The Control of Microbial Growth

- Sepsis refers to microbial contamination.
- Asepsis is the absence of significant contamination.
- Aseptic surgery techniques prevent microbial contamination of wounds.

Terminology

- Sterilization: Removal of all microbial life
- Commercial sterilization: Killing *C. botulinum* endospores
- Disinfection: Removal of pathogens
- Antisepsis: Removal of pathogens from living tissue
- Degerming: Removal of microbes from a limited area
- Sanitization: Lower microbial counts on eating utensils
- Biocide/Germicide: Kills microbes
- Bacteriostasis: Inhibiting, not killing, microbes

- Bacterial populations die at a constant logarithmic rate

Effectiveness of Antimicrobial Treatment

- Depends on:
  - Number of microbes
  - Environment (organic matter, temperature, biofilms)
  - Time of exposure
  - Microbial characteristics

Actions of Microbial Control Agents

- Alternation of membrane permeability
- Damage to proteins
- Damage to nucleic acids

Heat

- Moist heat denatures proteins
- Autoclave: Steam under pressure

Physical Methods of Microbial Control

- Pasteurization reduces spoilage organisms and pathogens
- Equivalent treatments
  - 63°C for 30 min
  - High temperature, short time: 72°C for 15 sec
  - Ultra high temperature: 140°C for <1 sec
  - Thermoduric organisms survive

- Dry heat sterilization kills by oxidation
  - Flaming
  - Incineration
  - Hot-air sterilization

	Hot-air	Autoclave
Equivalent treatments	170˚C, 2 hr	121˚C, 15 min

- Filtration removes microbes
- Low temperature inhibits microbial growth
    - Refrigeration
    - Deep freezing
    - Lyophilization
- High pressure denatures proteins
- Desiccation prevents metabolism
- Osmotic pressure causes plasmolysis

- Radiation damages DNA
    - Ionizing radiation (X rays, gamma rays, electron beams)
    - Nonionizing radiation (UV)
    - (Microwaves kill by heat; not especially antimicrobial)

Chemical Methods of Microbial Control

- Principles of effective disinfection
    - Concentration of disinfectant
    - Organic matter
    - pH
    - Time

- Evaluating a disinfectant
    - Disk-diffusion method

Types of Disinfectants

- Phenol
- Phenolics: Lysol
- Bisphenols: Hexacholorphene, Triclosan
    - Disrupt plasma membranes

- Biguanides: Chlorhexidine
    - Disrupt plasma membranes

- Halogens: Iodine, chlorine
    - Oxidizing agents
    - Bleach is hypochlorous acid (HOCl)

- Alcohols: Ethanol, isopropanol
    - Denature proteins, dissolve lipids

- Heavy metals: Ag, Hg, and Cu
    - Oligodynamic action (toxic effect of metal-ions on living cells)
    - Denature proteins

- Surface-active agents or surfactants

Soap	Degerming
Acid-anionic detergents	Sanitizing
Quaternary ammonium compounds Cationic detergents	Bactericidal, Denature proteins, disrupt plasma membrane

- Quaternary ammonium compounds/cationic detergents - bacteriocidal, fungicidal, amoebicidal, virucidal (enveloped)
    - denature proteins, disrupt plasma membrane
    - ex. Zephiran (benzalkonium chloride; Cepacol (cetylpyridinium chloride)

- Chemical food preservatives
    - Organic acids
        - Inhibit metabolism
        - Sorbic acid, benzoic acid, and calcium propionate
        - Control molds and bacteria in foods and cosmetics
    - Nitrite prevents endospore germination
    - Antibiotics. Nisin and natamycin prevent spoilage of cheese

- Aldehydes
    - Inactivate proteins by cross-linking with functional groups (-NH_2, -OH, -COOH, -SH)
    - Glutaraldehyde, formaldehyde, and orthophthalaldehyde

- Gaseous sterilants
    - Denature proteins
    - Ethylene oxide

- Peroxygens
    - Oxidizing agents
    - O_3, H_2O_2, peracetic acid

Microbial Characteristics and Microbial Control

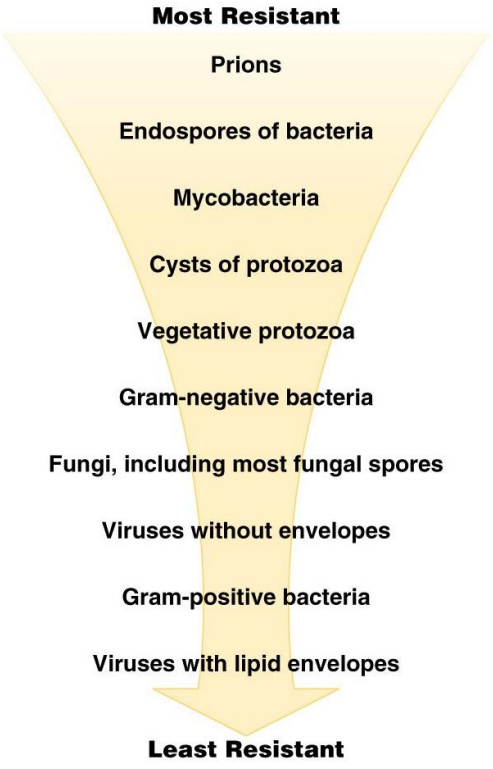

TABLE 7.7 The Effectiveness of Chemical Antimicrobials Against Endospores and Mycobaceria

Chemical Agent	Endospores	Mycobacteria
Mercury	No activity	No activity
Phenolics	Poor	Good
Bisphenols	No activity	No activity
Quaternary ammonium compounds	No activity	No activity
Chlorines	Fair	Fair
Iodine	Poor	Good
Alcohols	Poor	Good
Glutaraldehyde	Fair	Good
Chlorhexidine	No activity	Fair

Study Objectives

1. Define: sepsis, asepsis, antisepsis, sterilization, disinfection, degerming, sanitization, germicide, bacteriostasis.

2. Describe the factors influencing the effectiveness of antimicrobial agents.

3. Describe how the physical agents: heat, radiation, filtration, mechanical scrubbing, refrigeration, and osmotic pressure act to control the growth of microorganisms.

4. Describe how the chemical agents: ethylene oxide, aldehydes, the phenolics, quats, chlorine, iodine, alcohols, and heavy metals act to control the growth of microorganisms.