

Chapter 16

Infection Prevention and Control: Protective Mechanisms and Asepsis

Lesson 16.1

Infection Overview

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 the factors that make older adults more susceptible to infection
- 4) Explain how body's protective mechanisms work to prevent infection
- 5) Explain how the inflammatory and immune responses protect the body

Infection

- Infection: entry into the body of an infectious agent (a microorganism) that then multiplies and causes tissue damage
- Pathogens: microorganisms capable of causing disease
- Some microorganisms produce toxins and others release endotoxins
- Infection may result in illness and disease

Infectious Agents

- Bacteria
- Prions
- Viruses
- Protozoa
- Rickettsias
- Fungi
- Helminths
- Others—mycoplasmas, Chlamydia

Bacteria

(Slide 1 of 4)

- Single-celled microorganisms lacking a nucleus
- Reproduce every few minutes up to several weeks
- Classified according to need for oxygen, shape, and gram staining

Bacteria

(Slide 2 of 4)

- Need for oxygen
 - Aerobic: need oxygen to grow and thrive
 - Anaerobic: can grow only without oxygen
- Gram staining
 - Gram-positive bacteria retain the stain
 - Gram-negative bacteria take up counterstain
- Shape
 - Cocci: round
 - Bacilli: rod-shaped
 - Spirochetes: spiral- or corkscrew-shaped

Bacteria

(Slide 3 of 4)

- Identified by chemical testing and growing cultures
- Sensitivity testing determines which antibiotic can kill the organism
- Some are drug-resistant

Bacteria

(Slide 4 of 4)

- Multidrug-resistant organisms
 - Methicillin-resistant *Staphylococcus aureus* (MRSA)
 - Vancomycin-resistant Enterococcus (VRE)
 - Extended-spectrum beta-lactamase–producing (ESBL) gonorrhea GNR (*Neisseria gonorrhoeae*)
 - *Clostridium difficile* (C. diff)
 - Penicillin-resistant *Streptococcus pneumoniae*

Prions

- Protein particles that lack nucleic acids and are not inactivated by usual procedures for destroying viruses
- Do not trigger an immune response
- Cause degenerative neurologic disease, such as variant Creutzfeldt-Jakob disease (mad cow disease)

Protozoa

- One-celled microscopic organisms belonging to the animal kingdom
- Examples of pathogenic protozoa
 - Plasmodium species: causes malaria
 - *Entamoeba histolytica*: causes amebic dysentery
 - Other strains capable of causing diarrhea

Viruses

- Extremely small; seen only with an electron microscope
- Composed of particles of nucleic acids, either DNA or RNA, with a protein coat
- Grow and replicate only within a living cell; survival and replication depend on host tissue

Rickettsia

- Small round or rod-shaped organisms
- Transmitted by the bites of fleas, lice, mites, and ticks
- Can multiply only in host cells
- Causes Rocky Mountain spotted fever and typhus

Fungi

- Tiny primitive organisms of the plant kingdom that contain no chlorophyll
- Include yeast and mold
- Feed off living animals and decaying organic matter
- Reproduce by use of spores
- Cause candidiasis and tinea pedis (athlete's foot)

Helminths

- Parasitic worms or flukes
- Belong to the animal kingdom
- Pinworms, which mostly affect children, most common helminths worldwide
- Roundworms and tapeworms are other helminths

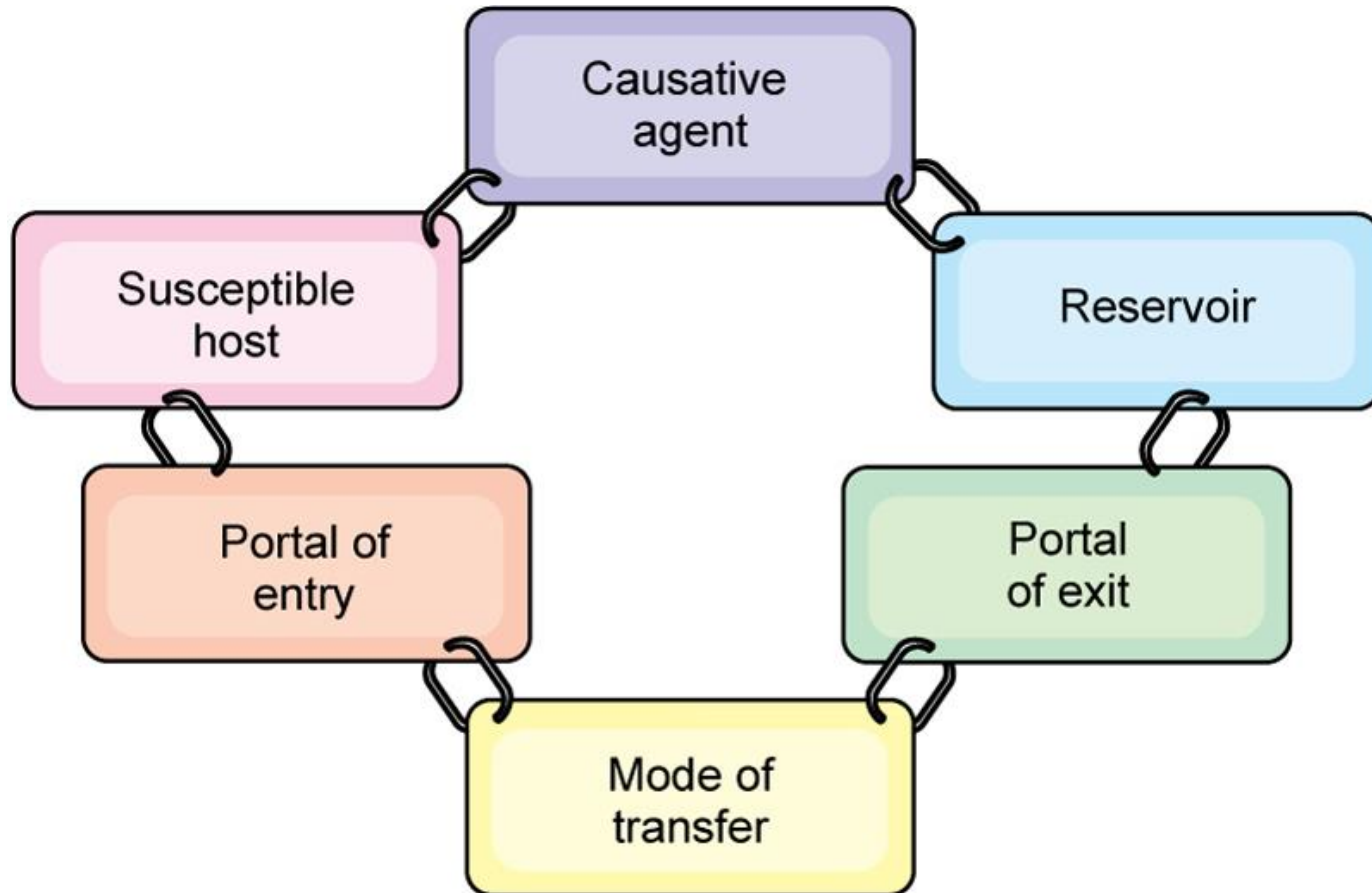
Other Infectious Agents

- Mycoplasmas
 - Very small organisms without a cell wall
 - Cause infections of respiratory or genital tract
 - Example: *Mycoplasma pneumoniae*
- Chlamydia
 - Affects the genitourinary and reproductive tracts
 - Increasingly more common in the past 20 years

Process (Chain) of Infection

- An infectious disease is spread from one person to another; a continuous chain
- Chain links
 - Causative agent (link 1)
 - Reservoir
 - Portal of exit
 - Mode of transfer
 - Portal of entry
 - Susceptible host

The Infection Chain



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Causative Agent (Link 1)

- Any microorganism or biologic agent capable of causing disease
- Bacteria, viruses, protozoa, rickettsias, fungi, helminths
- Virulence of the agent is affected by its ability to:
 - Adhere to mucosal surfaces or skin
 - Penetrate mucous membranes
 - Multiply once in the body
 - Secrete harmful enzymes or toxins
 - Resist phagocytosis

Reservoir (Link Two)

- Places where microorganisms are found
 - Infected wounds, human or animal waste, animals and insects, contaminated food and water, and the person with an infection
- Precautions to prevent the spread of infection
 - Good hand hygiene
 - Sterile technique

Portal of Exit (Link Three)

- Route by which pathogen leaves its host
 - Gastrointestinal tract
 - Feces may transport the typhoid bacillus from an infected person
 - Respiratory tract
 - Microorganisms are released with coughing or sneezing
 - Measles, mumps, pulmonary tuberculosis can be transmitted by exit from the respiratory tract
 - Skin and mucous membranes
 - Open wound

Modes of Transfer (Link Four)

- Direct personal contact with body excreta or drainage from an ulcer, infected wound, boil, or chancre
- Indirect contact with contaminated inanimate objects, such as needles, eating utensils, and dressings
- Vectors, such as mosquitoes, that harbor infectious agents and transmit through bites and stings
- Droplet infection, or contamination by the aerosol route through sneezing and coughing
- Spread of infection from one body part to another

Portal of Entry (Link Five)

- Enter the body through eyes, mouth, nose, trachea, skin, mucous membranes
- To prevent entry of microorganisms:
 - Use only sterile and clean items in patient care
 - Use barrier precautions (gloves, masks, condoms)
 - Safely handle food and water
 - Use good personal hygiene
 - Avoid high-risk behaviors
 - Use protection from insect bites and stings

Susceptible Host (Link Six)

- A human host may be susceptible by virtue of:
 - Age
 - State of health
 - Broken skin
- Susceptibility can be decreased by:
 - Teaching good health and hygiene habits
 - Immunizations

Susceptibility of the Older Adult

- Factors placing the older adult at risk for infection
 - Poor nutrition
 - Immobility
 - Poor hygiene
 - Chronic illness
 - Physiologic changes such as thinner skin

Body Defenses Against Infection

- Intact skin is the first line of defense against infection
 - Secretions (lysozyme) from mucous membranes lining the respiratory, gastrointestinal, and reproductive tracts
 - Cilia in the respiratory tract
 - Kupffer cells in the liver
 - Gastric secretions

Second Line of Defense

- Fever: slows growth of many pathogens until other defenses can be mobilized
- Leukocytosis
 - Leukocytes engulf the invader
- Phagocytosis
 - Phagocytes remove cellular debris, destroy bacteria and viruses, remove metabolic waste products
- Inflammation
- Interferon
 - Stimulates antiviral proteins

Inflammatory Response

- Localized protective response brought on by injury or destruction of tissue
- Blood vessels dilate, bring more blood to area, causing redness, warmth, edema
- Purposes
 - Neutralize and destroy harmful agents
 - Limit their spread to other tissues in the body
 - Prepare the damaged tissues for repair

Immune Response

- Passive acquired immunity: giving antitoxin or antiserum containing antibodies or antitoxins
- Naturally acquired passive immunity: fetus receives antibodies from the mother
- Artificially acquired immunity: immunizations
- Passive artificially acquired immunity: injecting antibodies derived from serum of infected people or animals

Lesson 16.2

Protective Mechanisms and Asepsis

(Slide 1 of 2)

Theory

- 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

Lesson 16.2

Protective Mechanisms and Asepsis

(Slide 2 of 2)

Clinical Practice

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

Asepsis and Control of Microorganisms (Slide 1 of 2)

- Asepsis: making the environment and objects free of microorganisms
- Medical asepsis: reducing number of organisms or reducing the risk of transmission of organisms
 - Prevents the spread of infection from person to person or reinfection of the same person
 - Involves cleanliness and protecting items from contamination and disinfecting contaminated items

Asepsis and Control of Microorganisms (Slide 2 of 2)

- Surgical asepsis: preparing and handling instruments and materials in a way that prevents the patient's exposure to living microorganisms
 - Involves sterilization of all surgical instruments used in surgery and of supplies used to invade the body such as catheters or needles

Hand Hygiene

- One of the most effective ways to reduce number of microorganisms on the hands
- Gloves should be used to prevent contact with any body fluids
- Health care workers must perform hand hygiene before and after giving care to a patient

Standard Precautions

- Hand hygiene
- Gloves
- Mask, eye protection, face shield
- Gown
- Patient care equipment
- Environmental control
- Linens
- Occupational health and blood-borne pathogens
- Patient placement

Gown

- Clean barrier gown that is impermeable to fluid
- Must be impermeable to water
- Removed after use, being careful not to contaminate the skin or clothing

Mask

- Applied before entering a room if chance of contact with an airborne pathogen or splashed body fluids
- Placed over the nose and mouth and secured by an elastic band or ties
- N95 respirator mask worn when entering area where pulmonary tuberculosis or other dangerous airborne microorganisms are present

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
- May be goggles, a face shield, or glasses with side and top pieces

Head Cover

- Worn if danger of contamination of the hair or if microorganisms resident in the hair might endanger the patient
- Remove carefully

Shoe Covers

- Shoes are covered so that pathogens are not carried out of the room
- Covers are removed when exiting the room

Gloves

- Used for Standard Precautions
- Worn when there is a chance that there will be contact with blood or body fluids, mucous membranes, nonintact skin, or secretions
- Reduce the possibility of transmission of microorganisms from the nurse to the patient

Latex Allergy

- May cause redness, local inflammation, and pruritus of the hands, and anaphylaxis
- Prevention
 - Use gloves appropriately, not for routine tasks
 - Removed directly over a trash receptacle without “snapping” them off
 - Do not use petroleum-based lotions under latex gloves

Disposal of Sharps

- Placed directly into a special red puncture-resistant sharps biohazard container immediately after use
- All needles, IV cannulas, and items that might cause a skin break are placed in the sharps container

Contaminated Waste

- Must be disposed of in sealed, impermeable plastic bags marked “Hazardous Waste” or “Biohazard”
- Includes soiled dressings, used sanitary pads, suction drainage containers, and any other item that has been in contact with body fluids

Cleaning

- Pathogens can be killed or inactivated by disinfection, sterilization, or sanitizing agents
- Clean and remove debris in cold water
- Wash and scrub in hot water; use a stiff-bristled brush
- Rinse with hot water; dry

Disinfection

- Eliminates some organisms after cleaning
- Uses compounds such as phenol, alcohol, or chlorine
- Recommended disinfectant: 1 part chlorine bleach to 10 parts water
- Uses bacteriostatic or bactericidal agents

Sterilization

- Best method for eliminating microorganisms
- Five methods of sterilization
 - Steam/moist heat
 - Dry heat/hot air
 - Ethylene oxide
 - Low-temperature gas plasma
 - Radiation

Sepsis in the Home Environment

- A 1:10 solution of chlorine bleach and water can be used on counters and bathrooms
- Run the dishwasher on the “sanitize” cycle
- Frequent “damp” dusting and vacuuming reduces microorganisms
- Forceps, scissors, and other instruments can be washed with hot water and detergent, then soaked in bleach solution

Infection Control Surveillance

- Infection control practitioner
 - Responsible for ensuring infection prevention and control measures are followed
 - Works with the health care staff to ensure they understand which patient care and environmental cleaning measures are to be used
 - Assesses for spread of infection

Question 1

Which person is at highest risk for developing a hospital-acquired (nosocomial) infection?

- 1) A visitor
- 2) An employee
- 3) An 80-year-old cancer patient
- 4) A 6-year-old getting ready for discharge from the hospital

Question 2

The most effective way to destroy all types of microorganisms is to:

- 1) expose them to moist heat at a high temperature for 16 to 20 minutes.
- 2) expose them to dry heat at a high temperature for 5 minutes.
- 3) wash them thoroughly for 5 minutes.
- 4) wash them thoroughly for 15 minutes under warm soapy water.

Question 3

An LPN is going in for her annual review. She is told to stop by employee health to get a hepatitis B shot. This is providing the employee with what type of immunity?

- 1) Naturally acquired immunity
- 2) Passive acquired immunity
- 3) Naturally acquired passive immunity
- 4) Artificially acquired immunity

Question 4

Brenda is a student nurse observing and assisting in the operating room. In order to maintain surgical asepsis, she must include all of the following *except*:

- 1) perform a 5-minute hand scrub before entering the operating room.
- 2) use sterile protective garb such as gown, mask, and gloves.
- 3) sterilize all instruments and inanimate objects used in surgery.
- 4) maintain clean technique while in the operating room.

Question 5

Sherry is working as a home health nurse. She is teaching her patient and family about asepsis in the home environment. All of the following are true *except*:

- 1) precautions in the home environment are important.
- 2) handwashing can be modified and is not as important as in the hospital.
- 3) syringes are placed in a clean milk jug with bleach and water.
- 4) frequent dusting and vacuuming are necessary to decrease the number of microorganisms.