leaves the body of its host. An example of a portal of exit is the gastrointestinal tract, through which the feces may transport the typhoid bacillus from an infected person. The respiratory tract is a portal of exit when microorganisms, such as those causing measles, mumps, pulmonary tuberculosis, and influenza, are released with coughing or sneezing. The skin and mucous membranes can also serve as a portal of exit when an open or draining wound exists.

Portal-of-exit transmission can be interrupted by identifying and treating infected patients. Isolation techniques and barrier precautions that include the proper handling and disposal of secretions, urine and feces, and **exudate** can prevent pathogen transfer. CDC recommendations for Transmission-Based Precautions and isolation techniques are based on scientific evidence that has proven how various pathogens are transmitted. Chapter 17 outlines specific recommendations.

MODE OF TRANSFER (LINK FOUR)

Modes of transfer of pathogens include (1) direct personal contact with body excretions or drainage such as from an infected wound; (2) indirect contact with contaminated inanimate objects (called **fomites**), such as needles, drinking and eating utensils, dressings, and hospital equipment; (3) vectors such as fleas, ticks, mosquitoes, and other insects that harbor infectious agents and transmit infection to humans through bites and stings; (4) droplet infection, or contamination by the aerosol route through sneezing and coughing; and (5) spread of infection from one part of the body to another.

The mode of transmission can be interrupted by effective hand hygiene, proper disinfection and sterilization of medical equipment, use of **aseptic** (free of microorganisms) technique in performing procedures and diagnostic tests, and use of Standard Precautions to prevent contamination. Teach patients to cover the mouth when sneezing or coughing, to dispose of soiled tissues correctly, to wash hands after contact with potentially contaminated items, and to avoid people who have an infection to reduce transmission of pathogens.

Clinical Cues

Current CDC recommendations are to sneeze or cough into the bended elbow rather than covering the mouth with the hands. This way the spread of the respiratory droplets is prevented and hands are not contaminated.

Controlling insects with abatement programs, such as mosquito control, and filtering air in health care facilities are other methods of reducing pathogen transmission.

Think Critically

Hepatitis A is spread through the oral-fecal route. In what ways could hepatitis A virus be spread in a restaurant if one of the employees is the reservoir?

PORTAL OF ENTRY (LINK FIVE)

Pathogens can enter the body through the mucous membranes of the eyes, nose, mouth, trachea, or skin. Consuming food or water that is contaminated with disease-causing microorganisms is one example of how entrance can occur. Breathing in droplets containing pathogens and contracting a virus through broken skin or mucous membranes are other examples of portals of entry. Table 16-3 shows some of the pathogenic organisms that enter through various body portals.

Using only sterile and clean items when caring for patients reduces the entry of pathogens. Barrier precautions (gloves, masks, condoms), safe handling of food and water, good personal hygiene, avoidance of high-risk behaviors, and protection from insect bites and stings can prevent entry of microorganisms.

SUSCEPTIBLE HOST (LINK SIX)

A human **host** may be susceptible by virtue of age, state of health, or broken skin. Measures are used to prevent exposure to infectious agents and to improve a person's health by teaching good health and hygiene habits. Immunization to help protect against influenza or pneumococcal pneumonia is another means of decreasing susceptibility.

Clinical Cues

Influenza immunization is recommended yearly for all health care workers and anyone over 6 months of age.

Susceptible hosts can be protected by using aseptic techniques, barrier precautions, and protective isolation (see Chapter 17). Proper nutrition and a

Table 16-3 Portals of Entry for Selected Pathogenic Organisms

INFECTING ORGANISMS	RESULTANT DISEASES
Respiratory Tract	
Neisseria meningitides	Meningococcal pneumonia, meningococcal meningitis, meningococcemia
Cryptococcus neoformans	Cryptococcal meningitis, cryptococcal pneumonia
Mycobacterium tuberculosis	Tuberculosis
Influenza A virus	Influenza
Streptococcus pneumoniae	Pneumococcal pneumonia
Measles virus (rubeola)	Measles
Legionella pneumophila	Legionnaires disease
Varicella-zoster virus	Chickenpox
Gastrointestinal Tract	
Salmonella enteritidis	Gastroenteritis
Salmonella typhi	Typhoid fever
Clostridium botulinum	Botulism
Poliovirus	Poliomyelitis
Hepatitis A virus	Hepatitis A
Escherichia coli O157:H7	Possibly, hemolytic uremic syndrome
Genitourinary Tract	
Neisseria gonorrhoeae	Gonorrhea
Chlamydia trachomatis	Lymphogranuloma venereum, cervicitis, urethritis, endometritis
Enterobacteriaceae (*E. coli, Klebsiella* species, *Serratia* species, *Proteus* species)	Urinary tract infections
Intact Skin or Mucous Membranes	
Rhinovirus	Common cold
Respiratory syncytial virus	Pneumonia, bronchiolitis, tracheobronchitis
Schistosoma species	Schistosome dermatitis (swimmer's disease)
Herpes simplex virus	Oral or genital herpes
Bloodstream	
Hepatitis B or C viruses	Hepatitis B or C
Plasmodium species	Malaria
Clostridium tetani	Tetanus
Human immunodeficiency virus (HIV)	Acquired immunodeficiency syndrome (AIDS)

From Ignatavicius, D. D., & Workman, M. L. (2006). *Medical-Surgical Nursing: Patient-Centered Collaborative Care* (5th ed., p. 509). Philadelphia: Elsevier Saunders.

healthy lifestyle also increase resistance to infection. Table 16-4 lists factors that increase susceptibility to infection. Table 16-5 shows how the chain of infection can be broken at each link.

Susceptibility of the Elderly

Many factors can place the elderly person at higher risk of infection. Poor nutrition, inadequate hygiene, impaired mobility, chronic illness, and physiologic changes all increase the risk of disease (Table 16-6). Elderly people are hospitalized more frequently than younger people for problems caused by a chronic illness or for treatment after a fall. This places them at higher risk for a **health care–associated infection** (infection acquired by a patient after admission to a health care facility due to the transfer of microorganisms to the patient by contaminated hands or objects or infected people).

? Think Critically

Which organisms are you most frequently exposed to that could cause disease? How can you protect yourself against disease-causing microorganisms?

BODY DEFENSES AGAINST INFECTION

The body has many natural defenses against pathogen invasion. Intact skin serves as a **first line of defense** against harmful environmental agents. Skin functions as a protective barrier for the underlying tissues. Sebaceous glands excrete sweat, lactic acid, and fatty acids to limit microbial growth.

Secretions from the mucous membranes lining the respiratory, gastrointestinal, and reproductive tracts contain an abundance of the enzyme **lysozyme,** which is bactericidal. Lysozyme is also found in tears and

Table 16-4 Factors That Increase Susceptibility to Infection

FACTOR	CONSEQUENCE
Age	The elderly and the very young are more susceptible to infection, likely because of the declining or immature immune function, respectively.
Malnutrition	Poor nutrition interferes with cell growth and replacement, which contributes to decreased immune function.
Excessive stress or fatigue	These states seem to interfere with the body's normal defense mechanisms.
Low leukocyte (WBC) count	Fewer white blood cells (WBCs) are available to fight infection.
Altered defense mechanisms	Body damage from trauma disrupts the natural defense mechanism of the skin and mucous membranes, allowing entry to microorganisms.
Alcoholism	This has an inhibiting effect on the immune system.
Chronic illness	Chronic illness upsets the homeostatic balance within the body, impairing the normal defense mechanisms. Serious illness taxes the immune system, causing greater susceptibility to other pathogens.
Indwelling tubes, devices, or equipment	Fracture pins, Foley catheters, intravenous (IV) cannulas, feeding tubes, prosthetic heart valves, and hip prostheses all provide either a portal of entry or a place for colonization of microorganisms.
Immunosuppressive treatment, chemotherapy, or corticosteroid treatment	Immunosuppressive treatment or chemotherapy depresses the immune system or harms the bone marrow, decreasing the number of leukocytes and macrophages. Corticosteroids depress the inflammatory response, inhibiting one of the body's defense mechanisms.

Table 16-5 Breaking the Chain of Infection

LINK	WAYS TO BREAK THE CHAIN	INTERVENTIONS
Reservoir		
Infected patient	Prevent transfer of microorganisms	Proper hand hygiene; use of gloves; Standard Precautions; Transmission-Based Precautions
Portal of Exit		
Secretions Feces Blood Urine Sputum	Prevent contamination	Thorough hand hygiene; Standard and Transmission-Based Precautions; not recapping needles; handling sharps correctly; containing contaminated materials; disinfection; following medical aseptic practices
Mode of Transfer		
Hands Contaminated food Contaminated supplies and other objects	Prevent contamination Eliminate vectors	Standard and Transmission-Based Precautions; proper hand hygiene; sterilization, proper cleaning, and refrigeration of foods; disinfection; proper disposal; surgical asepsis; pest control
Entrance		
Mouth Break in skin Mucous membranes	Put only clean things in mouth Protect skin Protect mucous membranes	Keeping objects out of mouth; good hygiene practices; good skin care; thorough cleansing of skin before an invasive procedure; covering skin breaks with occlusive dressing; Standard Precautions: goggles, face shield or mask, gloves, gown
Host		
Susceptible person	Protect natural body defenses by: • Good nutrition • Good hygiene • Adequate sleep • Decreased stress	Assessing degree of risk of infection; promoting natural body defenses; protective isolation; Standard and Transmission-Based Precautions; proper hand hygiene

Table 16-6 Increased Susceptibility of the Elderly to Infection

The elderly are at higher risk of infection than the younger adult. Any elderly person with a chronic illness experiences increased stress on the body and a strain on the body's defense mechanisms from that disease; this makes the person more susceptible to other infections. The following factors also increase the risk of infection. You can institute certain interventions to try to decrease that risk.

AREA	FACTOR	NURSING INTERVENTION
Homeostasis	The elderly lose their homeostatic state more easily than younger adults as a result of loss of functioning cells in all body organs with aging.	Protect from exposure to pathogens. Promote good nutrition, exercise, and adequate rest to boost resistance to disease.
Immune function	Both immediate and delayed immune responses are decreased or altered.	Protect from exposure to pathogens. Immunize against influenza and pneumonia. Promote good nutrition to boost immune system.
Respiratory function	Impaired cough mechanism and impaired function of cilia decrease ability to expel foreign substances and mucus from the lungs, predisposing the person to respiratory tract infection.	Discourage smoking. Encourage deep breathing and intake of fluid to keep lung secretions thinned.
	Decreased macrophage activity in the lungs.	Encourage good oral hygiene to decrease potential for colonization of trachea and lungs with microorganisms.
	Less ability to expand the thorax predisposes elderly person to atelectasis after surgery.	Help postoperative patients maintain a semi-upright position (semi-Fowler) to aid lung expansion. Encourage use of incentive spirometer, deep breathing, and coughing. Ambulate as soon as possible.
Skin	Decreased elasticity, increased dryness, and decreased vascular supply make the skin susceptible to injury or breakdown and slower to repair. Breaks allow entry of microorganisms.	Instruct in appropriate skin care. Keep skin well moisturized. Prevent abrasions by using a lift sheet or a trapeze bar for positioning. Inspect skin at least once each shift for pressure areas.
Gastrointestinal system	Elderly person has decreased secretion of gastric acid resulting in decreased destruction in the stomach of microorganisms ingested in food and drink.	Promote good oral hygiene to prevent swallowing pathogenic microorganisms.
	Pancreatic enzyme secretion is decreased, causing less destruction of microorganisms in the gastrointestinal (GI) tract.	Instruct in proper preparation and storage of food to prevent GI infection.
Urinary tract	Prostatic hypertrophy, cystocele, rectocele, and degeneration of nerves to bladder cause urine stasis in bladder as a result of incomplete emptying. Stasis predisposes to urinary tract infection.	Encourage intake of sufficient fluid to keep urine dilute. Encourage intake of cranberry juice and other foods that keep urine acidic, which will discourage the growth of microorganisms.

saliva. Cilia, which line the respiratory tract, trap microorganisms and **debris** (dead tissue or foreign matter) and propel them up and out of the body with a wavelike action. The bones protect the more delicate and vital organs from outside trauma. The bone marrow produces defensive blood cells.

The intestinal system is a major portal of entry for pathogens, and the liver is an essential part of the body's defense system. The Kupffer cells in the liver destroy bacteria that enter the portal liver circulation. Only about 1% of bacteria that enter the portal circulation from the intestines pass through the liver into the general circulation. The liver also detoxifies harmful chemicals by isolating various substances and facilitating their breakdown and excretion from the body.

Gastric secretions such as hydrochloric acid destroy ingested pathogens. Evacuation of feces flushes bacteria from the intestine, and the formation and elimination of urine flush the urinary system.

The body's **second line of defense** helps destroy pathogens that escape the first line of defense. This includes the mechanisms of fever, leukocytosis, phagocytosis, inflammation, and the action of **interferon** (biologic response modifier that affects cellular growth).

The body automatically raises its temperature in response to infection. A fever can slow the growth of many pathogens until other body defenses can be mobilized.

Clinical Cues

Fever is a natural defense mechanism. Therefore a fever should not be treated right away unless it is dangerously high. In many instances it is not desirable to lower the body temperature to normal. Rest and increased fluids are the correct treatment for the first few days.

Leukocytes, which are WBCs, are released in response to microorganisms, particularly bacteria, entering the body. This increased production or release of leukocytes is termed **leukocytosis.** They travel through the capillary walls out into the tissues to engulf the invader. Located in the lymphatic tissue, the alveoli of the lungs, the gastrointestinal system, the spleen, and the liver, **phagocytes** work to destroy or stop their invasion. The macrophages assist in body defense by removing cellular debris, engulfing and destroying bacteria and viruses, and removing metabolic waste products. Some phagocytes are called **tissue macrophages;** others, which are concerned with immunity, are the **lymphocytic cells.**

Phagocytosis is part of the inflammatory response, another defense mechanism of the body. When infection and leukocytosis occur, the WBC count is elevated. A large increase in the percentage of monocytes often indicates a bacterial infection. If the neutrophil count is decreased on the differential WBC count, while the monocyte count and lymphocyte counts are elevated, the cause of infection is probably viral. Increase in the percentage of basophils may indicate parasitic infection.

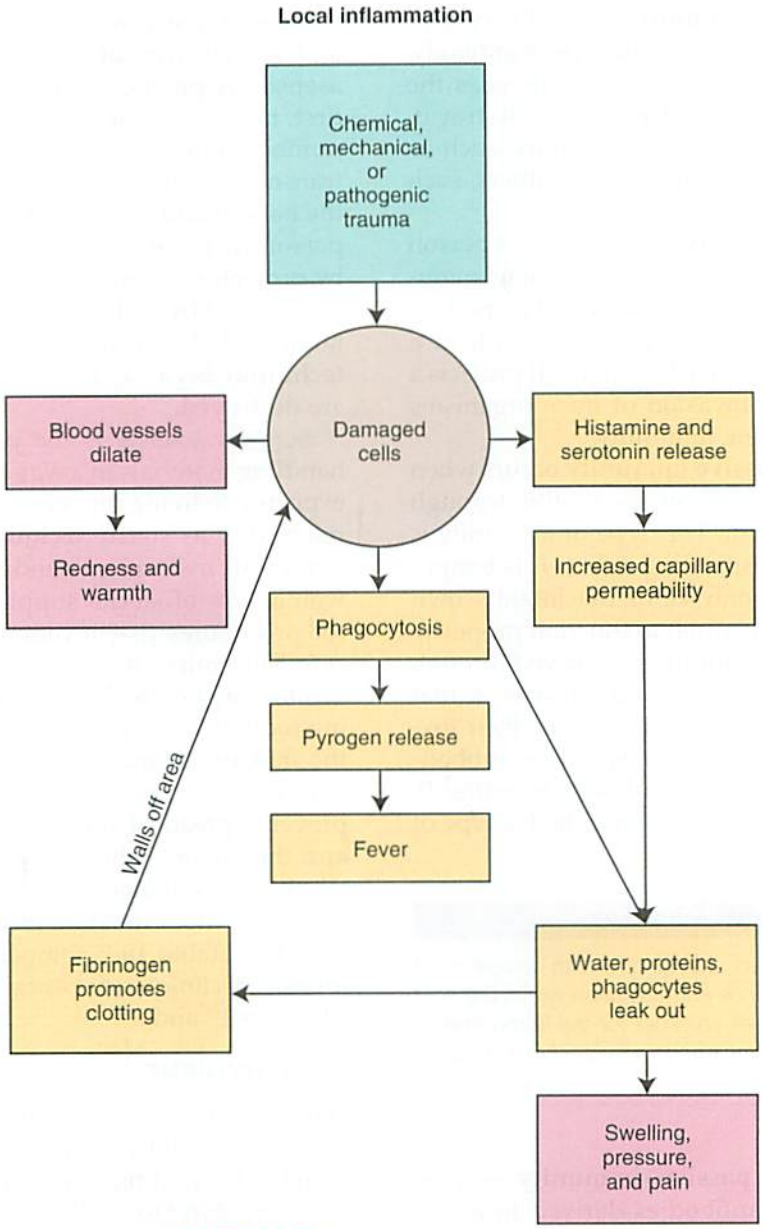
Interferons are produced in response to viral invasion of the cell. They stimulate antiviral proteins that prevent replication of viruses. Interferons can attack a wide variety of viruses, inhibiting or destroying them. Interferons stimulate the immune system, increase resistance to viral invasion, and interfere with viral replication.

INFLAMMATORY RESPONSE

The inflammatory response can be induced by any mechanical, chemical, or infectious disease–producing factor that injures cells of the body. Inflammation is an immediate response of the body to any kind of injury to its cells and tissues. The blood vessels dilate, bringing more blood to the damaged area, causing redness, warmth, and edema. **Inflammation is a localized protective response brought on by injury or destruction of tissues.** The basic purposes of the inflammatory response are to (1) neutralize and destroy harmful agents, (2) limit their spread to other tissues in the body, and (3) prepare the damaged tissues for repair. During inflammation the chemicals **histamine** and **serotonin** are released. These chemicals act on the walls of the capillaries, causing them to be more permeable so that water, proteins, and defensive cells can pass out of the blood and into the fluid surrounding the damaged cells. This leakage of fluid is responsible for localized swelling, which in turn causes increased pressure and pain. Fibrinogen promotes clotting, blocking the lymphatic vessels. This results in a walling off of the area that delays spread of bacteria, toxins, and other harmful agents to other parts of the body (Concept Map 16-1). Purulent drainage called **pus,** caused by the debris that sometimes results from the inflammation process, may accumulate at the site. Leukocytosis is then triggered and draws phagocytes to the damaged tissue to begin their work.

IMMUNE RESPONSE

The immune response is the **third line of defense** against pathogenic organisms. Microorganisms and other substances that do not belong in the body, such as pollen, are recognized as foreign invaders and trigger an **immune response** (the body's reaction to substances interpreted as nonself). For example, macrophages in the lungs engulf bacteria, dust particles, and any other foreign material that might threaten to damage the lung tissues. If the foreign particles are not expectorated, the leukocytes and later macrophages in the alveoli help wall them off, thereby preventing their spread to other tissues. An example of this process is the localizing of tubercle bacilli that have not been destroyed by the



CONCEPT MAP 16-1 The inflammatory response.

body's other defenses. *Mycobacterium tuberculosis* bacilli are walled off, preventing their dissemination to full-blown pulmonary tuberculosis.

The immune system response is specific to the type of invader. Unique antigens on the surface of individual cells aid the immune system in distinguishing *self* from *nonself* (invaders) so it can destroy foreign material **(antigens).** Once exposed to a microorganism, the body produces **antibodies** against that invader. In this way, **naturally acquired immunity** occurs. Every antigen stimulates formation of a specific type of antibody. The next time that same microorganism invades the body, the antibodies respond and attempt to destroy it. Some types of naturally acquired immunity, such as varicella (chickenpox), last a lifetime, but others, such as influenza, last only a short time.

Passive acquired immunity occurs when a person is given an antitoxin or antiserum that contains antibodies or antitoxins that have been developed in another person. Tetanus antitoxin is an example of a substance that provides passive immunity. It protects a person from the current invasion of microorganisms but does not provide lasting immunity.

Naturally acquired passive immunity occurs when the fetus receives antibodies from the mother through placental blood before birth. This type of immunity is also acquired by the breastfeeding infant. It is temporary and typically lasts only until the infant's own immune system matures enough to function properly.

Artificially acquired immunity is achieved through injection of vaccines or immunizing substances that contain dead or inactive microorganisms or their toxins. The vaccine prompts the body to produce antibodies. Vaccinations against polio, measles, hepatitis B, influenza, tetanus, and diphtheria provide this type of immunity.

Clinical Cues

All patients should be asked during a health assessment whether they have had a tetanus immunization within the past 10 years. If they have not, seek an order for the immunization as long as the patient is healthy enough to receive it. Tetanus can be deadly.

Artificially acquired passive immunity is provided by injection with antibodies derived from the infected blood of people or animals. Serum immune globulin is often used for this purpose and is given to people who have been exposed to hepatitis A virus or mumps and who have not been previously immunized. The injection provides antibodies that will protect the person for a short time while their own body begins to develop antibodies to protect against current and future exposure.

Think Critically

What alterations could you make in your lifestyle to make yourself less susceptible to infection?

ASEPSIS AND CONTROL OF MICROORGANISMS

MEDICAL ASEPSIS AND SURGICAL ASEPSIS

Asepsis is the practice of making the environment and objects free of microorganisms. Two types of asepsis are practiced within health care agencies. The first, **medical asepsis,** is the practice of reducing the number of organisms present or reducing the risk for transmission of organisms. It prevents reinfection of the patient and the spread of infection from person to person. It involves cleanliness and is accomplished by protecting items in the environment from contamination and by disinfecting items that have been contaminated. Medical asepsis is referred to as **clean technique** because most, but not all, microorganisms are destroyed.

Surgical asepsis is the practice of preparing and handling materials in a way that prevents the patient's exposure to living microorganisms. Surgical asepsis is referred to as **sterile technique.** It involves sterilization of all instruments and inanimate equipment, as well as use of sterile supplies and sterile technique, for procedures that invade the body and for wound care. Most microorganisms are destroyed. Timed hand scrubs may be used by people working in the operating room to reduce the number of microorganisms on the skin, or a hand rub with an alcohol-based product may be used instead. Barrier garments are used to prevent spread of microorganisms between the staff and the patient. The air in the operating room is filtered and exchanged at least 15 times an hour. The operating room must be thoroughly disinfected after each use. Table 16-7 compares medical and surgical asepsis. Techniques for surgical asepsis are covered in Chapters 17 and 37.

HAND HYGIENE

Hand hygiene is one of the most effective ways to reduce the number of microorganisms on the hands, thereby preventing the transfer of microorganisms from one object to another or from person to person by the nurse. Any person may harbor microorganisms that are harmless to that person but may be potentially harmful to another person if they gain a portal of entry.

Gloves should be used to prevent contact with any blood or body fluids. **Health care workers must perform hand hygiene before and after giving care to a patient.** In 2002 the CDC concluded from research that alcohol hand rubs can be more effective than

Table 16-7 Comparison of Medical Asepsis and Surgical Asepsis

FACTOR	MEDICAL ASEPSIS	SURGICAL ASEPSIS
Patient	Has infection, lowered resistance to other infections	Potential host; lowered resistance makes more susceptible
Reservoir of infection	Patient	Other people and the environment
Objective of barriers	Confine organisms to the patient's room, unit, or locale	Prevent organisms from reaching patient, staff, or surrounding area
Equipment and supplies	Disinfect, sterilize, or dispose of after contact with patient; use only clean materials, supplies, or devices	Disinfect or sterilize before contact with patient; use sterile materials
Nurse's protective attire: gown, mask, gloves	Use clean attire to protect worker from organisms; discard after contact with patient	Use sterile attire to protect patient; remedy if contaminated
Goal of nursing action	Confine organisms and prevent spread of infection to others. (Medical asepsis reduces the number of microorganisms or contains them to reduce risk of transmission.)	Reduce number of organisms and prevent spread of infection to patient. (Surgical asepsis keeps an area or objects free of all microorganisms for a period of time.)

FIGURE 16-4 Nurse using an alcohol hand rub to cleanse the hands of microorganisms.

handwashing in ridding the hands of microorganisms (CDC, 2002). Many hospitals and health care agencies provide alcohol hand rubs for personnel to use when hands **are not visibly contaminated** (Figure 16-4). Box 16-2 provides an overview of the current CDC hand hygiene guidelines.

When hands are visibly soiled, the CDC recommends wetting the hands; adding soap; performing at least 15 seconds of vigorous rubbing (friction) to aid in spreading the soap over the hands, fingers, and wrists; rinsing the hands under warm running water; and drying the hands thoroughly. Skill 16-1 provides the steps for correct hand hygiene. For a surgical scrub the hands are washed with soap and water first and then scrubbed with a Food and Drug Administration (FDA)–approved antimicrobial scrub agent or alcohol-based antiseptic hand rub agent. The procedure for surgical hand antisepsis is presented in Chapter 17.

Do not wear jewelry when you are providing patient care because microorganisms become lodged in the settings of stones, in the grooves of rings, and on the skin beneath the jewelry. The only exceptions are a plain wedding band and a watch with an expandable band that allows it to be pushed up above the wrist area for hand hygiene. Fingernails should be kept clean and short (no more than ¼ inch past the fingertips), both for patient safety and for easier cleaning. Polish, if allowed, should not be chipped because it can harbor bacteria. No artificial nails, extenders, silk nail wraps or tips, gels, or nail jewelry should be worn. Proper hand care includes prevention of hangnails and skin abrasions, which provide a point of entry for bacteria.

Health Promotion

Basics of Hand Hygiene

Perform hand hygiene before eating and after using the bathroom, bedpan, or commode. Wash hands thoroughly after handling raw meat. Most supermarkets provide sanitizing wipes to clean the grocery cart handle before using it. Perform hand hygiene after handling money.

Text continued on p. 224

Box 16-2 Overview of the Current CDC Hand Hygiene Guidelines

The Centers for Disease Control and Prevention (CDC) recommendations for hand hygiene in health care settings should be followed by all health care agencies and workers. *Hand hygiene* is a term that applies to either handwashing with soap and water, use of an antiseptic alcohol-based hand rub, or surgical hand antisepsis (water and antiseptic agent). Evidence suggests that hand antisepsis—the cleansing of hands with an antiseptic hand rub—is more effective in reducing health care–associated infections than washing the hands with soap and water.

FOLLOW THESE GUIDELINES IN THE CARE OF *ALL* PATIENTS

- Continue to cleanse hands with either a non-antimicrobial soap and water or an antimicrobial soap and water (see Skill 16-1) whenever the hands are visibly soiled.
- Use an alcohol-based hand rub to routinely decontaminate the hands in the following clinical situations: (NOTE: If alcohol-based hand rubs are not available, the alternative is hand hygiene with soap and water.)
  - Before and after direct patient contact
  - After contact with a patient's intact skin (e.g., when taking a pulse or blood pressure or lifting and moving a patient)
  - Before donning sterile gloves when assisting in the insertion of central intravascular catheters
  - Before performing invasive procedures (e.g., urinary catheter insertion, nasotracheal suctioning) that do not require surgical asepsis
  - After contact with blood, body fluids, excretions or other potentially infectious materials, mucous membranes, nonintact skin, and wound dressings
  - If hands will be moving from a contaminated body site to a clean body site during patient care
  - After contact with inanimate objects (including medical equipment) in the immediate vicinity of the patient
  - After removing gloves
- Before and after eating and after using a restroom, wash hands with a health care facility–approved alcohol-based hand rub or soap and water.
- Antimicrobial-impregnated wipes (i.e., towelettes) are not a substitute for using an alcohol-based hand rub or antimicrobial soap.
- If contact with spores (e.g., *Clostridium difficile, Candida albicans,* or *Bacillus anthracis*) is likely to have occurred, wash hands with soap and water. The physical action of washing and rinsing hands is recommended because alcohols, chlorhexidine products, iodophors, and other antiseptic agents have poor activity against spores.
- Do not wear artificial fingernails, extensions, tips, wraps, gels, or nail jewelry if you provide direct contact with patients.

METHOD FOR DECONTAMINATING HANDS

When using an alcohol-based hand rub, apply product to palm of one hand and rub hands together, covering all surfaces of hands and fingers, until hands are dry. Follow the manufacturer's recommendations regarding the volume of product to use. Note how many applications of the product are permitted before handwashing with soap and water must be performed. Most products state no more than five applications before washing the hands with soap and water.

GUIDELINES FOR SURGICAL HAND ANTISEPSIS

- Surgical hand antisepsis reduces the resident microbial count on the hands to a minimum. See Skill 17-1 for the surgical hand scrub procedure.
- The CDC recommends using an antimicrobial soap and scrubbing hands and forearms up to the elbows for the length of time recommended by the manufacturer, usually 2 to 5 minutes. Refer to agency policy for time required.
- When using an alcohol-based surgical hand scrub product with persistent antimicrobial activity, follow the manufacturer's instructions. Before applying the alcohol solution, prewash hands and forearms with a non-antimicrobial soap, clean under the nails, and rinse and dry hands and forearms completely. After application of the alcohol-based product as recommended, allow hands and forearms to dry thoroughly before donning sterile gloves.

GENERAL RECOMMENDATIONS FOR HAND HYGIENE

- Use health care facility–approved hand lotions or creams to prevent irritant contact dermatitis associated with hand antisepsis or hand hygiene.
- Do not wear artificial fingernails or extenders when having direct contact with patients at high risk (e.g., those in intensive care units or operating rooms).
- Keep natural nails; tips less than ¼-inch long.
- Wear gloves when contact with blood, body fluids, other potentially infectious materials, mucous membranes, or nonintact skin could occur.
- Remove gloves after caring for a patient (see Steps 16-1). Do not wear the same pair of gloves for the care of more than one patient, and do not wash gloves between uses with different patients.

Modified from Siegel, J. (2007). *Guideline for Isolation Precautions: Preventing Transmission of Infectious Agents in Healthcare Settings.* Atlanta: Centers for Disease Control and Prevention.

Skill 16-1 Hand Hygiene

Perform hand hygiene at the beginning of the shift, before and after caring for each patient, before performing procedures, after toileting, before and after eating, before entering special care areas, and whenever the hands have become visibly soiled. Before beginning the shift, wash the hands vigorously for at least 15 seconds (30 seconds or longer if in specialty care areas), or according to agency policy. Thereafter, perform hand hygiene either by washing with soap and water or by use of a facility approved alcohol-based hand rub product. The Centers for Disease Control and Prevention (CDC) recommend that no artificial nails, extenders, gels, silk nail wraps, tips, or nail jewelry be worn and that natural nails should be kept no longer than ¼ inch past the fingertips.

Supplies

- Sink with warm running water
- Facility-approved liquid soap
- Disposable paper towels
- Trash can
- Facility-approved hand lotion
- Approved alcohol-based hand rub agent

Review and carry out the Standard Steps in Appendix D.

ACTION *(RATIONALE)*

Hand Hygiene with Soap and Water

Assessment (Data Collection)

1. Determine correct liquid soap agent to be used and length of time needed for handwashing according to task that was completed or degree of hand soiling that has occurred. *(The longer the washing with the approved agent, the more microorganisms are removed.)*

Planning

2. Check that soap and towels are nearby before beginning. *(Saves time.)*
3. Activate the towel dispenser so that towels are ready to tear off when needed before beginning. Push wristwatch and long sleeves (if present) up the arm. *(Activating the towel dispenser prevents contamination of clean, wet hands by the dispenser after washing. Two to four towels are necessary. Pushing the wristwatch and sleeves up the arm protects the watch and clothing from becoming soiled or wet.)*

Implementation

4. Turn on water and adjust to a comfortable temperature with medium water force. Keep body away from sink. *(Warm, continuously running water aids in the removal of microorganisms. Using medium water force to avoid splashing and not leaning against the sink help ensure your clothes are not contaminated.)*
5. Wet your hands with water, pointing your fingers toward the bottom of the sink. *(Water drains from the wrists to the fingertips, carrying organisms away.)*

Step **5** Wetting the hands.

6. Apply a small amount of liquid soap (2 to 4 mL). *(Using liquid soap rather than a soap bar helps prevent transfer of microorganisms.)*
7. Wash your hands:
   a. Use 10 circular strokes for the palms while applying friction. *(Friction helps work up a lather and loosens or removes microorganisms.)*
   b. Wash the back of each hand with 10 circular motions. *(Vigorous rubbing removes organisms. Ten strokes should dislodge the organisms.)*
   c. Wash the fingers with 10 circular motions; rub the palms together, slide the back of one hand up the palm of the other while encircling the fingers with the opposite hand, and circle the thumb of opposite hand; run the hand over the back of other hand and around the wrist, alternating hands; and interlace the fingers of one hand with those of the other, and with friction rub back and forth 10 times to clean the spaces between the fingers. Repeat as needed for the full length of the scrub. *(All surfaces of the fingers, hands, and wrists are washed.)*

Continued

Skill 16-1 Hand Hygiene—cont'd

Step **7** Scrubbing the hands.

8. Begin rinsing at the wrists, then hands, and fingertips, keeping the fingers pointed downward. Avoid touching any part of the sink or faucet. *(Pointing hands and fingers toward the sink moves debris downward rather than upward onto cleaner areas. Touching the sink would contaminate the newly washed area of the hand or fingers.)*

Step **8** Rinsing the hands.

9. Remove towels from the dispenser, and dry the hands and wrists thoroughly, beginning at the fingertips, working up the hand to the wrist. Pat hands and wrists dry rather than rub. *(Dry gently but thoroughly to prevent chapping of the skin. Use a clean towel for each combined wrist and hand.)*

Step **9** Drying the hands.

10. With a dry paper towel, being careful not to touch the handles with the bare hand, turn off the water if hand controls are present. Discard towel in trash receptacle. *(Using a clean towel prevents recontamination of freshly washed hands.)*

Step **10** Turning off the water.

11. Apply hand lotion if subject to chapping. *(Lubricates skin and keeps it soft; prevents cracking of the skin.)*

Evaluation

12. Check to see that hands are clean and dry and have been washed the proper length of time. Assess for breaks in the skin. *(Ensures hands are clean. Breaks in the skin provide a point of entry for microorganisms.)*

Skill 16-1 Hand Hygiene—cont'd

Documentation

None required. *(Hand hygiene does not ordinarily need to be documented.)*

Special Considerations

- Visibly soiled hands must be washed with soap and water.
- Wait until lotion has been absorbed before donning latex gloves to avoid increasing the risk of developing latex allergy.
- For surgical asepsis scrubs, hold hands upward throughout the scrub and the rinse. Sinks are used that accommodate this position. When possible, rinse hands with fingertips higher than the wrist.
- When working in a patient's home, a clean hand towel may be used in place of paper towels if no paper towels are available.
- Home care nurses should carry a container of liquid soap and alcohol-based hand rub in their bag.
- Caregivers and family members who have contact with the patient should be taught proper hand hygiene technique.
- If the rim or perimeter around the sink is wet, use a folded dry towel to dry it without contaminating your hands.
- If fingernails are dirty, clean with nail of other hand or with an orange stick.

Hand Hygiene with Approved Alcohol-Based Hand Rub Agent

If hands are not visibly soiled, then the use of an alcohol-based hand rub is appropriate.

1. Dispense the required amount of hand rub into the palm of one hand. Using both hands, disperse the product over the entire surface of the hands and fingers to the wrists. *(Follow the manufacturer's written instructions regarding amount of hand rub to use and the number of times it may be used before handwashing with soap and water is required. Different products require different amounts to be used for hand hygiene. Often after four or more uses of the hand rub, hands should be washed with soap and water. Product must make contact with all parts of the skin to eliminate microorganisms.)*
2. Continue to rub hands together over all surfaces of the wrists, hands, and fingers until all are completely dry. *(Contact with the skin until dry assists with elimination of microorganisms.)*

Step 2 Using hand rub for hand hygiene.

Special Considerations

- When working with a patient who has *Clostridium difficile* or yeast infections, wash your hands with soap and water rather than using a hand rub product. Hand rub products do not kill tuberculosis spore–forming microorganisms.
- When working with a patient who has diarrhea, wash hands with soap and water because the diarrhea may be caused by *C. difficile*, which is not eliminated by alcohol-based hand rub products.

Critical Thinking Questions

1. When assigned to care for two patients, how long would you wash your hands when you have left the room of a patient with diarrhea before entering the room of a patient undergoing chemotherapy for metastatic cancer?
2. If you just used an alcohol-based hand cleanser and you enter the room of a patient to perform a physical assessment and the patient states, "I didn't see you wash your hands," what would you do?

STANDARD PRECAUTIONS

Infectious disease can be controlled by interrupting the chain of infection at any link, thus breaking the transmission cycle. The CDC has developed **Standard Precautions** to facilitate breaking the chain of infection. **These precautions protect both the nurse and the patient and are to be used for every patient contact; they include the use of hand hygiene and personal protective equipment (PPE)** (Box 16-3). PPE includes gloves, gowns, masks, protective eyewear, shoe covering, and hair covering.

Box 16-3 CDC Standard Precaution Guidelines

Use Standard Precautions, or the equivalent, for the care of all patients. *Category IB*

A. HAND HYGIENE

(1) Wash hands after touching blood, body fluids, secretions, excretions, and contaminated items, whether or not gloves are worn. Perform hand hygiene immediately after gloves are removed, between patient contacts, and when otherwise indicated to avoid transfer of microorganisms to other patients or the surrounding environment. It may be necessary to wash hands between tasks and procedures on the same patient to prevent cross-contamination of different body sites. *Category IB*

(2) Use a plain (non-antimicrobial) soap for routine hand hygiene. *Category IB*

(3) Use an antimicrobial agent or a waterless antiseptic agent for specific circumstances (e.g., control of outbreaks or hyperendemic infections), as defined by the infection prevention and control program. *Category IB*

B. GLOVES

Wear gloves (clean, nonsterile gloves are adequate) when touching blood, body fluids, secretions, excretions, and contaminated items. Put on clean gloves just before touching mucous membranes and nonintact skin. Change gloves between tasks and procedures on the same patient after contact with material that may contain a high concentration of microorganisms. Remove gloves promptly after use, before touching noncontaminated items and environmental surfaces, and before going to another patient, and wash hands immediately to avoid transfer [of] microorganisms to other patients or environments. *Category IB*

C. MASK, EYE PROTECTION, FACE SHIELD

Wear a mask and eye protection or a face shield to protect mucous membranes of the eyes, nose, and mouth during procedures and patient-care activities that are likely to generate splashes or sprays of blood, body fluids, secretions, and excretions. *Category IB*

D. GOWN

Wear a gown (a clean, nonsterile gown is adequate) to protect skin and to prevent soiling of clothing during procedures and patient-care activities that are likely to generate splashes or sprays of blood, body fluids, secretions, or excretions. Select a gown that is appropriate for the activity and amount of fluid likely to be encountered. Remove a soiled gown as promptly as possible, and wash hands to avoid transfer of microorganisms to other patients or environments. *Category IB*

E. PATIENT-CARE EQUIPMENT

Handle used patient-care equipment soiled with blood, body fluids, secretions, and excretions in a manner that prevents skin and mucous membrane exposures, contamination of clothing, and transfer of microorganisms to other patients and environments. Ensure that reusable equipment is not used for the care of another patient until it has been cleaned and reprocessed appropriately. Ensure that single-use items are discarded properly. *Category IB*

F. ENVIRONMENTAL CONTROL

Ensure that the health care facility has adequate procedures for the routine care, cleaning, and disinfection of environmental surfaces, beds, bed rails, bedside equipment, and other frequently touched surfaces, and ensure that these procedures are being followed. *Category IB*

G. LINEN

Handle, transport, and process used linen soiled with blood, body fluids, secretions, and excretions in a manner that prevents skin and mucous membrane exposures and contamination of clothing, and that avoids transfer of microorganisms to other patients and environments. *Category IB*

H. OCCUPATIONAL HEALTH AND BLOOD-BORNE PATHOGENS

(1) Take care to prevent injuries when using needles, scalpels, and other sharp instruments or devices; when handling sharp instruments during and after procedures; when cleaning used instruments; and when disposing of used needles and other sharp devices. Never recap used needles, or otherwise manipulate them using both hands, or use any other technique that involves directing the point of a needle toward any part of the body; rather, use either a one-handed "scoop" technique or a mechanical device designed for holding the needle sheath. Do not remove used needles from disposable syringes by hand, and do not bend, break, or otherwise manipulate used needles by hand. Place used disposable syringes and needles, scalpel blades, and other sharp items in appropriate puncture-resistant containers, which are located as close as practical to the area in which the items were used, and place reusable syringes, needles, and other sharp devices in a puncture-resistant container for transport to the reprocessing area. *Category IB*

(2) Use mouthpieces, resuscitation bags, or other ventilation devices as an alternative to mouth-to-mouth resuscitation methods in areas where the need for pulmonary resuscitation is predictable. *Category IB*

I. PATIENT PLACEMENT

Place a patient who contaminates the environment or who does not (or cannot be expected to) assist in maintaining appropriate hygiene or environmental control in a private room. If a private room is not available, consult with infection preventionist regarding patient placement or other alternatives. *Category IB*

From Siegel, J. (2007). *Guideline for Isolation Precautions: Preventing Transmission of Infectious Agents in Healthcare Settings*. WB7HK91 Atlanta: Centers for Disease Control and Prevention.

Gown

Wear a clean barrier gown that is impermeable to water and other fluids when there is a chance of being splashed with blood, body fluid, or other potentially infectious materials, or when these fluids may be aerosolized. Remove the gown after use, being careful not to contaminate the skin or clothing. Skill 16-2 on p. 226 explains how to put on and take off a barrier gown.

Mask

Apply a regular surgical face mask before entering the room if there is a chance that you will be in contact with airborne pathogens larger than 5 microns (e.g., influenza or meningitis) or splashed body fluids, such as when a patient is coughing or you are performing suctioning. Place the mask over the nose and mouth and secure it in place by an elastic band or ties (Figure 16-5). Wear an N95 respirator mask when entering an area where airborne microorganisms less than 5 microns in size (e.g., *Mycobacterium tuberculosis* [TB]) are known to be present. N95 respirator masks must be approved by the National Institute for Occupational Safety and Health (NIOSH). They prevent passage of 95% of particulate matter. There are several styles of both regular and respirator masks. When removing masks, handle only the elastic band or ties, and discard in a regular waste receptacle; do not leave them hanging around the neck or in a pocket. **Change the mask any time it becomes moist.**

Protective Eyewear

Wear protective eyewear to prevent fluid from entering the eye area and coming in contact with the mucosa or surface of the eye through splattering or aerosolization. Eyewear may be in the form of goggles, a face shield, or glasses with side and top pieces. Protective eyewear may be disposable or durable. If durable, the eyewear should be disinfected after each use. Wear eyewear for performing oral, nasotracheal, or endotracheal suctioning (unless a closed system is used); for performing wound irrigations; and for performing or assisting with procedures in which blood or other body fluids might splatter (e.g., the insertion of a central venous line).

Head Cover

Place a cap or head cover on the head if there is danger of contamination of the hair or if microorganisms resident in the hair might endanger the patient. After use, remove the cap by slipping the fingers beneath the elastic and handling only the inner surface of the head cover to prevent hand contamination. A head cover is also required in select locations such as the operating room because skin can shed into the operative site. This applies even to those who are baldheaded.

Shoe Covers

Cover skin around the ankles by appropriate protective covers whenever there is a chance of splashing body fluids during a procedure. **Shoes are covered so that pathogens are not carried out of the room; the covers are removed when exiting the room in the same manner as the head cover.** Many facilities no longer require staff to wear these; however, staff are encouraged to wear them in places like the delivery room or in the emergency department when dealing with trauma patients.

Gloves

Wear disposable gloves for Standard Precautions when there is a chance of contact with blood or body fluids, mucous membranes, nonintact skin, or secretions or excretions. Also use gloves for handling items contaminated with these substances. Put on gloves after the other pieces of PPE have been donned. When a gown is worn, pull gloves up over the cuffs of the gown. Gloves reduce the possibility of transmission of

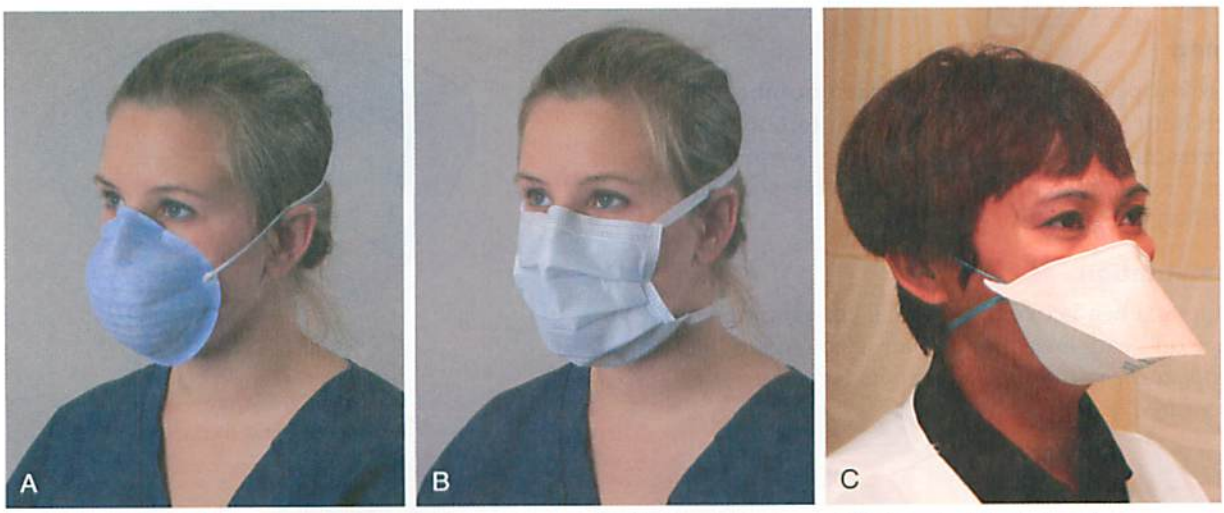


FIGURE 16-5 A, Preformed mask. B, Accordion mask with ties. C, One type of N-95 (particulate filter) mask.

Skill 16-2 Using Personal Protective Equipment (PPE): Gown, Mask, Gloves, Eyewear

An isolation or barrier gown is most often an impermeable paper gown with long sleeves and cuffs, although a treated fabric gown may be provided. Use a gown whenever your clothing might be contaminated with body substances or airborne microorganisms from a patient who is undergoing isolation precautions. A mask is required when a patient is infected with an organism that can be transmitted by droplet or airborne particles. A mask is also necessary when entering a protective isolation unit to act as a barrier between you and the patient. It is helpful to speak to patients from the doorway and let the patients see your face before donning the mask. Use protective eyewear anytime there is a possibility of being splashed by blood, body fluids, or other potentially infectious materials. Carefully remove all PPE items after use to prevent transfer of microorganisms onto clothing or the environment.

Supplies

- Head cover
- Mask
- Eyewear
- Isolation gown
- Shoe covers
- Gloves

Review and carry out the Standard Steps in Appendix D.

ACTION *(RATIONALE)*

Assessment (Data Collection)

1. Determine PPE equipment necessary and assess cart or anteroom for available supplies. *(Ensures that items needed are present. [Assume that a gown, mask, gloves, and eyewear are needed.])*

Planning

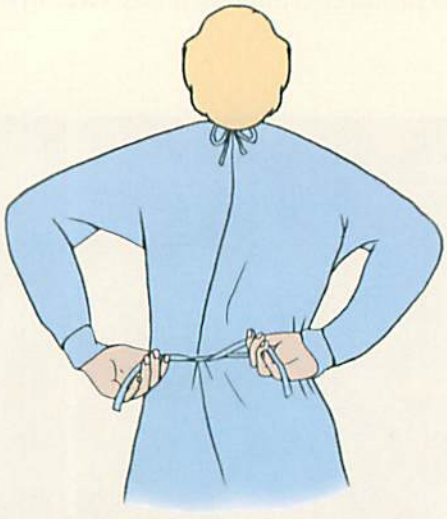
2. Check supplies to see that sufficient numbers of each item are on the cart or in the anteroom for the entire shift. *(Prevents you from having to run to the supply room for an item when you or others are trying to deliver care.)*

Implementation

3. Remove a head cover or surgical cap from the box. Place on head, ensuring all hair is covered. *(To minimize the risk of hair falling onto patient during a procedure.)*
4. Remove a gown from the supply on the cart or in the anteroom of the isolation unit. Hold it by the neck area and allow it to unfold with the opening in the back toward you. *(Allows entry into the gown. A clean gown is used every time the patient's room is entered.)*

Step **4** Donning a nonsterile gown.

5. Slip arms into the sleeves and tie the ties at the back of the neck and the waist. *(The tied gown prevents contaminants from coming in contact with your clothing.)*



Step **5** Tying the gown.

Skill 16-2 Using Personal Protective Equipment (PPE): Gown, Mask, Gloves, Eyewear—cont'd

6. Remove a mask from the cart or anteroom and place the mask with the metal band on the outside at the nose. Cover both the mouth and the nose. Secure the mask to the head with the elastic band, or tie the ties above the ears first. Adjust so that the bottom of the mask covers the mouth and chin, then tie it around the neck. *(A mask protects against airborne infection. The mask should fit close to the face without gaps. Accordion-type masks should cover the nose, mouth, and chin. Pinching the metal band so the mask conforms to the shape of your nose helps keep it from slipping. When a special respirator mask is needed, use only an N95 or higher respirator variety. These types of masks require specialized fit testing so that a tight seal is obtained and maintained each time the mask is worn. Regardless of the type, a mask must be replaced if it becomes moist.)*

Step **6** Putting on a mask.

7. Wear shoe covers and head cover if there is danger of contamination of the shoes and/or hair or for protective isolation. *(Disposable shoe covers and head cover protect the shoes and hair from contamination and from carrying microorganisms out of the isolation room.)*
8. Put on protective eyewear if such is not attached to the mask. *(Eyewear that has a full face shield that curves around the face, or top and side pieces to protect the eye area, keeps droplets and splashes from entering the mucosa of the eye.)*

Step **8** Putting on eyewear.

9. Don gloves last. *(Glove cuffs are pulled up over the gown cuffs. This prevents any gap of unprotected skin at the wrists.)*

Removing PPE

10. Remove the gloves without contaminating your hands (see Figure 16-6 and Steps 16-1). *(If the skin of the hand touches the contaminated surface of the glove, microorganisms can be transferred.)*
11. Remove the protective eyewear without touching your face, and place disposable face covering in the trash. Place reusable eyewear in an impervious container so it can be disinfected. *(Careful handling of the contaminated eyewear prevents transfer of microorganisms.)*
12. If used, remove head cover carefully. *(To prevent possibility of contaminating self or environment.)*
13. Unfasten the waist tie on the gown, then the neck ties. Place your hands inside the neckline, and pull the gown down off the shoulders and over your upper arms. Slip your hands up inside each sleeve. Pull out your arms and hands and place the gown's outside surfaces together so it is turned inside out. Handle only the inside of the gown. Discard it in the proper receptacle. *(Prevents further contamination of the hands and clothing. Reduces transfer of microorganisms.)*
14. Remove the face mask by untying the lower strings first, then the upper ones; or remove it by the elastic band. Discard the used mask in the proper receptacle. *(Reduces transfer of microorganisms. A used face mask should never be allowed to dangle around the neck when not in use.)*
15. Perform hand hygiene. *(Removes microorganisms.)*

Continued

Skill 16-2 Using Personal Protective Equipment (PPE): Gown, Mask, Gloves, Eyewear—cont'd

Evaluation

16. Ask yourself if the PPE was effective. Would you do anything differently the next time? *(Evaluates technique of garbing in PPE.)*

Documentation

17. Document use of PPE for patients in isolation. *(Verifies that correct protective procedure was used.)*

Documentation Example

10/12 2012 Wound irrigated with 10 mL NS; site clean, no s/s of infection or drainage noted; gown, mask, goggles, and gloves worn throughout procedure.

_____
(Nurse's signature)

Critical Thinking Questions

1. What articles of PPE should you wear if you enter the room of a patient who has undergone bone marrow transplantation after full-body irradiation that severely depletes immune function?
2. What items of PPE do you need to put on when you are going to irrigate an infected wound?

Steps 16-1 Removing Gloves

Use nonsterile gloves for Standard Precautions and most isolation procedures. After use, remove the contaminated gloves in a manner that prevents the spread of microorganisms.

ACTION *(RATIONALE)*

1. Grasp the cuff of the glove of one hand and slide the glove off the hand, folding the outside of the contaminated glove to the inside. *(Care must be taken not to touch the skin of the wrist or hand with the contaminated gloved hand, or microorganisms may be transferred.)*
2. Hold the glove removed in the palm of the other gloved hand, and slip the ungloved hand under the band of the second glove. Roll the glove off, turning it inside out over the first glove. *(Being careful not to touch the contaminated glove with the bare hand reduces transfer of microorganisms.)*
3. Touching only the inside surface of the rolled-up gloves, drop them in the trash. *(Rolling the contaminated gloves together with only the uncontaminated inner surface exposed helps prevent the transfer of microorganisms. Disposing of gloves properly helps reduce the spread of infection.)*

microorganisms between the nurse and the patient. **Perform hand hygiene before gloving and immediately after removing the gloves because no glove is 100% protective.** Gloves are contaminated once they are used and must be discarded before doing the next task or caring for the next patient. Steps 16-1 show how to properly remove contaminated gloves (Figure 16-6). Immediately place the gloves in a trash receptacle, and perform hand hygiene. **Never reuse or wash gloves.**

Latex Allergy. Because of the greater exposure through glove use, more people have developed sensitivity or allergy to latex. Exposure may cause redness, local inflammation, pruritus of the hands, and anaphylaxis. People who have had multiple surgical procedures; who have food allergies to bananas, kiwis, or avocados; or who have a history of reactions to other latex-containing products are at risk for developing this allergy. If a health care worker has a latex allergy, by law the employer must supply an alternative type of glove at no cost to the employee. Measures to help prevent latex sensitivity include using gloves in appropriate situations and not for routine tasks in which a blood, body fluid, or microorganism contact exposure is unlikely. Gloves are removed directly over a trash receptacle without "snapping" them off. Do not use petroleum-based lotions under latex gloves because they attract latex proteins from the

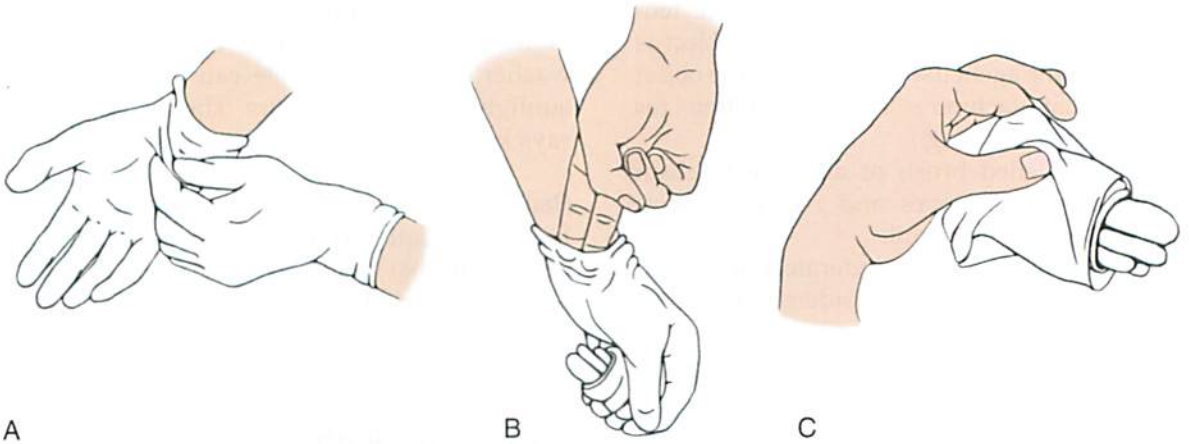


FIGURE 16-6 **A,** Removal of the right glove. **B,** Removal of the left glove. **C,** Method of holding the removed gloves.

FIGURE 16-7 Deposit a used syringe and needle in a sharps container.

gloves, which can increase the risk of developing the allergy.

Disposal of Sharps

Disposable sharp instruments, referred to as "sharps," are placed directly into a special puncture-resistant sharps biohazard container immediately after use (Figure 16-7). Place all needles, intravenous (IV) cannulas, and items that are sharp or might cause a skin break in the sharps container. Replace sharps containers when they are two-thirds full.

Contaminated Waste

Dispose of items contaminated with infectious material in sealed, impermeable plastic bags marked "Hazardous Waste" or "Biohazard." This includes soiled dressings, used sanitary pads, suction drainage containers, and any other item that has been in contact with body fluids. An easy way to determine whether an item goes into a biowaste container is if anything on or in the item can be squeezed, slung, flung, or flicked off. Handle contaminated linens in a like manner unless all linen in the facility is treated as a contaminated biohazard. Gather soiled linens carefully and bag at the site of use.

Clinical Cues

Keep used linens away from your uniform. Do not put them on the floor or chair because microorganisms from the patient can be spread this way. Place them directly into the linen hamper.

Safety Alert

Disposing of Sharps

Drop used syringes and other sharps into the container designated for sharps disposal, and then activate the lever that drops the sharp into the container. Never allow your fingers to enter the container. Never recap needles that have been used on a patient.

CLEANING AND DISINFECTION

Pathogens can be killed or inactivated by disinfection, sterilization, or the use of sanitizing agents. Eliminating the reservoir is a good way to prevent transmission. Water, sewage treatment, and rodent control eliminate reservoirs for pathogens.

Appropriate cleaning removes and inhibits the growth of microorganisms. Always wear gloves when cleaning visibly soiled objects or performing wound care. Whether in the hospital, a long-term care facility, or a home setting, follow these steps to clean objects:

1. Rinse the object with cold water to remove organic material. Hot water coagulates the proteins contained in organic material, making them more adherent to the item being cleaned.
2. Once all visible organic material has been removed, wash the object in hot, soapy water.

Soap's emulsifying action reduces surface tension and helps remove soil. (How the object is washed and the agent used depends on the object and the manufacturer's recommendation for cleansing and sanitizing.)
3. Use a stiff-bristled brush or abrasive to clean equipment with grooves and narrow spaces. Friction helps dislodge soil.
4. Rinse the object well with moderately hot water.
5. Dry the object; it is now considered clean, but not sterile.

Always disinfect the cleaning equipment and the sink when you have finished cleaning soiled objects.

Disinfectant agents can be used to eliminate some types of organisms that are left after cleansing. **Disinfectants** are solutions containing chemical compounds such as phenol, alcohol, or chlorine that kill or inactivate nearly all microorganisms. These chemicals can be caustic to the skin and are used only on inanimate objects. A recommended disinfectant is chlorine bleach and water at a ratio of 1:10. Before disinfection, items must be thoroughly rinsed after cleaning because soap residue may react with the disinfectant, preventing its killing properties from working. An **antiseptic** is a chemical compound that is used on skin or tissue to inhibit the growth of or to eliminate microorganisms. Disinfectants and antiseptics have bactericidal or bacteriostatic properties. A **bactericidal** solution destroys bacteria; a **bacteriostatic** solution prevents the growth and reproduction of some bacteria. Povidone-iodine is an example of an antiseptic. Items that cannot be sterilized, such as skin, can be disinfected with antiseptic agents.

Wounds are cleansed using sterile normal saline or an antiseptic solution. Often a bacteriostatic cream or ointment is applied before the wound is dressed (Nursing Care Plan 16-1). (Also see the Evolve website for Nursing Care Plan E16-1: Care of the Patient with a Foot Wound.)

Sterilization

Sterilization is the best method of eliminating microorganisms from equipment and supplies. There are five methods of sterilization: steam under pressure (moist heat), dry heat, ethylene oxide, liquid chemicals, and hydrogen peroxide gas plasma.

Moist heat is most often used by applying steam under pressure in a device called an **autoclave.** Steam sterilization has four parameters: steam, pressure, temperature, and time. Since it is being applied under pressure, temperatures are higher than the boiling point. Under pressure, steam reaches temperatures of 250° to 270° F (121° to 132° C).

Ethylene oxide gas is effective against microorganisms and spores. It is used for heat-sensitive items and where good penetration is essential.

For cleansing items in the home, boiling in water is the easiest method. Items should be boiled for a minimum of 15 minutes. Items that cannot be boiled or disinfected by running them through the dishwasher's "sanitize" cycle can be exposed to direct sunlight for several hours. The heat and ultraviolet rays kill many exposed microorganisms.

Radiation. Ultraviolet light can be used for disinfection. Ionizing radiation is used to sterilize drugs, foods, and other items that would be damaged by heat. Irradiation is now being used on select fruits, vegetables, and meats as a way to ensure a safer food supply in the United States.

SEPSIS IN THE HOME ENVIRONMENT

Precautions are not as stringent in the home as in the hospital because the ordinary home does not contain the many pathogens found in a hospital environment. The number and degree of home precautions are based on whether there is an infected or immunocompromised person in residence and what microorganism is involved. Secure contaminated dressings and other disposable supplies in plastic zip-closure bags before disposal. Place linens contaminated with blood or body secretions in a sealed plastic bag until laundered. Rinse them in cold water as soon as possible, and then wash in hot, soapy water.

A 1:10 solution of chlorine bleach and water can be used to disinfect counters and bathrooms if they become soiled with body secretions. Running the dishwasher on the "sanitize" cycle or rinsing eating utensils with boiling water will reduce microorganisms.

Frequent "damp" dusting and vacuuming decrease the number of microorganisms in the environment. Exposing bedding and other items the patient uses that cannot be disinfected to 6 to 8 hours of sunshine may reduce the number of microorganisms on them. Tissues containing an infected patient's expectorated sputum or nasal secretions should be disposed of in a sealable plastic bag.

Forceps, scissors, and other small implements used for dressing changes can be washed with hot water and detergent, and then soaked in a bleach solution. They should be rinsed with hot water, drained, allowed to air dry, and then stored in a covered container. Drainage bags can be cleansed, disinfected, dried, and reused.

INFECTION CONTROL SURVEILLANCE

In most health care agencies an infection prevention and control practitioner, known as an infection preventionist (IP), is responsible for ensuring that infection prevention and control measures are followed. When a patient is known to have an infection, the information is typically reported to the IP. This person works with the health care staff to ensure they understand which

Nursing Care Plan 16-1 Care of the Patient with Abrasions and Splenectomy

SCENARIO Terry Jackson, age 32, was admitted to the emergency department after a motorcycle accident in which he skidded and was thrown into a telephone pole. He has many abrasions on his legs and forehead and underwent a splenectomy for a ruptured spleen.

***PROBLEM*/NURSING DIAGNOSIS** *Incision*/Impaired skin integrity related to surgical incision and multiple abrasions.
Supporting Assessment Data: ***Subjective:*** "These scrapes sting." ***Objective:*** Abdominal surgical incision covered with a dressing; abrasions on both legs and on forehead.

Goals/Expected Outcomes	Nursing Interventions	Selected Rationale	Evaluation
Surgical incision will heal within 2 wk without signs of infection. Abrasions will heal within 2 wk without signs of infection.	Change dressing as ordered using sterile technique.	Sterile technique will decrease likelihood of microorganisms entering the wound.	*Are incision and abrasions healing without signs of infection?* Yes, although the forehead abrasion is draining serous fluid.
	Inspect for signs of infection every shift.	Monitoring temperature, pulse, and WBCs and inspecting wounds for redness, drainage, warmth, and pain help detect infection.	Temperature 99.0° F (37.2° C), pulse 78, WBCs 10,090. Incision clean and dry; abrasions beginning to scab. *Wound care performed?* Yes, ointment and fresh dressing applied daily.
	Cleanse wound site with prescribed method, then apply antiseptic ointment to abrasions.	Cleansing and then applying antiseptic ointment will decrease microorganisms at wound site.	
	Apply fresh dressing at least daily.	Dressing will prevent further microorganisms from entering the wound.	

***PROBLEM*/NURSING DIAGNOSIS** *Surgical incisions*/Risk for infection related to abdominal surgery, splenectomy, and abrasions.
Supporting Assessment Data: ***Objective:*** Spleen was removed after it was lacerated in motorcycle accident. Several abrasions sustained in accident.

Goals/Expected Outcomes	Nursing Interventions	Selected Rationale	Evaluation
Patient will not contract tetanus from introduction of microorganisms from road surface.	Administer 0.5 mL tetanus toxoid IM.	Tetanus toxoid vaccine increases antibody production to tetanus bacillus.	*Tetanus toxoid given?* Yes.
	Monitor for malaise or fever.		
Patient will not contract health care–associated infection before discharge.	Discourage visitors who have an active infection.	Patients without a spleen are more susceptible to infection.	*Any signs of infection?* No.
	Maintain strict aseptic technique when handling IV lines and Foley catheter and when performing wound care.	Aseptic technique reduces the introduction of microorganisms to the patient.	*Aseptic technique maintained?* Yes. IV site clean, dry, and without redness. Foley catheter draining clear urine without foul odor.
	Perform appropriate hand hygiene before touching patient, tubes, or dressings and on completion of any procedure.	Hand hygiene significantly reduces the spread of microorganisms to the patient and surrounding environment.	Hand hygiene performed rigorously.
	Assess for signs of surgical wound infection: chills, redness, swelling, increased pain in area, foul odor from wound, elevated WBC count, purulent drainage.	Serious infection may be averted if early signs of infection are noted.	*Any sign of surgical wound infection?* No; incision clean and dry without redness, swelling, or increased pain. WBC count 10,090. Continue plan.

Critical Thinking Questions

1. What causes tetanus? Why is it a particular concern for Terry with this type of injury?
2. What other complications could occur if the surgical wound becomes infected?
3. Why are people who have lost their spleen more susceptible to infection?

Key: *IM*, Intramuscular; *IV*, intravenous; *WBC*, white blood cell.

patient care and environmental cleaning measures are to be used. The IP also assesses the facility for spread of infection. All hospital patients are at risk for health care–associated infection, and each nurse must be vigilant in watching for signs of infection in each patient under his care.

Patients at high risk for infection are those who (1) are weakened by injury or severe illness; (2) have another chronic illness; (3) have a central venous catheter, IV cannula, indwelling drainage tube, or endotracheal tube for mechanical ventilation; (4) are very young or very old; (5) have an open wound; (6) have a surgical incision; or (7) have a compromised immune system from chemotherapy or immunosuppression. Whenever an infection is suspected, take additional precautions to prevent the possible spread of microorganisms, which if left untreated could lead to sepsis or even death.

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Key Points

- Microorganisms are abundant in our environment, and many can cause infection if not controlled.
- Pathogens include bacteria, viruses, protozoa, rickettsia, fungi, prions, and helminths.
- The most effective way to destroy many kinds of microorganisms is to expose them to moist heat at a high temperature for 15 to 20 minutes.
- Standard Precautions are used for all patients to prevent the spread of microorganisms.
- The spread of infection is prevented by breaking any one of the six links of the infection chain (see Figure 16-3).
- The elderly are typically more susceptible to infection due to the effects of natural aging on the body (see Table 16-6).
- Body defenses against infection are intact skin, the inflammatory process, and the immune response.
- The purposes of the inflammatory process are to neutralize and destroy harmful agents, limit their spread, and prepare damaged tissue for repair.
- There are five types of immunity: naturally acquired, passive acquired, naturally acquired passive, artificially acquired, and artificially acquired passive.
- Medical asepsis, or clean technique, reduces the number of microorganisms present and decreases the risk of transmission of microorganisms from one person to another.
- Surgical asepsis, or sterile technique, is a method of preparing and handling materials or equipment in such a way that microorganisms cannot be transferred from them to a person.
- Asepsis is not as stringent in the home environment as in a health care agency, but patients and families must be taught infection prevention and control techniques.
- Hand hygiene is the most effective way to prevent the transfer of microorganisms and is performed before and after caring for each patient.
- PPE is used to carry out Standard Precautions and includes items such as head cover, gowns, masks, protective eyewear, gloves, and sometimes shoe covers.
- Infection prevention and control are the responsibility of all health care workers.
- Pathogens can be killed or inactivated by disinfection, by sterilization, or by the use of antimicrobial agents.
- There are five methods of sterilization: steam/moist heat, dry heat/hot air, ethylene oxide, low-temperature gas plasma, and radiation.

Additional Learning Resources

SG Go to your Study Guide for additional learning activities to help you master this chapter content.

Evolve Go to your Evolve website (http://evolve.elsevier.com/deWit/fundamental) for the following FREE learning resources:

- Animations
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Review Questions for the NCLEX® Examination

*Choose the **best** answer for each question.*

1. The most common method of microorganism transfer from one person to another in a hospital is prevented by:
   1. disinfecting instruments in special solutions.
   2. filtering the air in the hospital.
   3. changing bed linens daily.
   4. performing hand hygiene thoroughly and frequently.

2. The skin is the first line of defense and protects the body by: *(Select all that apply.)*
   1. repelling microorganisms.
   2. providing an intact physical barrier.
   3. secreting bactericidal substances.
   4. releasing macrophages.
   5. shedding dead cells.

3. The reason for performing hand hygiene for 15 to 30 seconds when hands are contaminated is to:
   1. render the skin totally free of microorganisms.
   2. mechanically remove as many microorganisms as possible.
   3. increase the circulation in the hands.
   4. provide a thicker layer of soap foam.