PRINCIPLES OF DISEASE AND EPIDEMIOLOGY

1. Normal Microbiota and Infectious Disease

A. Etiology

B. Pathology

C. Infection

D. Disease

E. Normal microbiota (normal flora)

2. Normal and Opportunistic Microorganisms

A. Commensalism vs. parasitism

B. Normal flora vs. opportunistic microorganisms

Opportunistic organisms ordinarily do not cause disease in their normal habitat in a healthy person. AIDS is often accompanied by opportunistic infection. Example is Pneumocystis jiroveci (Pneumocystis carinii).

3. Etiology of infectious disease

A. Koch's postulates

1. The same disease organism must be present in every case of the disease.

2. The pathogen must be isolated from the diseased host and grown in pure culture.

3. The pathogen from the pure culture must cause the disease when inoculated into a healthy, susceptible animal.

4. The pathogen must be again isolated from the animal and must be shown to be the same pathogen as the original.

Emerging Infectious Diseases : new or increasing infectious diseases

Probable reasons for emerging infectious diseases.

1. **Genetic recombination and evolutionary changes, example: avian flu**
2. **Unwarranted or wide spread use of antibiotics and pesticides, example: antibiotics in animal feed**
3. **Environmental changes, example: global warming**
4. **Modern transportation of existing disease, example: West Nile virus**
5. **Infections of humans due to expansion of human settlements, war, natural disaster, example: malaria, ebola, Valley Fever (coccidioidomycosis)**
6. **Animal control measures affect the incidence of disease, ex.: deer populations vs. Lyme disease**
7. **Failure of public health measures, example: missed vaccine events, such as diphtheria**

4. Other important concepts

A. Stages of disease

B. Transmission of disease

1. **Contact: Direct, indirect**

1. **Contact: Direct, indirect (fomite), droplet**

2. **Vehicle transmission: e.g., food, water, air**

3. **Vectors: mechanical vs. biological**

C. Reservoir of infection: human carriers, animal nonliving (soil, water)

D. Nosocomial (Hospital-Acquired) Infections

E. Compromised host: broken skin and invasive procedures, depressed immune system, antibiotic use

F. Epidemiology: when, where, how.

G. Morbidity, mortality, and notifiable disease (case reporting).

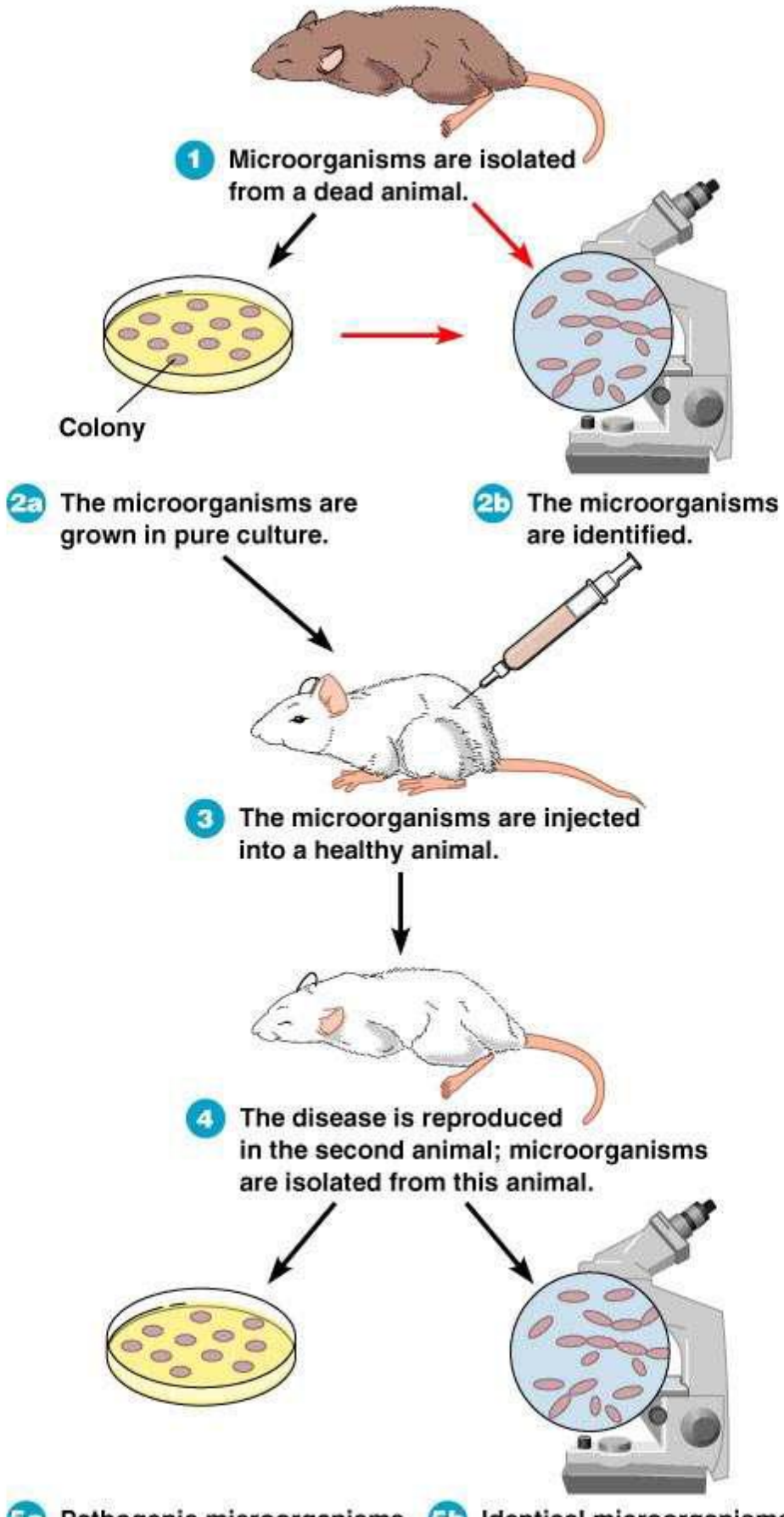

TABLE 14.1 Representative Members of the Normal Microbiota by Body Region*

Region	Principal Components	Comments
Skin	*Propionibacterium, Staphylococcus, Corynebacterium, Micrococcus, Acinetobacter, Brevibacterium; Pityrosporum* (fungus), *Candida* (fungus), *Malassezia* (fungus)	Most of the microbes in direct contact with skin do not become residents because secretions from sweat and oil glands have antimicrobial properties. Keratin is a resistant barrier, and the low pH of the skin inhibits many microbes. The skin also has a relatively low moisture content.

TABLE 14.1 Representative Members of the Normal Microbiota by Body Region* *(continued)*

Region	Principal Components	Comments
Eyes (conjunctiva)	*Staphylococcus epidermidis, S. aureus,* diphtheroids, *Propionibacterium, Corynebacterium,* streptococci, *Micrococcus*	The conjunctiva, a continuation of the skin or mucous membrane, contains basically the same microbiota found on the skin. Tears and blinking also eliminate some microbes or inhibit others from colonizing.

TABLE 14.1 *(continued)*

Region	Principal Components	Comments
Nose and throat (upper respiratory system)	*Staphylococcus aureus, S. epidermidis,* and aerobic diphtheroids in the nose; *S. epidermidis, S. aureus,* diphtheroids, *Streptococcus pneumoniae, Haemophilus,* and *Neisseria* in the throat	Although some normal microbiota are potential pathogens, their ability to cause disease is reduced by microbial antagonism. Nasal secretions kill or inhibit many microbes, and mucus and ciliary action remove many microbes.
Mouth	*Streptococcus, Lactobacillus, Actinomyces, Bacteroides, Veillonella, Neisseria, Haemophilis, Fusobacterium, Treponema, Staphylococcus, Corynebacterium,* and *Candida* (fungus)	Abundant moisture, warmth, and the constant presence of food make the mouth an ideal environment that supports very large and diverse microbial populations on the tongue, cheeks, teeth, and gums. However, biting, chewing, tongue movements, and salivary flow dislodge microbes. Saliva contains several antimicrobial substances.

TABLE 14.1 *(continued)*

Region	Principal Components	Comments
Large intestine	*Escherichia coli, Bacteroides, Fusobacterium, Lactobacillus, Enterococcus, Bifidobacterium, Enterobacter, Citrobacter, Proteus, Klebsiella, Candida* (fungus)	The large intestine contains the largest numbers of resident microbiota in the body because of its available moisture and nutrients. Mucus and periodic shedding of the lining prevent many microbes from attaching to the lining of the gastrointestinal tract, and the mucosa produces several antimicrobiol chemicals. Diarrhea also flushes out some of the normal microbiota.
Urinary and reproductive systems	*Staphylococcus, Micrococcus, Enterococcus, Lactobacillus, Bacteroides,* aerobic diphtheroids, *Pseudomonas, Klebsiella,* and *Proteus* in urethra; lactobacilli, aerobic diphtheroids, *Streptococcus, Staphylococcus, Bacteroides, Clostridium, Candida albicans* (fungus), and *Trichomonas vaginalis* (protozoan) in vagina	The lower urethra in both sexes has a resident population; the vagina has its acid-tolerant population of microbes because of the nature of its secretions. Mucus and periodic shedding of the lining prevent microbes from attaching to the lining; urine flow mechanically removes microbes, and the pH of urine and urea are antimicrobial. Cilia and mucus expel microbes from the cervix of the uterus into the vagina, and the acidity of the vagina inhibits or kills microbes.

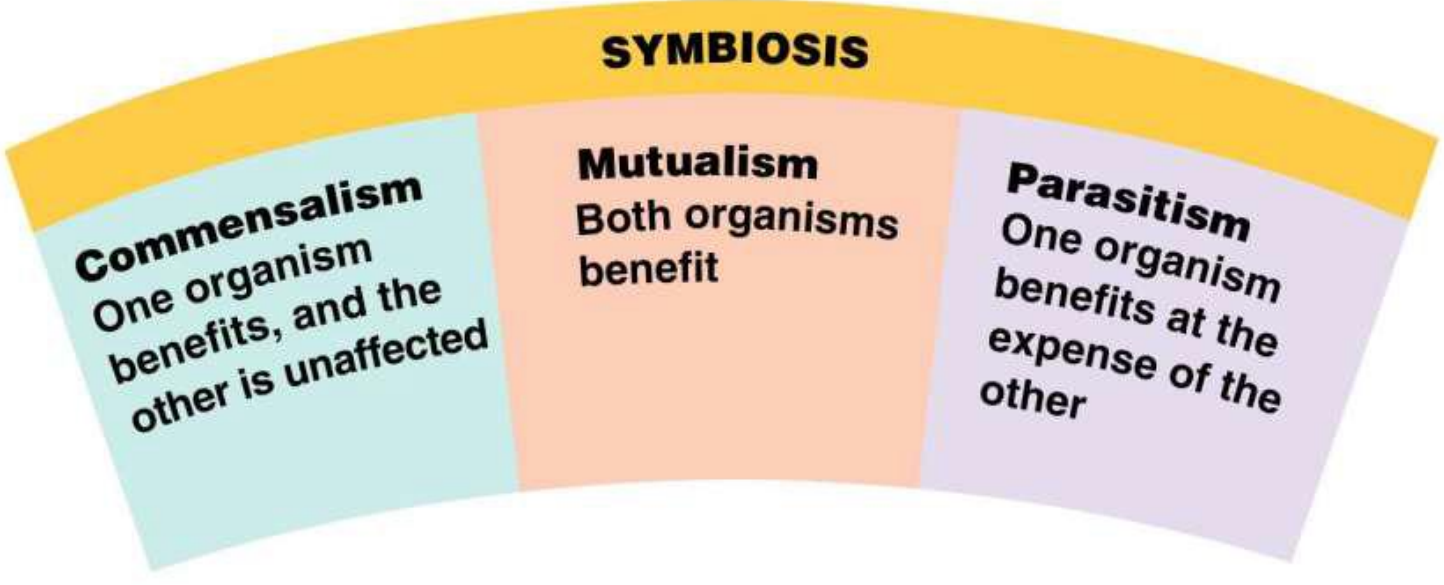

TABLE 14.3 Representative Arthropod Vectors and the Diseases They Transmit

Disease	Causative Agent	Arthropod Vector	Chapter Reference
Malaria	*Plasmodium* spp.	*Anopheles* (mosquito)	23
African trypanosomiasis	*Trypanosoma brucei gambiense* and *T. b. rhodesiense*	*Glossina* sp. (tsetse fly)	22
Chagas' disease	*T. cruzi*	*Triatoma* sp. (kissing bug)	23
Yellow fever	*Alphavirus* (yellow fever virus)	*Aedes* (mosquito)	23
Dengue	*Alphavirus* (dengue fever virus)	*A. aegypti* (mosquito)	12, 23
Arthropod-borne encephalitis	*Alphavirus* (encephalitis virus)	*Culex* (mosquito)	22
Ehrlichiosis	*Ehrlichia* spp.	*Ixodes* spp. (tick)	23
Epidemic typhus	*Rickettsia prowazekii*	*Pediculus humanus* (louse)	23
Endemic murine typhus	*R. typhi*	*Xenopsylla cheopis* (rat flea)	23
Rocky Mountain spotted fever	*R. rickettsii*	*Dermacentor andersoni* and other species (tick)	23
Plague	*Yersinia pestis*	*Xenopsylla cheopis* (rat flea)	23
Relapsing fever	*Borrelia* spp.	*Ornithodorus* spp. (soft tick)	23
Lyme disease	*B. burgdorferi*	*Ixodes* spp. (tick)	23

TABLE 14.2 Selected Zoonoses *(continued)*

Disease	Causative Agent	Reservoir	Method of Transmission	Chapter Reference
Bacterial				
Anthrax	*Bacillus anthracis*	Domestic livestock	Direct contact with contaminated hides or animals; air; food	23
Brucellosis	*Brucella* spp.	Domestic livestock	Direct contact with contaminated milk, meat, or animals	23
Bubonic plague	*Yersinia pestis*	Rodents	Flea bites	23
Cat-scratch disease	*Bartonella henselae*	Domestic cats	Direct contact	23
Ehrlichiosis	*Ehrlichia* spp.	Deer, rodents	Tick bite	23
Leptospirosis	*Leptospira*	Wild mammals, domestic dogs and cats	Direct contact with urine, soil, water	26
Lyme disease	*Borrelia burgdorferi*	Field mice	Tick bites	23
Psittacosis (ornithosis)	*Chlamydia psittaci*	Birds, especially parrots	Direct contact	24
Rocky Mountain spotted fever	*Rickettsia rickettsii*	Rodents	Tick bites	23
Salmonellosis	*Salmonella* spp.	Poultry, rats, reptiles	Ingestion of contaminated food and water and putting hands in mouth	25
Endemic typhus	*Rickettsia typhi*	Rodents	Flea bites	23

TABLE 14.2 Selected Zoonoses

Disease	Causative Agent	Reservoir	Method of Transmission	Chapter Reference
Viral				
Influenza (some types)	*Influenzavirus*	Swine, birds	Direct contact	24
Rabies	*Lyssavirus*	Bats, skunks, foxes, dogs, racoons	Direct contact (bite)	22
Western equine encephalitis	*Alphavirus*	Horses, birds	*Culex* mosquito bite	22
Hantavirus pulmonary syndrome (HPS)	*Hantavirus*	Rodents (primarily deer mice)	Direct contact with rodent saliva, feces, or urine	23

TABLE 14.2 **Selected Zoonoses** *(continued)*

Disease	Causative Agent	Reservoir	Method of Transmission	Chapter Reference
Fungal				
Ringworm	*Trichophyton* *Microsporum* *Epidermophyton*	Domestic mammals	Direct contact; fomites (nonliving objects)	21
Protozoan				
Malaria	*Plasmodium* spp.	Monkeys	Anopheles mosquito bite	23
Toxoplasmosis	*Toxoplasma gondii*	Cats and other mammals	Ingestion of contaminated meat or by direct contact with infected tissues or fecal matter	23
Helminthic				
Tapeworm (pork)	*Taenia solium*	Pigs	Ingestion of undercooked contaminated pork	25
Trichinellosis	*Trichinella spiralis*	Pigs, bears	Ingestion of undercooked contaminated pork	25

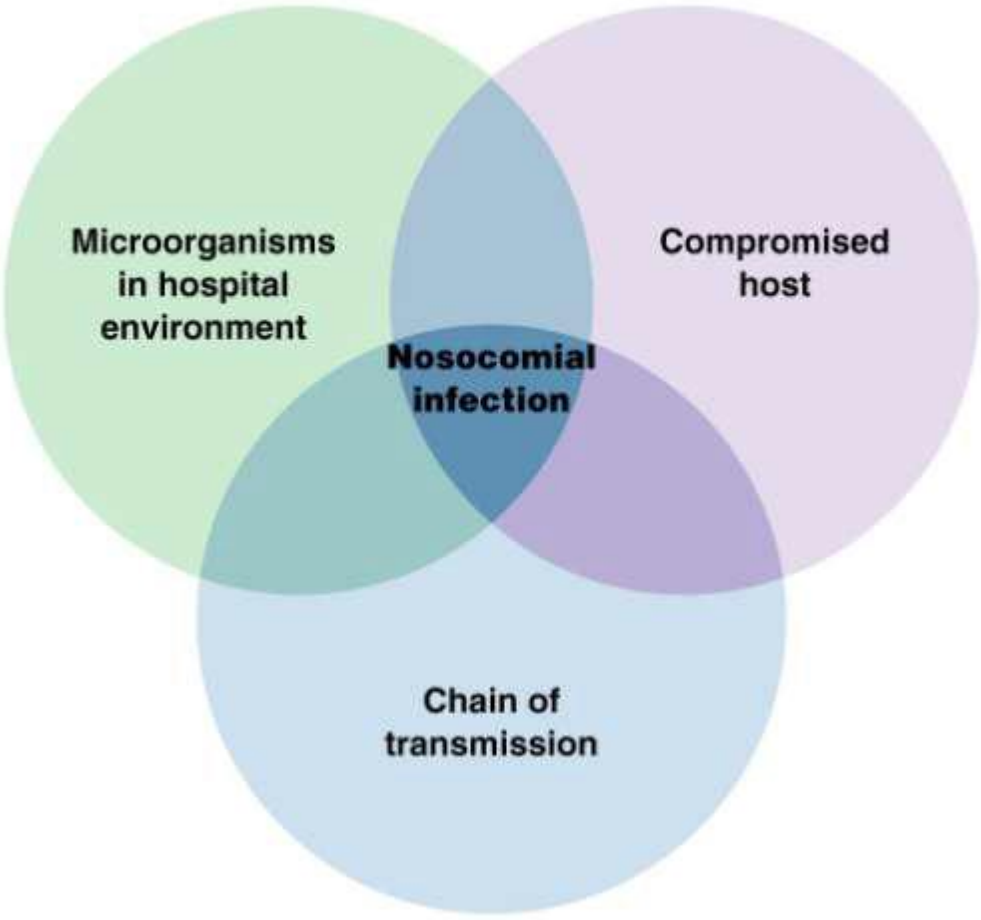

TABLE 14.4 Microorganisms Involved in Most Nosocomial Infections

Microorganism	Percentage of Total Infections	Percentage Resistant to Antibiotics	Infections Caused
Coagulase-negative staphylococci	25%	89%	Most common cause of sepsis
Staphylococcus aureus	16%	60%	Most frequent cause of pneumonia
Enterococcus	10%	29%	Most common cause of surgical wound infections
Escherichia coli, Pseudomonas aeruginosa, Enterobacter, and *Klebsiella pneumoniae*	23%	5–32%	Pneumonia and surgical wound infections
Clostridium difficile	13%	—	Causes nearly half of all nosocomial diarrhea
Fungi (mostly *Candida albicans*)	6%	—	Urinary tract infections and sepsis
Other gram-negative bacteria (*Acinetobacter, Citrobacter, Haemophilus*)	7%	—	Urinary tract infections and surgical wound infections

Source: Data from CDC, National Nosocomial Infections Surveillance.

TABLE 14.5 Principal Sites of Nosocomial Infections

Type of Infection	Comment
Urinary tract infections	Most common, usually accounts for about 40% of all nosocomial infections. Typically related to urinary catheterization.
Surgical site infections	Ranks second in infection incidence (about 20%). An estimated 5–12% of all surgical patients develop postoperative infections; the percentage can reach 30% for certain surgeries, such as colon surgery and amputations.
Lower respiratory infections	Nosocomial pneumonias account for about 15% and have high mortality rates (13–55%). Most of these pneumonias are related to respiratory devices that aid breathing or administer medications.
Cutaneous infections	Cutaneous infections account for about 8% of nosocomial infections. Newborns have a high rate of susceptibility to skin and eye infections.

TABLE 14.5 Principal Sites of Nosocomial Infections

Type of Infection	Comment
Bacteremia, caused primarily by intravenous catheterizations	Bacteremias account for about 6% of nosocomial infections. Intravenous catheterization is implicated in nosocomial infections of the bloodstream, particularly infections caused by bacteria and fungi.
Other	All other infection sites account for about 11% of nosocomial infections.

Source: Data from CDC, National Nosocomial Infection Surveillance.