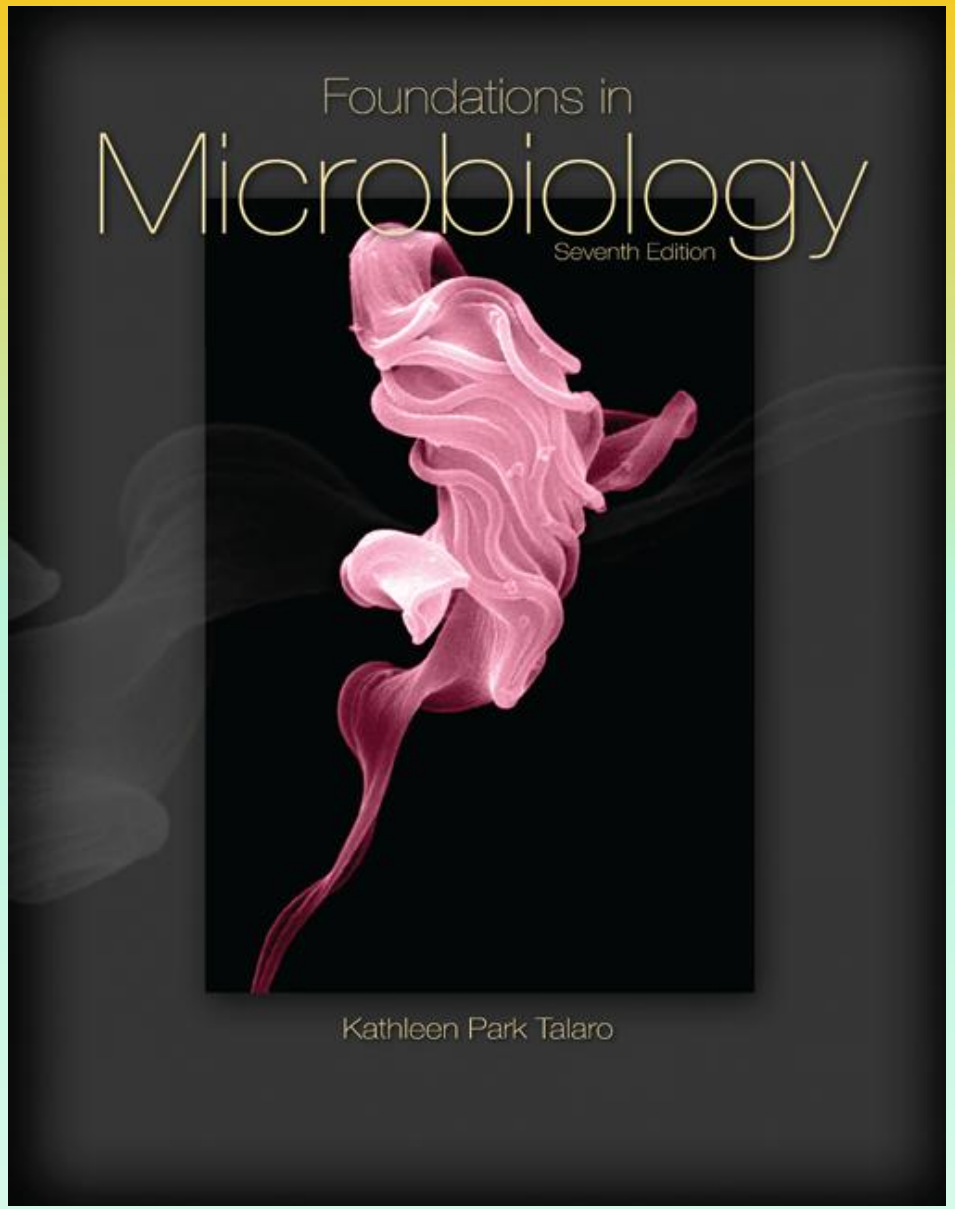
Foundations in Microbiology

Seventh Edition

Talaro

Chapter 13



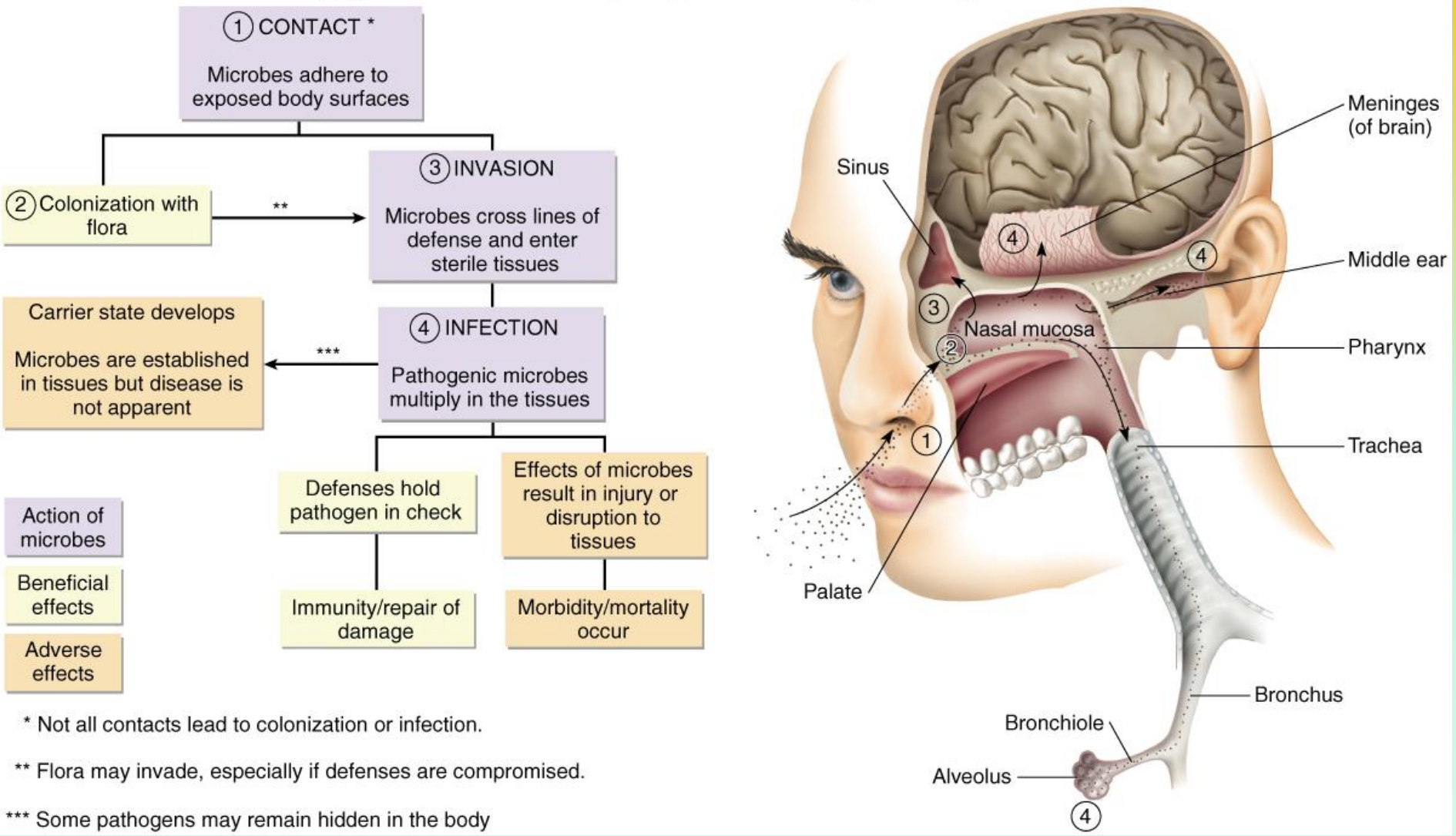
13.1 We Are Not Alone

- The human body exists in a state of dynamic equilibrium
- Many interactions between human body and microorganisms involve the development of biofilms
- Colonization of the body involves a constant “give and take”

Contact, Colonization, Infection, Disease

- Microbes that engage in mutual or commensal associations – **normal (resident) flora**, indigenous flora, microbiota
- **Infection** – a condition in which pathogenic microbes penetrate host defenses, enter tissues, and multiply
- **Pathogen** – infectious agent
- **Infectious disease** – an infection that causes damage or disruption to tissues and organs

Figure 13.1



Resident Flora

- Most areas of the body in contact with the outside environment harbor resident microbes
- Internal organs, tissues, and fluids are microbe-free
- **Transients** – microbes that occupy the body for only short periods
- **Residents** – microbes that become established

TABLE 13.1 Sites That Harbor a Normal Flora

- Skin and its contiguous mucous membranes
- Upper respiratory tract
- Gastrointestinal tract (various parts)
- Outer opening of urethra
- External genitalia
- Vagina
- External ear and canal
- External eye (lids, lash follicles)

TABLE 13.2 Sterile (Microbe-Free) Anatomical Sites and Fluids

All Internal Tissues and Organs

- Heart and circulatory system
- Liver
- Kidneys and bladder
- Lungs
- Brain and spinal cord
- Muscles
- Bones
- Ovaries/testes
- Glands (pancreas, salivary, thyroid)
- Sinuses
- Middle and inner ear
- Internal eye

Fluids within an Organ or Tissue

- Blood
- Urine in kidneys, ureters, bladder
- Cerebrospinal fluid
- Saliva prior to entering the oral cavity
- Semen prior to entering the urethra
- Amniotic fluid surrounding the embryo and fetus

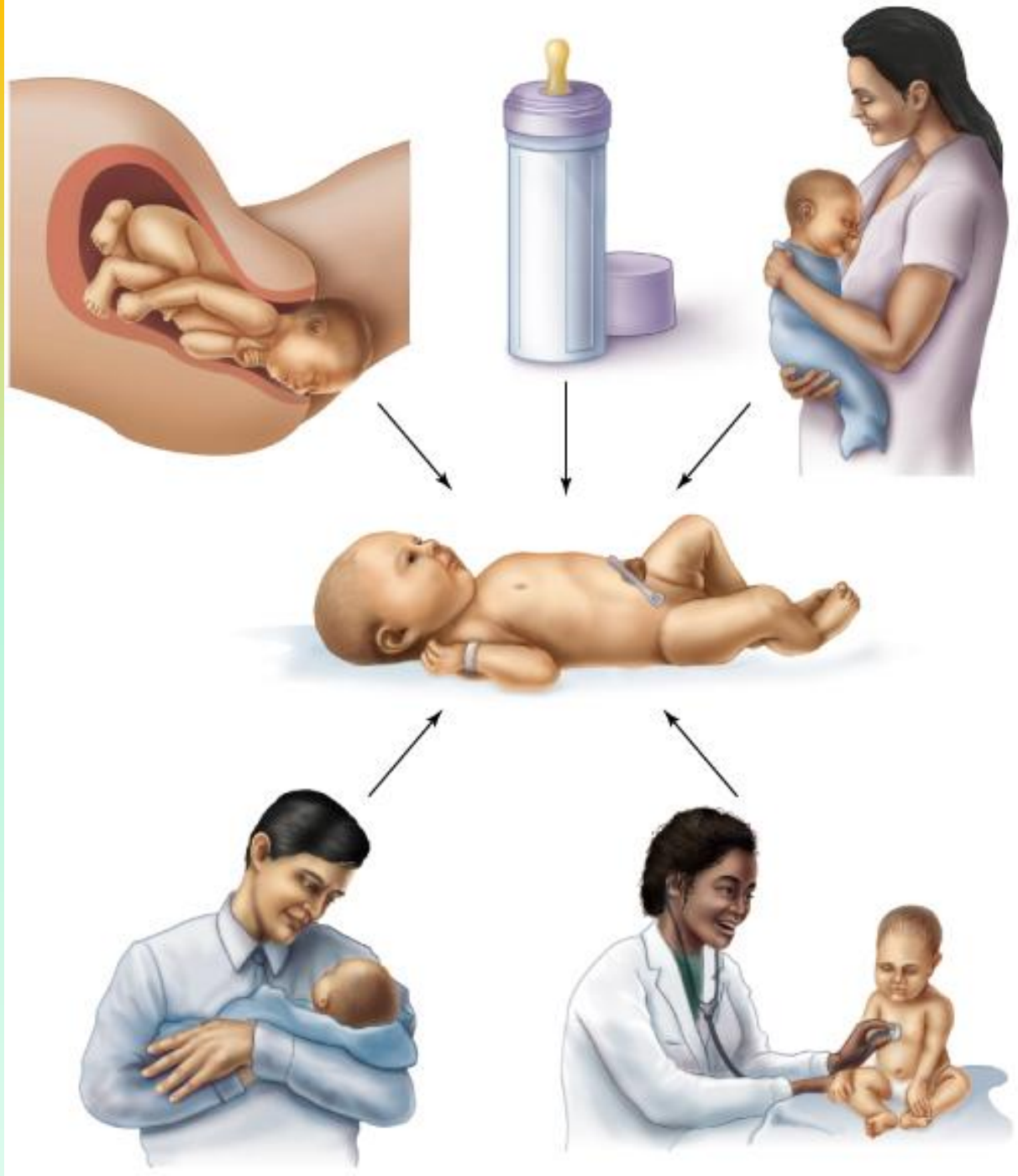
Resident Flora

- Bacterial flora benefit host by preventing overgrowth of harmful microbes – **microbial antagonism**
- **Endogenous infections** – occur when normal flora is introduced to a site that was previously sterile

Initial Colonization of the Newborn

- Uterus and contents are normally sterile and remain so until just before birth
- Breaking of fetal membrane exposes the infant; all subsequent handling and feeding continue to introduce what will be normal flora

Figure 13.2



Indigenous Flora of Specific Regions

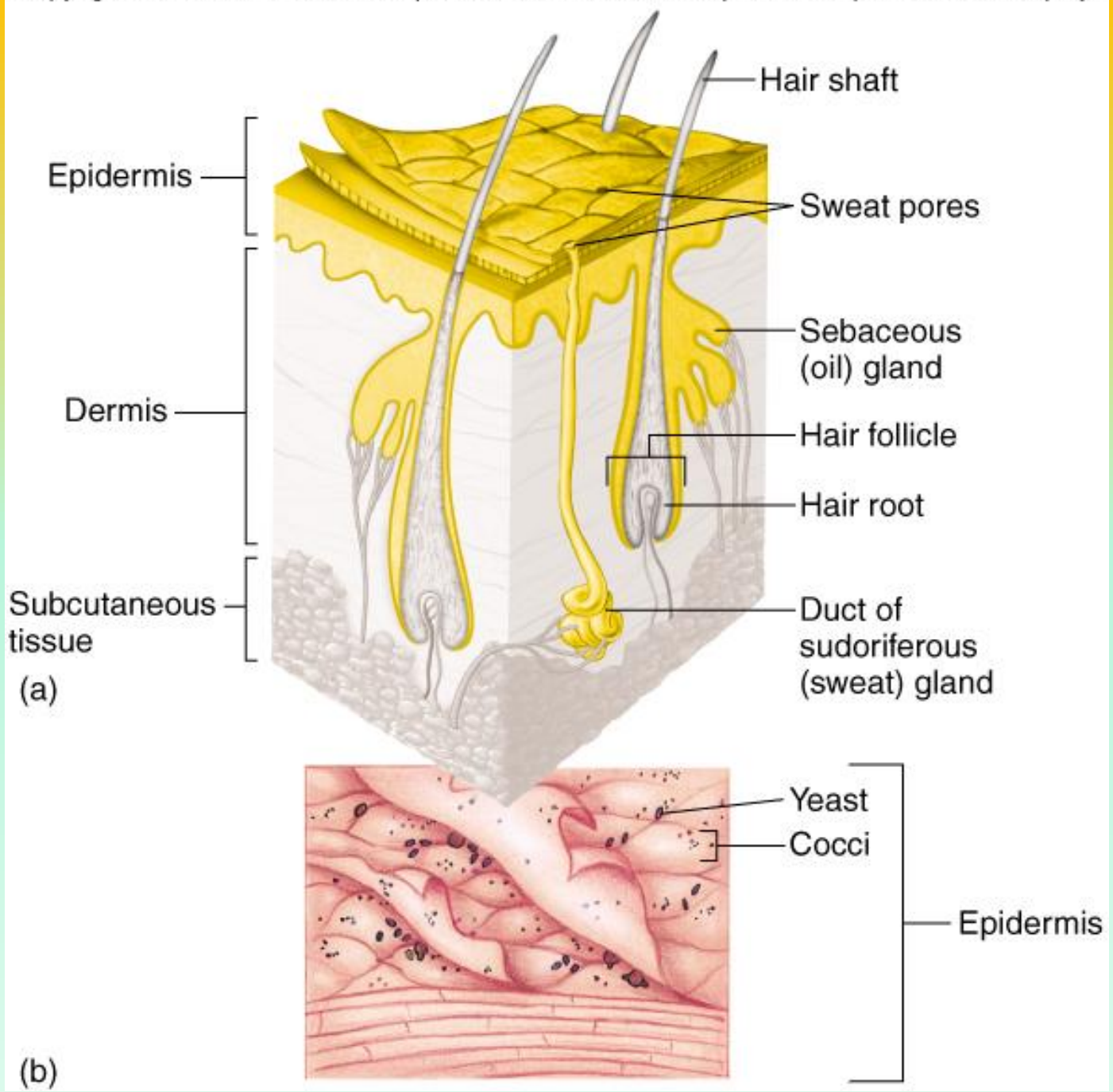
TABLE 13.3 Life on Humans: Sites Containing Well-Established Flora and Representative Examples

Anatomic Sites	Common Genera	Remarks
Skin	**Bacteria:** *Staphylococcus, Micrococcus, Corynebacterium, Propionibacterium, Streptococcus*	Microbes live only in upper dead layers of epidermis, glands, and follicles; dermis and layers below are sterile.
	Fungi: *Candida, Malassezia*	Dependent on skin lipids for growth
	Arthropods: *Demodix* mite	Present in sebaceous glands and hair follicles
Gastrointestinal Tract		
Oral cavity	**Bacteria:** *Streptococcus, Neisseria, Veillonella, Fusobacterium, Lactobacillus, Bacteroides, Actinomyces, Eikenella, Treponema, Haemophilus*	Colonize the epidermal layer of cheeks, gingiva, pharynx; surface of teeth; found in saliva in huge numbers
	Fungi: *Candida* sp.	Can cause thrush
	Protozoa: *Entamoeba gingivalis*	Inhabit the gingiva of persons with poor oral hygiene
Large intestine and rectum	**Bacteria:** *Bacteroides, Fusobacterium, Bifidobacterium, Clostridium,* fecal streptococci and staphylococci, *Lactobacillus,* coliforms (*Escherichia, Enterobacter*), *Proteus* sp.	Areas of lower gastrointestinal tract other than large intestine and rectum have sparse or nonexistent flora. Flora consists predominantly of strict anaerobes; other microbes are aerotolerant or facultative.
	Fungi: *Candida*	Yeast can survive this habitat.
	Protozoa: *Entamoeba coli, Trichomonas hominis*	Feed on waste materials in the large intestine
Upper Respiratory Tract	Microbial population exists in the nasal passages, throat, and pharynx; owing to proximity, flora is similar to that of oral cavity.	Trachea may harbor a sparse population; bronchi, bronchioles, and alveoli have no normal flora and are essentially sterile due to local host defenses.
Genital Tract	**Bacteria:** *Lactobacillus, Streptococcus, diphtheroids* (*Corynebacterium* and relatives) *Escherichia, Gardnerella*	In females, flora occupies the external genitalia and vaginal and cervical surfaces; internal reproductive structures normally remain sterile. Flora responds to hormonal changes during life.
	Fungi: *Candida*	Cause of yeast infections
Urinary Tract	**Bacteria:** *Staphylococcus, Streptococcus, Corynebacterium, Lactobacillus*	In females, flora exists only in the first portion of the urethral mucosa; the remainder of the tract is sterile. In males, the entire reproductive and urinary tract is sterile except for a short portion of the anterior urethra.
Eye	**Bacteria:** coagulase-negative staphylococci, *Streptococcus, Neisseria*	The lids and follicles harbor similar microbes as skin; the conjunctiva has a transient population; deep tissues are sterile.
Ear	**Bacteria:** staphylococci, diphtheroids **Fungi:** *Aspergillus, Penicillium, Candida,* yeasts	The external ear is similar to the skin in content; areas internal to the tympanum are generally sterile.

Flora of the Human Skin

- Skin is the largest and most accessible organ
- Two cutaneous populations
  - Transients: influenced by hygiene
  - Resident: stable, predictable, less influenced by hygiene

Figure 13.3



Flora of the Gastrointestinal Tract

- GI tract is a long hollow tube, bounded by mucous membranes
  - Tube is exposed to the environment
- Variations in flora distribution due to shifting conditions (pH, oxygen tension, anatomy)
- Oral cavity, large intestine, and rectum harbor appreciable flora

Flora of the Mouth

- Most diverse and unique flora of the body
- Numerous adaptive niches
- Bacterial count of saliva (5×10^{9} cells per milliliter)

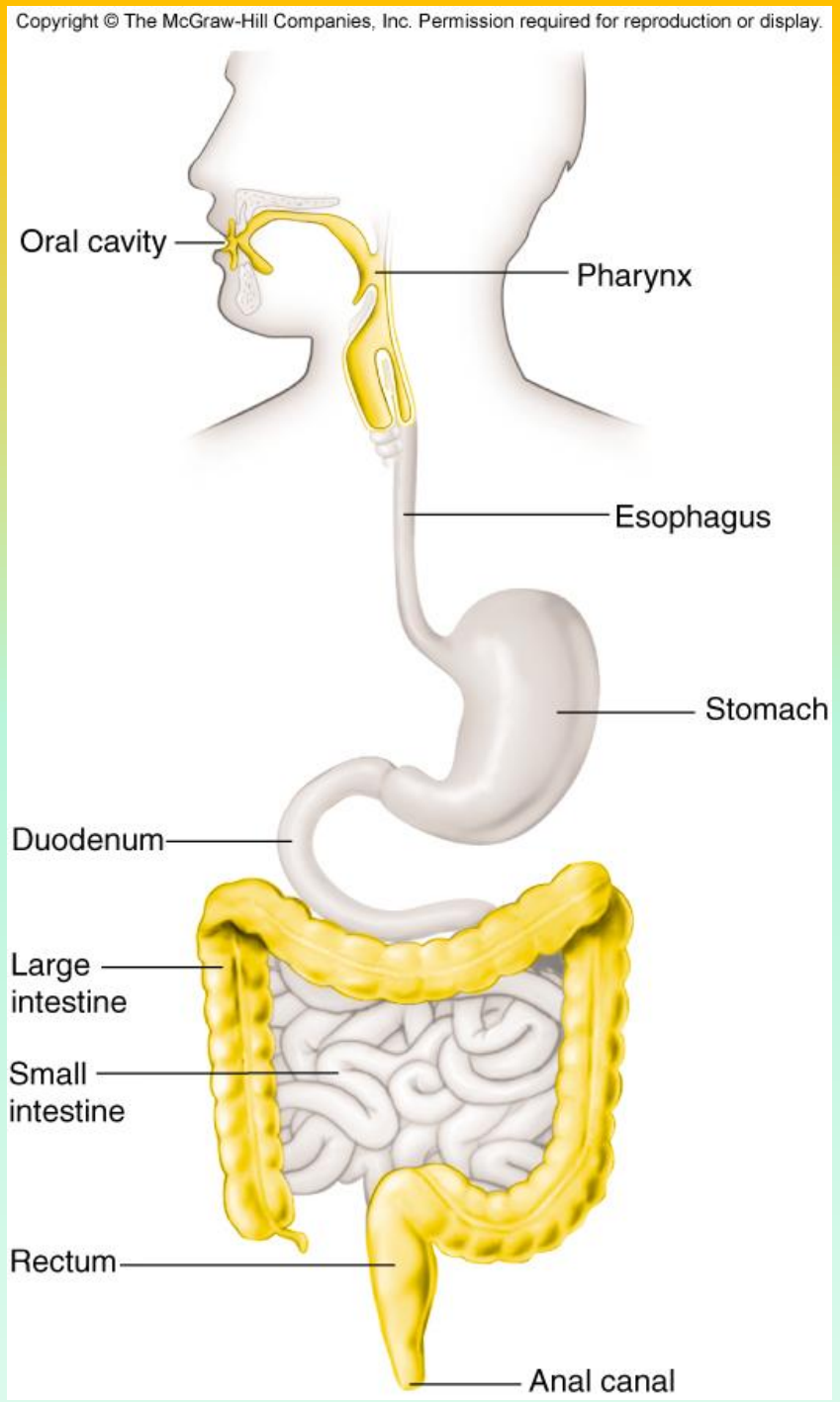
Flora of the Large Intestine

- Has complex and profound interactions with host
- 10^{8}-10^{11} microbes per gram of feces
- Intestinal environment favors anaerobic bacteria
- Intestinal bacteria contribute to intestinal odor

Flora of the Respiratory Tract

- Oral streptococci, first organisms to colonize
- Nasal entrance, nasal vestibule, anterior nasopharynx – *S. aureus*
- Mucous membranes of nasopharynx – *Neisseria*
- Tonsils and lower pharynx – *Haemophilus*

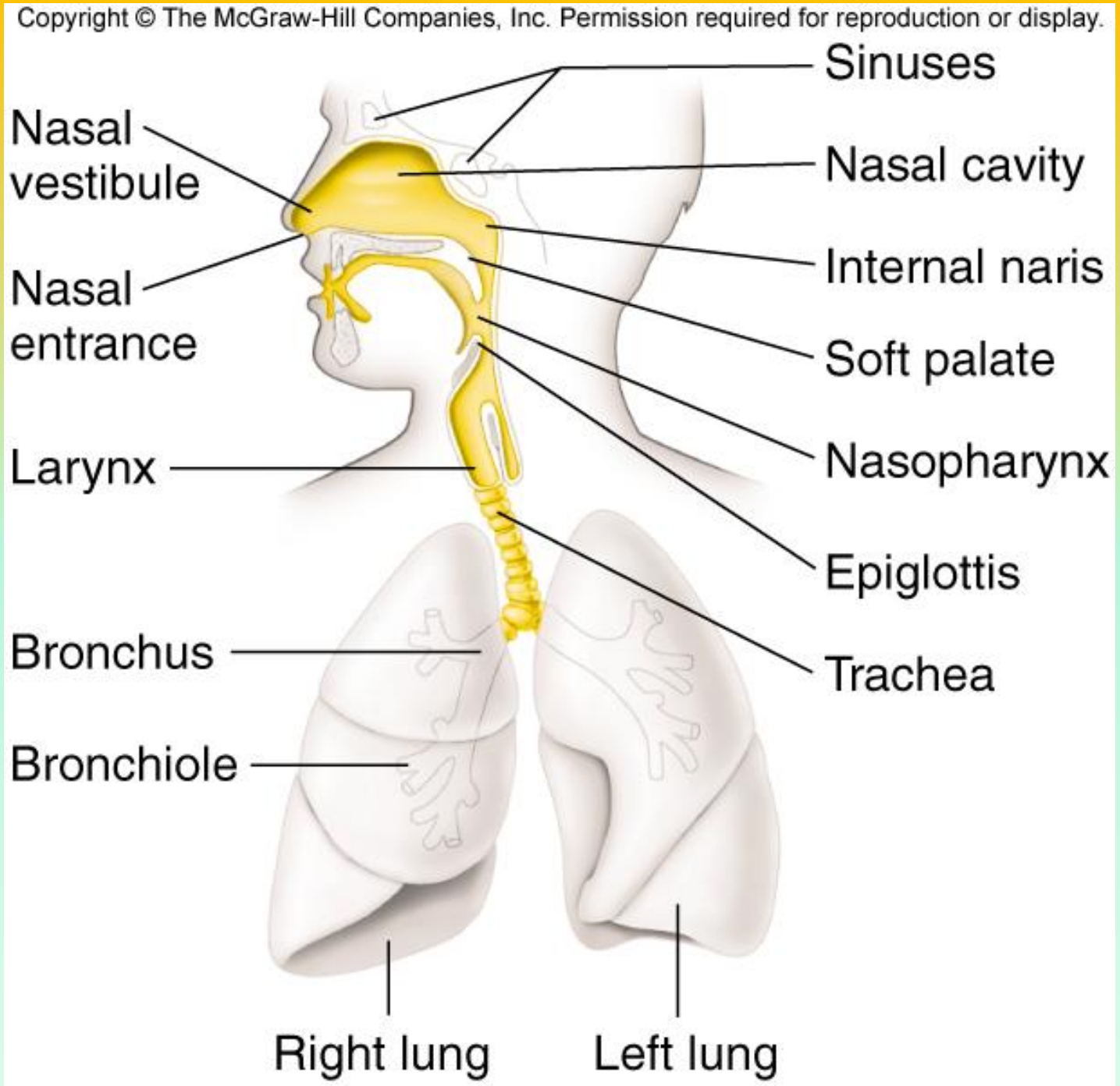
Figure 13.5


Copyright © The McGraw-Hill Companies, Inc. Permission required for reproduction or display.
Oral cavity
Pharynx
Esophagus
Stomach
Duodenum
Large intestine
Small intestine
Rectum
Anal canal

Flora of the Genitourinary Tract

- Sites that harbor microflora
  - Females – Vagina and outer opening of urethra
  - Males – Anterior urethra
- Changes in physiology influence the composition of the normal flora
  - Vagina (estrogen, glycogen, pH)

Figure 13.6


Copyright © The McGraw-Hill Companies, Inc. Permission required for reproduction or display.
Sinuses
Nasal vestibule
Nasal cavity
Internal naris
Nasal entrance
Soft palate
Nasopharynx
Larynx
Epiglottis
Bronchus
Trachea
Bronchiole
Right lung
Left lung

Maintenance of the Normal Resident Flora

- Normal flora is essential to the health of humans
- Flora create an environment that may prevent infections and can enhance host defenses
- Antibiotics, dietary changes, and disease may alter flora
- Probiotics – introducing known microbes back into the body

13.2 Major Factors in the Development of an Infection

13.2 Major Factors in the Development of an Infection

- **True pathogens** – capable of causing disease in healthy persons with normal immune defenses
  - Influenza virus, plague bacillus, malarial protozoan
- **Opportunistic pathogens** – cause disease when the host's defenses are compromised or when they grow in part of the body that is not natural to them
  - *Pseudomonas sp* & *Candida albicans*
- Severity of the disease depends on the **virulence** of the pathogen; characteristic or structure that contributes to the ability of a microbe to cause disease is a **virulence factor.**

TABLE 13.4 Factors That Weaken Host Defenses and Increase Susceptibility to Infection*

- Old age and extreme youth (infancy, prematurity)
- Genetic defects in immunity and acquired defects in immunity (AIDS)
- Surgery and organ transplants
- Organic disease: cancer, liver malfunction, diabetes
- Chemotherapy/immunosuppressive drugs
- Physical and mental stress
- Other infections

*These conditions compromise defense barriers or immune responses.

Becoming Established

Portals of entry – characteristic route a microbe follows to enter the tissues of the body

- Skin – nicks, abrasions, punctures, incisions
- Gastrointestinal tract – food, drink, and other ingested materials
- Respiratory tract – oral and nasal cavities
- Urogenital tract – sexual, displaced organisms
- Transplacental

- **Exogenous agents** originate from source outside the body
- **Endogenous agents** already exist on or in the body (normal flora)

Figure 13.7

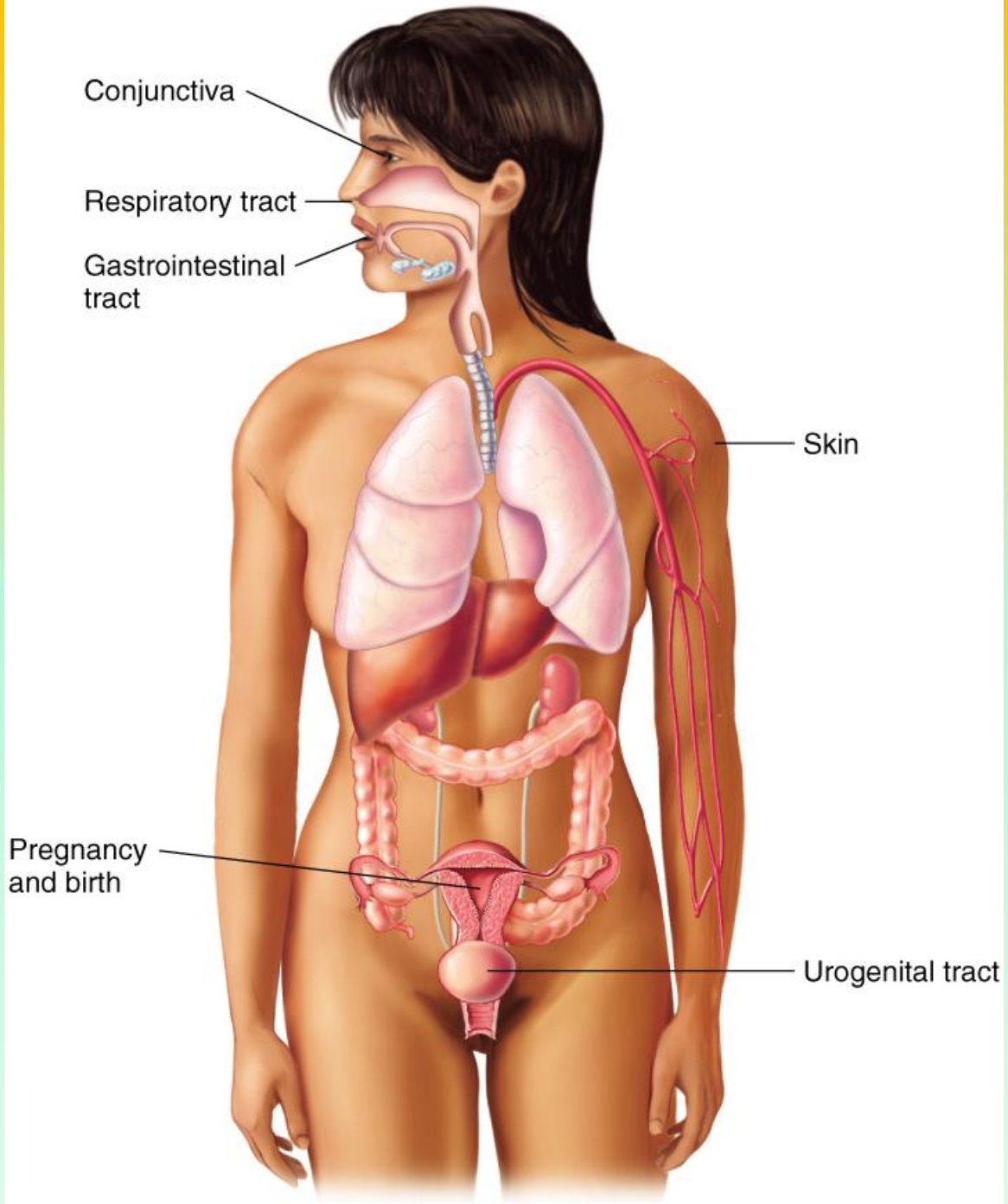
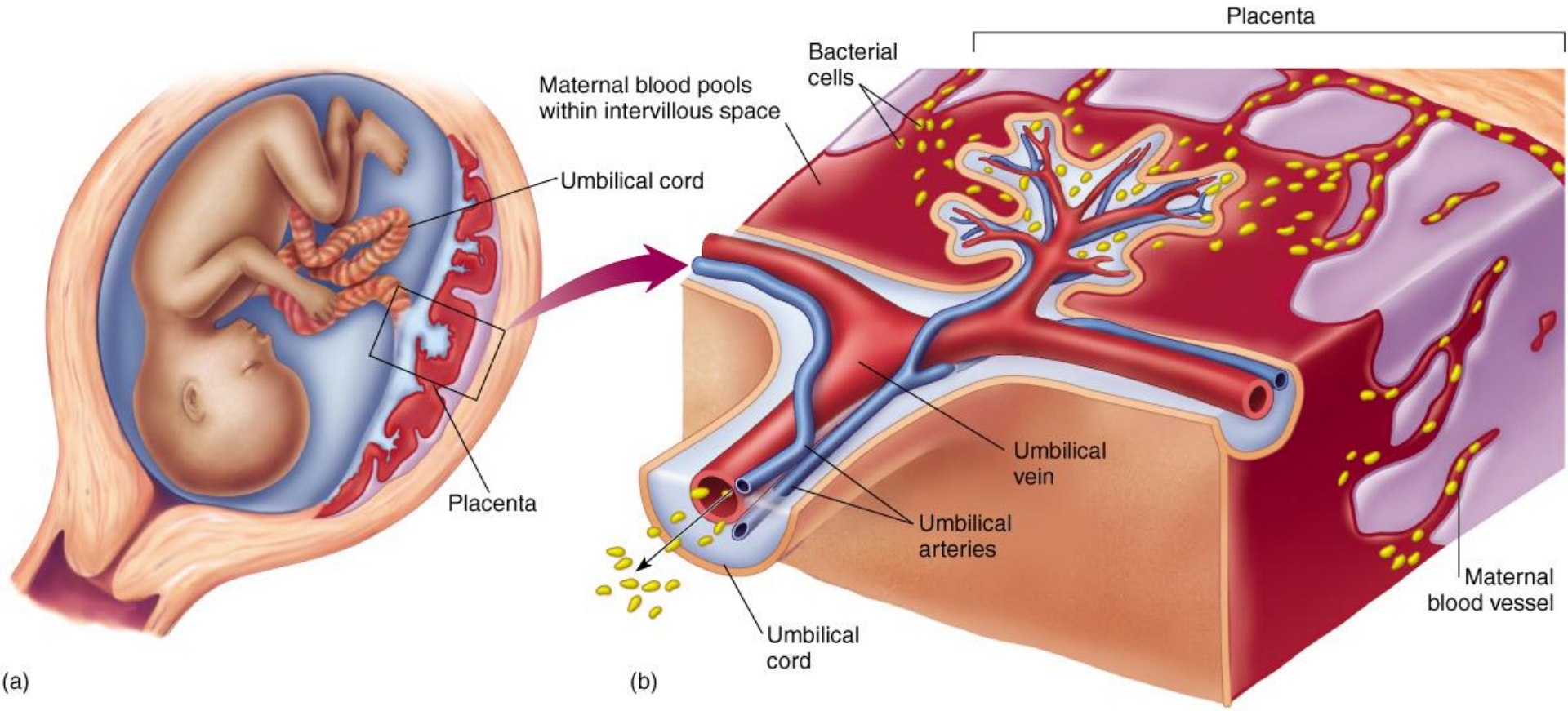


TABLE 13.5 Incidence of Common Sexually Transmitted Diseases

STD	Estimated Number of New Cases per Year in the United States
Human papillomavirus	7,500,000
Trichomoniasis	7,300,000
Herpes simplex	1,200,000
Chlamydiosis	1,024,314
Gonorrhea	305,500
Hepatitis B	65,000
AIDS	37,500
Syphilis	37,500

Figure 13.8



Requirement for an Infectious Dose (ID)

- Minimum number of microbes required for infection to proceed
- Microbes with small IDs have greater virulence
- Lack of ID will not result in infection

TABLE 13.6

Estimated Infectious Doses of Selected Pathogens*

Agent of	Infectious Dose Estimate	Primary Route of Infection
Measles	1 virus	Respiratory
Q fever	1–10 cells	Respiratory
Tularemia	10–50 cells	Various
Smallpox	10–100 viruses	Respiratory
Brucellosis	10–100 cells	Various
Viral encephalitis	10–100 viruses	Mosquito bite
Plague	100–500 cells	Flea bite
Gonorrhea	1,000 cells	Sexual contact
Anthrax	8,000–50,000 spores	Respiratory, cutaneous
Typhoid	10,000 cells	Ingestion
Cholera	100,000,000 cells	Ingestion

*Several of these agents are considered potential bioterror pathogens.

Attaching to the Host

- **Adhesion** – microbes gain a stable foothold at the portal of entry; dependent on binding between specific molecules on host and pathogen
  - Fimbrae
  - Flagella
  - Adhesive slimes or capsules
  - Cilia
  - Suckers
  - Hooks
  - Barbs

Figure 13.9

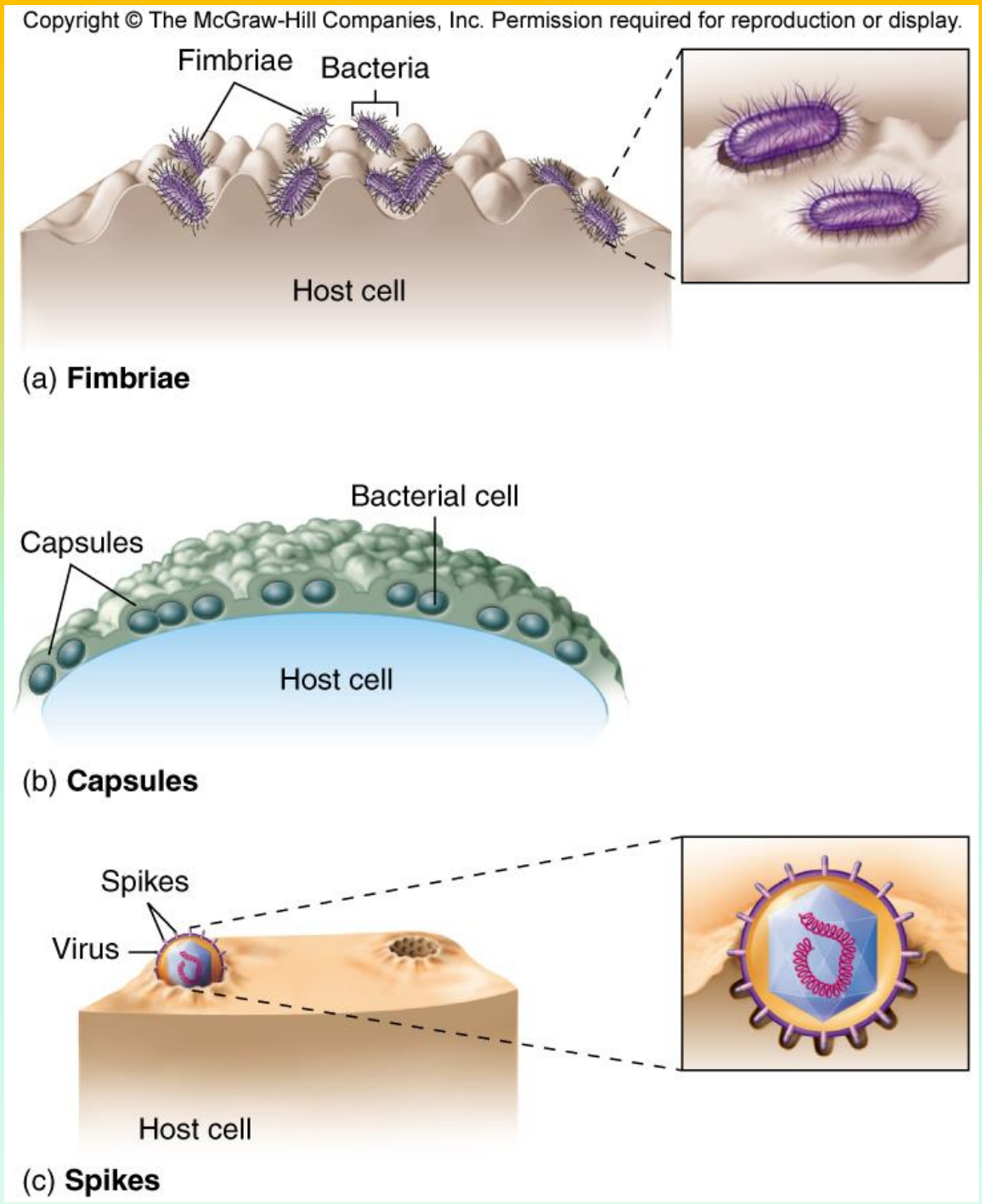

Copyright © The McGraw-Hill Companies, Inc. Permission required for reproduction or display.
Fimbriae
Bacteria
Host cell
(a) Fimbriae
Bacterial cell
Capsules
Host cell
(b) Capsules
Spikes
Virus
Host cell
(c) Spikes

TABLE 13.7 Adhesion Properties of Microbes

Microbe	Disease	Adhesion Mechanism
Neisseria gonorrhoeae	Gonorrhea	Fimbriae attach to genital epithelium.
Escherichia coli	Diarrhea	Well-developed fimbrial adhesin
Shigella	Dysentery	Fimbriae can attach to intestinal epithelium.
Vibrio	Cholera	Glycocalyx anchors microbe to intestinal epithelium.
Treponema	Syphilis	Tapered hook embeds in host cell.
Mycoplasma	Pneumonia	Specialized tip at ends of bacteria fuse tightly to lung epithelium.
Pseudomonas aeruginosa	Burn, lung infections	Fimbriae and slime layer
Streptococcus mutans, S. sobrinus	Dental caries	Dextran slime layer glues cocci to tooth surface.
Influenza virus	Influenza	Viral spikes react with receptor on respiratory surface.
Poliovirus	Polio	Capsid proteins attach to receptors on susceptible cells.
HIV	AIDS	Viral spikes adhere to white blood cell receptors.
Giardia lamblia (protozoan)	Giardiasis	Small suction disc on underside attaches to intestinal surface.
Trypanosoma (protozoan)	African and S. American trypanosomiasis	Flagellum is needed to penetrate and stay alive.

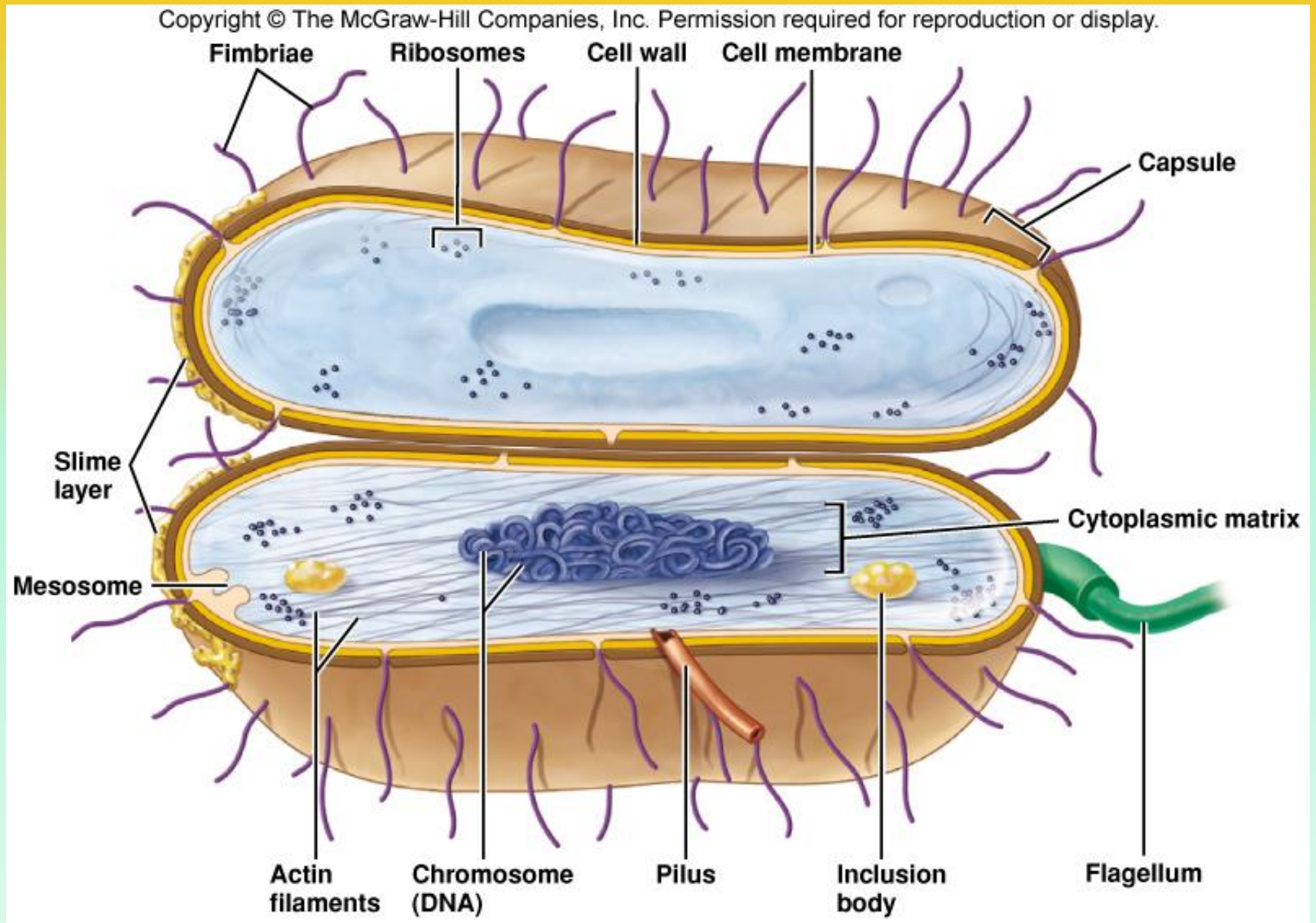
Surviving Host Defenses

- Initial response of host defenses comes from **phagocytes**
- **Antiphagocytic factors** – used to avoid phagocytosis
- Species of *Staphylococcus* and *Streptococcus* produce **leukocidins**, toxic to white blood cells
- **Slime layer** or **capsule** – makes phagocytosis difficult
- Ability to survive intracellular phagocytosis

Causing Disease

- **Virulence factors** – traits used to invade and establish themselves in the host, also determine the degree of tissue damage that occurs – severity of disease
- **Exoenzymes** – dissolve extracellular barriers and penetrate through or between cells
- **Toxigenicity** – capacity to produce toxins at the site of multiplication
  - **Endotoxin** – toxin that is not secreted but is released after the cell is damaged
  - **Exotoxin** – toxin molecule secreted by a living bacterial cell into the infected tissue
- **Antiphagocytic factors**

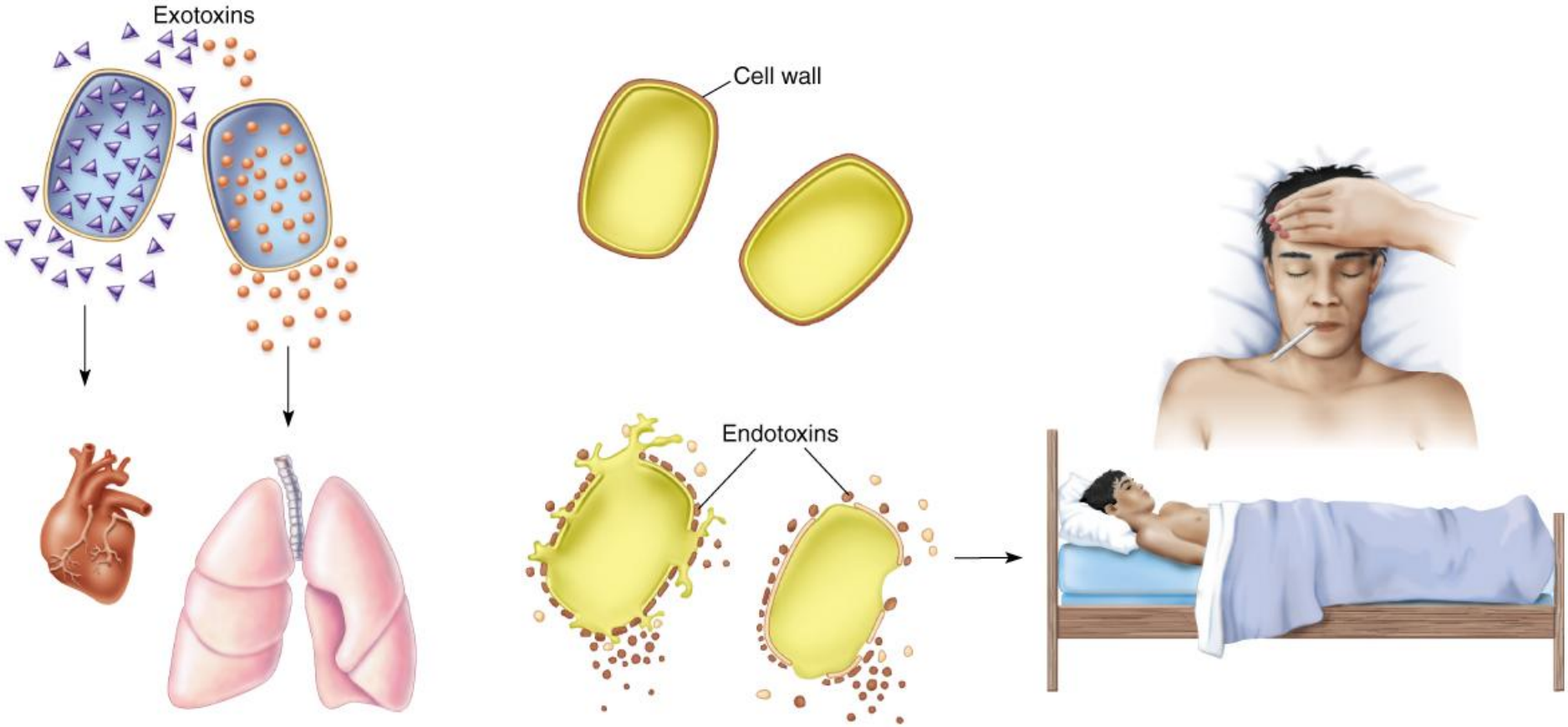
Figure 13.10


Copyright © The McGraw-Hill Companies, Inc. Permission required for reproduction or display.
Fimbriae
Ribosomes
Cell wall
Cell membrane
Capsule
Slime layer
Cytoplasmic matrix
Mesosome
Actin filaments
Chromosome (DNA)
Pilus
Inclusion body
Flagellum

Bacterial Toxins: A Potent Source of Cellular Damage

- Exotoxins: Strong specificity for a target cell
  - Hemolysins
  - A-B toxins (A-active, B-binding)
- Endotoxin – lipopolysaccharide (LPS), part of the outer membrane of gram-negative cell walls

Figure 13.11



(a) Target organs are damaged; heart, muscles, blood cells, intestinal tract show dysfunctions.

(b)

General physiological effects—fever, malaise, aches, shock

TABLE 13.8

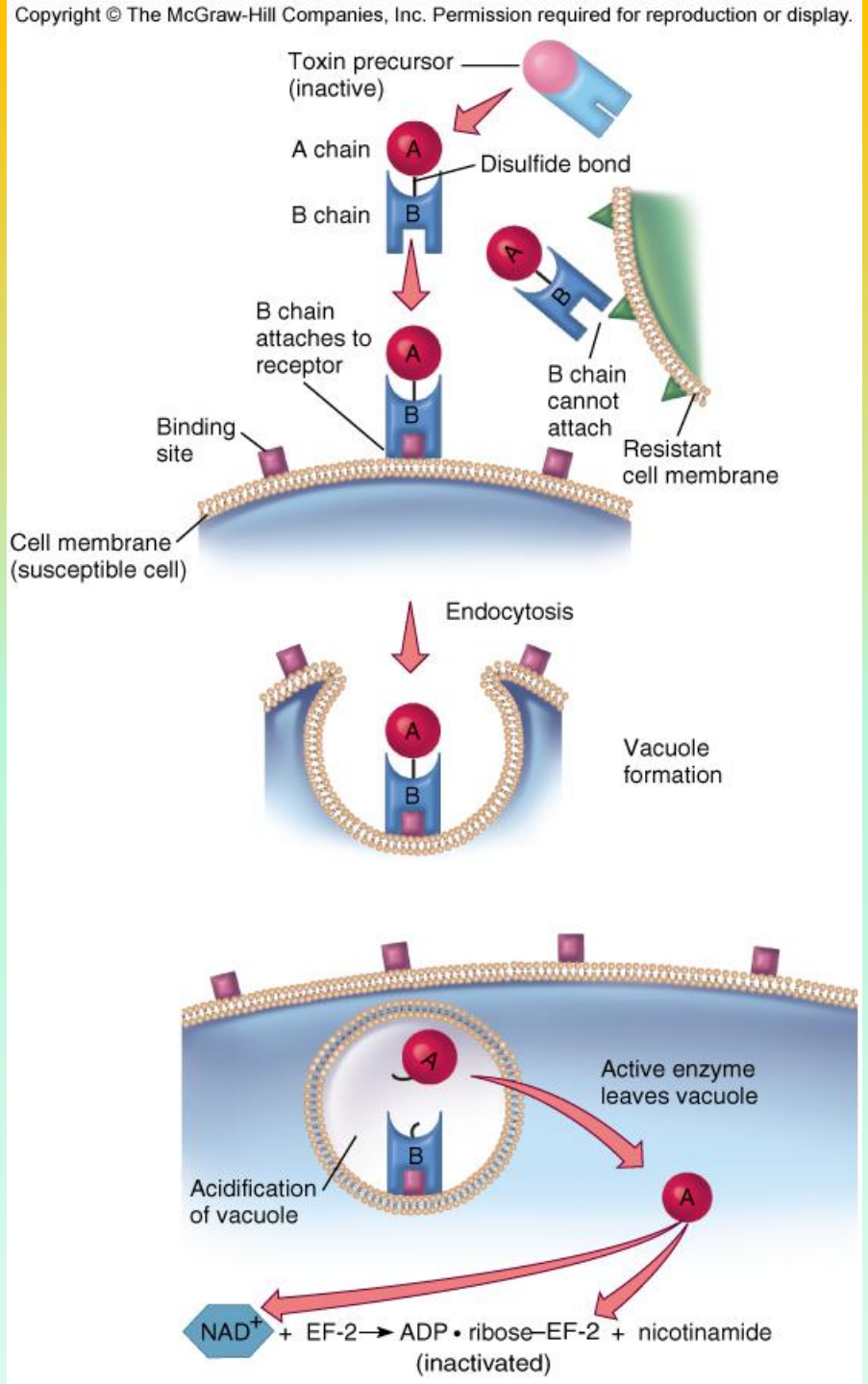
Differential Characteristics of Bacterial Exotoxins and Endotoxin

Characteristic	Exotoxins	Endotoxin
Toxicity	Toxic in minute amounts	Toxic in high doses
Effects on the Body	Specific to a cell type (blood, liver, nerve)	Systemic: fever, inflammation
Chemical Composition	Small proteins	Lipopolysaccharide of cell wall
Heat Denaturation at 60°C	Unstable	Stable
Toxoid Formation	Can be converted to toxoid*	Cannot be converted to toxoid
Immune Response	Stimulate antitoxins**	Does not stimulate antitoxins
Fever Stimulation	Usually not	Yes
Manner of Release	Secreted from live cell	Released from cell wall during lysis
Typical Sources	A few gram-positive and gram-negative	All gram-negative bacteria

**A toxoid is an inactivated toxin used in vaccines.*

***An antitoxin is an antibody that reacts specifically with a toxin.*

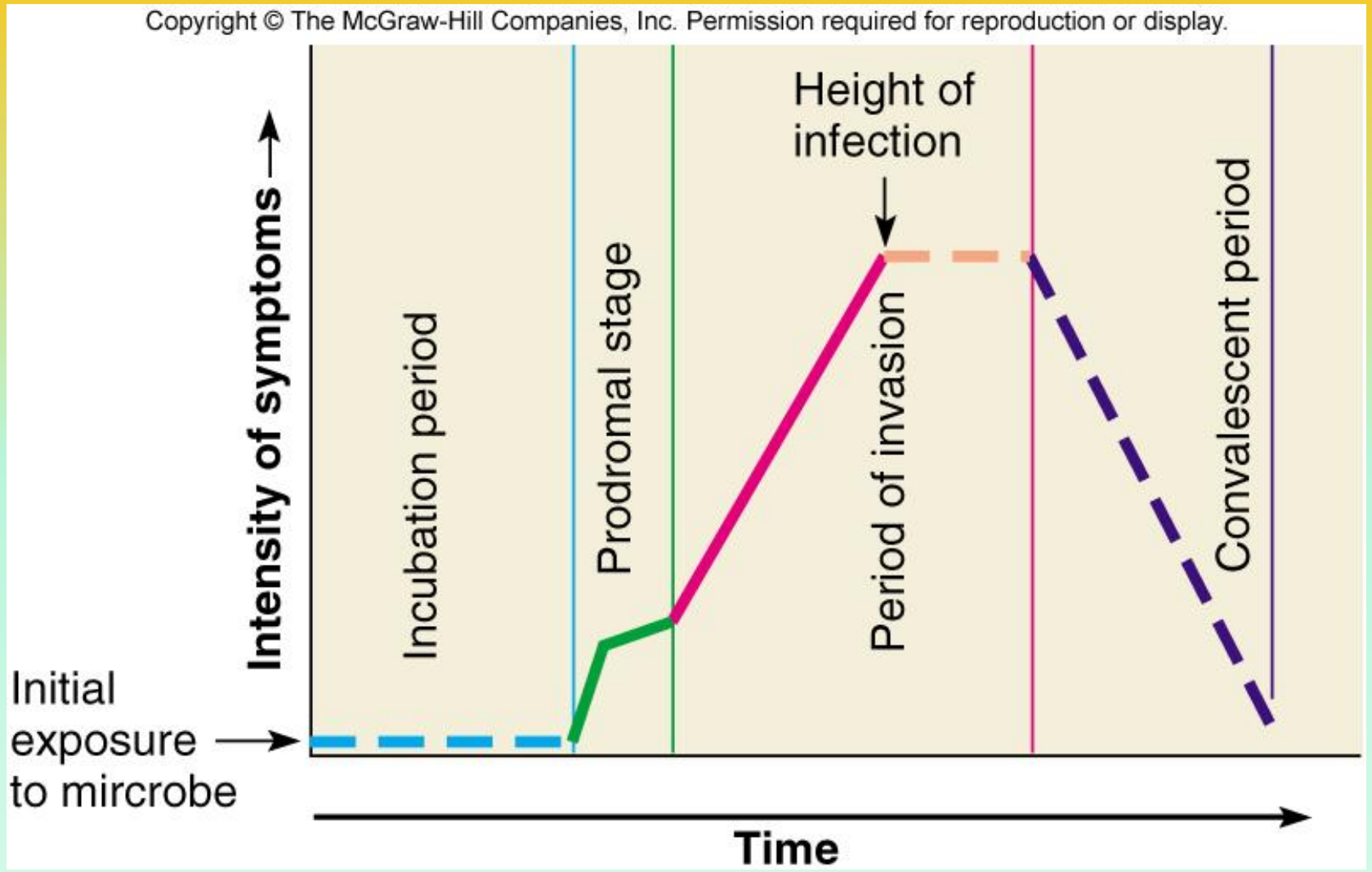
Figure 13.12


Copyright © The McGraw-Hill Companies, Inc. Permission required for reproduction or display.
Toxin precursor (inactive)
A chain
Disulfide bond
B chain
B chain attaches to receptor
B chain cannot attach
Binding site
Resistant cell membrane
Cell membrane (susceptible cell)
Endocytosis
Vacuole formation
Active enzyme leaves vacuole
Acidification of vacuole
NAD+ + EF-2 → ADP • ribose–EF-2 + nicotinamide
(inactivated)

The Process of Infection and Disease

- 4 distinct stages of clinical infections:
  - **Incubation period** – time from initial contact with the infectious agent to the appearance of first symptoms; agent is multiplying but damage is insufficient to cause symptoms; several hours to several years
  - **Prodromal stage** – vague feelings of discomfort; nonspecific complaints
  - **Period of invasion** – multiplies at high levels, becomes well-established; more specific signs and symptoms
  - **Convalescent period** – as person begins to respond to the infection, symptoms decline

Figure 13.13 Stages in the course of infection and disease

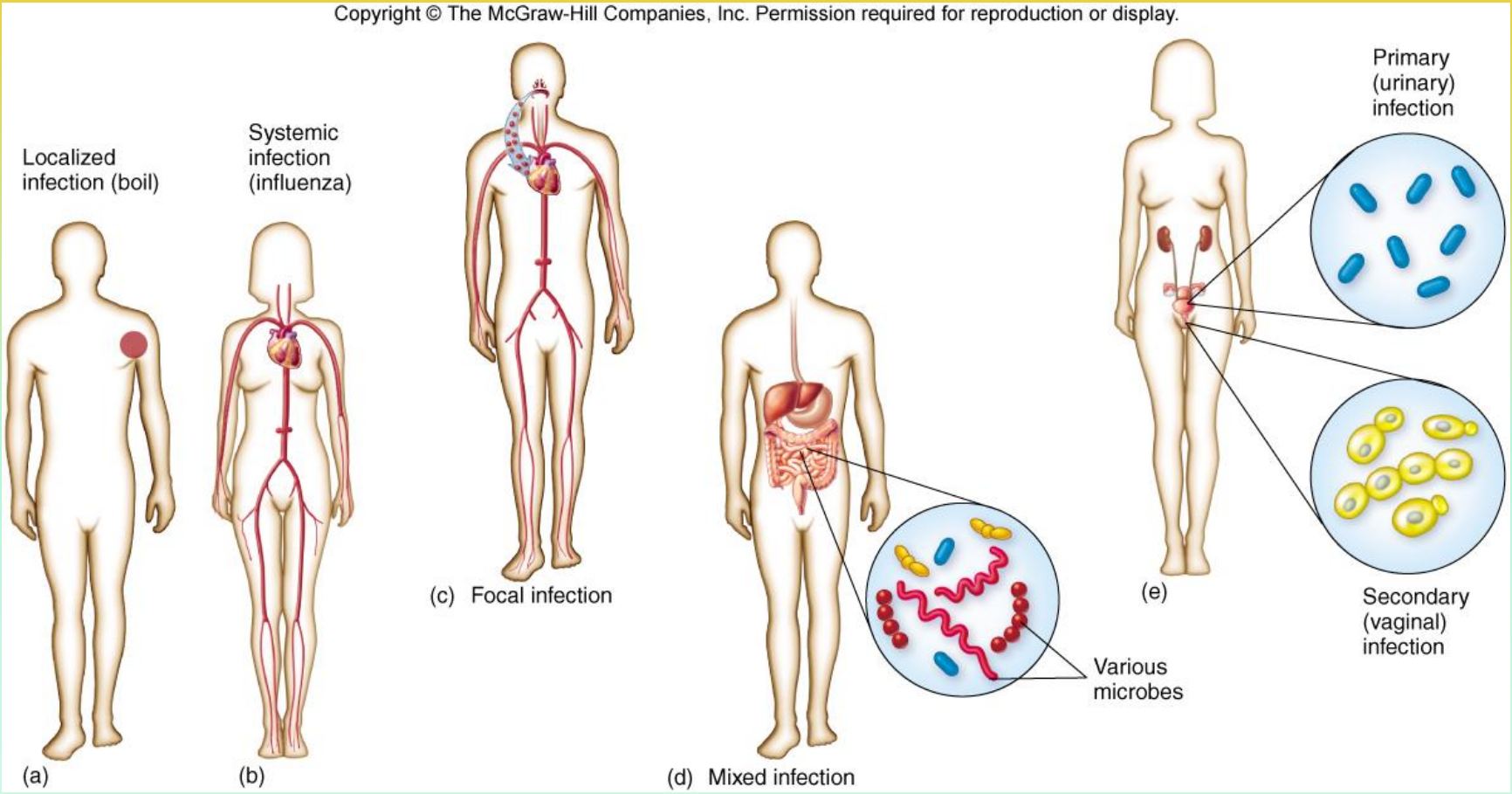


Establishment, Spread, and Pathologic Effects

Patterns of infection:

- **Localized infection** – microbes enter the body and remains confined to a specific tissue
- **Systemic infection** – infection spreads to several sites and tissue fluids usually in the bloodstream
- **Focal infection** – when infectious agent breaks loose from a local infection and is carried to other tissues

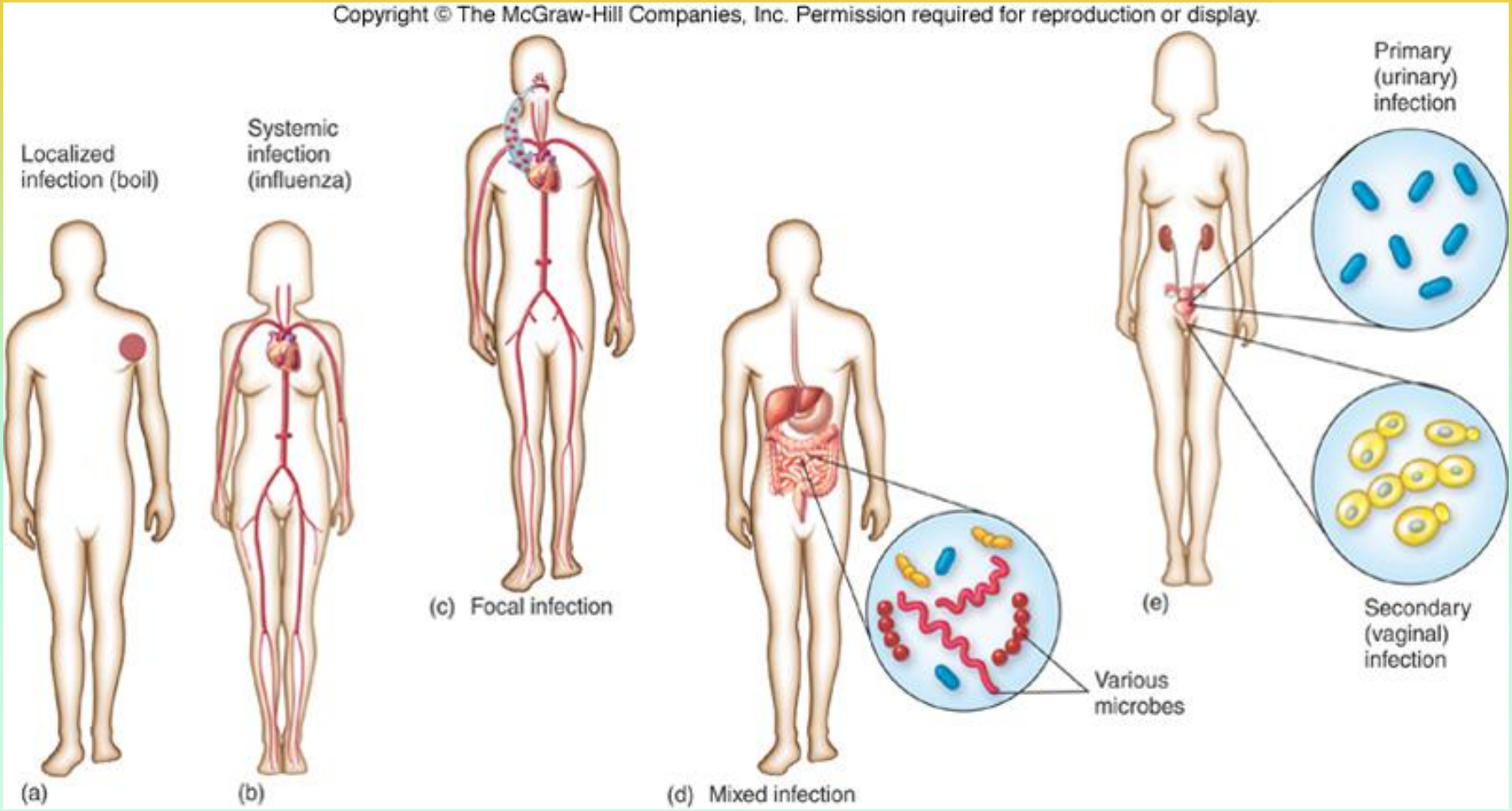
Figure 13.14


Copyright © The McGraw-Hill Companies, Inc. Permission required for reproduction or display.
Localized infection (boil)
Systemic infection (influenza)
(a)
(b)
(c) Focal infection
(d) Mixed infection
Various microbes
Primary (urinary) infection
(e)
Secondary (vaginal) infection

Patterns of Infection

- **Mixed infection** – several microbes grow simultaneously at the infection site - **polymicrobial**
- **Primary infection** – initial infection
- **Secondary infection** – another infection by a different microbe
- **Acute infection** – comes on rapidly, with severe but short-lived effects
- **Chronic infections** – progress and persist over a long period of time

Figure 13.14 Occurrence of infections with regard to location and sequence



Signs and Symptoms of Inflammation

- Earliest symptoms of disease as a result of the activation of the body defenses
  - Fever, pain, soreness, swelling
- Signs of inflammation:
  - Edema – accumulation of fluid
  - Granulomas and abscesses – walled-off collections of inflammatory cells and microbes
  - Lymphadenitis – swollen lymph nodes

Signs of Infection in the Blood

- Changes in the number of circulating white blood cells
  - Leukocytosis – increase in white blood cells
  - Leukopenia – decrease in white blood cells
  - Septicemia – microorganisms are multiplying in the blood and present in large numbers
    - Bacteremia – small numbers of bacteria present in blood not necessarily multiplying
    - Viremia – small number of viruses present not necessarily multiplying

TABLE 13.9 Common Signs and Symptoms of Infectious Diseases

Signs	Symptoms
Fever	Chills
Septicemia	Pain, irritation
Microbes in tissue fluids	Nausea
Chest sounds	Malaise, fatigue
Skin eruptions	Chest tightness
Leukocytosis	Itching
Leukopenia	Headache
Swollen lymph nodes	Weakness
Abscesses	Abdominal cramps
Tachycardia (increased heart rate)	Anorexia (lack of appetite)
Antibodies in serum	Sore throat

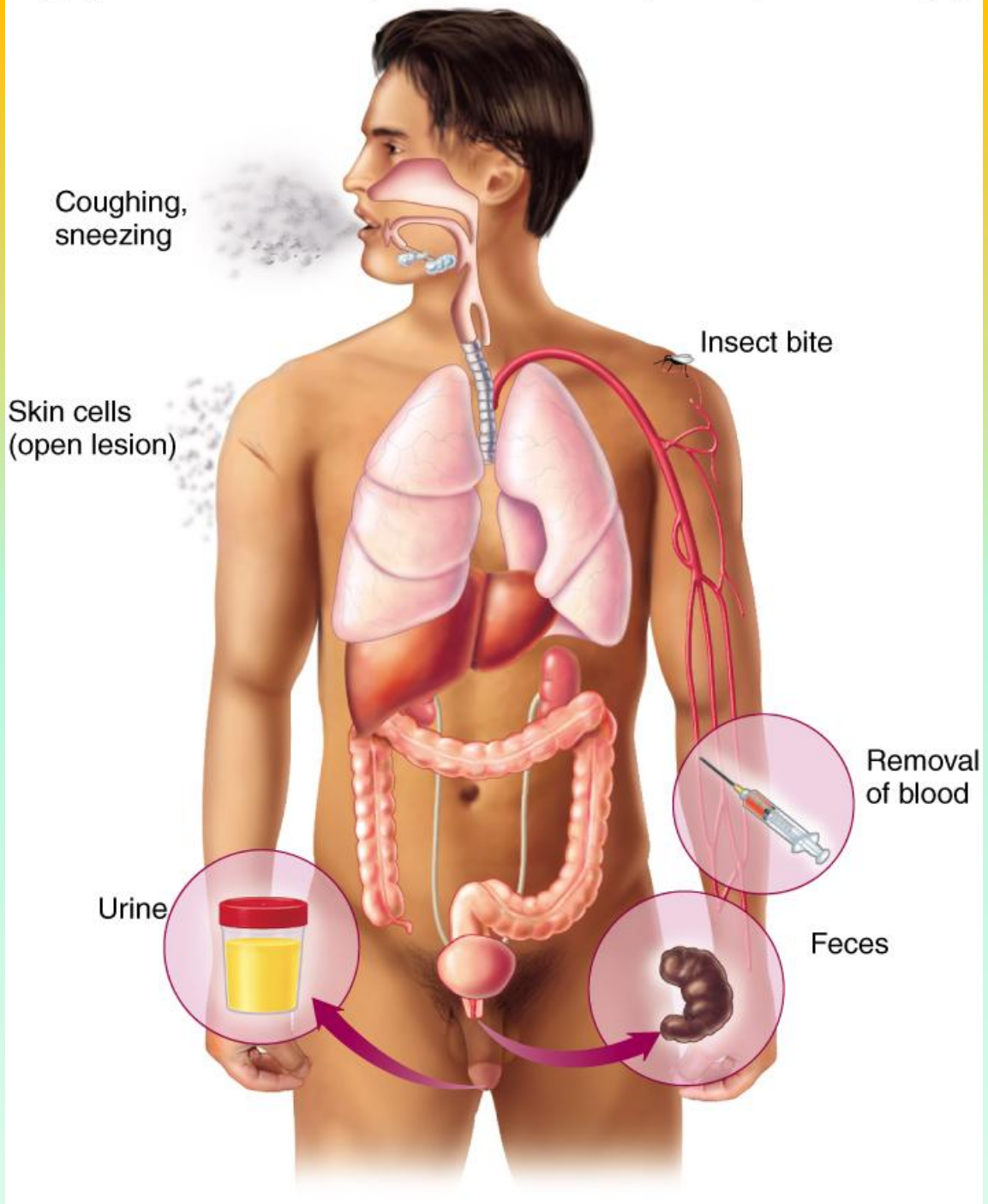
Infections That Go Unnoticed

- **Asymptomatic** (subclinical) infections – although infected, the host doesn't show any signs of disease
- Inapparent infection, so person doesn't seek medical attention

Portals of Exit

- Pathogens depart by a specific avenue; greatly influences the dissemination of infection
  - Respiratory – mucus, sputum, nasal drainage, saliva
  - Skin scales
  - Fecal exit
  - Urogenital tract
  - Removal of blood

Figure 13.15



Persistence of Microbes and Pathologic Conditions

- Apparent recovery of host does not always mean the microbe has been removed
- **Latency** – after the initial symptoms in certain chronic diseases, the microbe can periodically become active and produce a recurrent disease; person may or may not shed it during the latent stage
- **Chronic carrier** – person with a latent infection who sheds the infectious agent
- **Sequelae** – long-term or permanent damage to tissues or organs

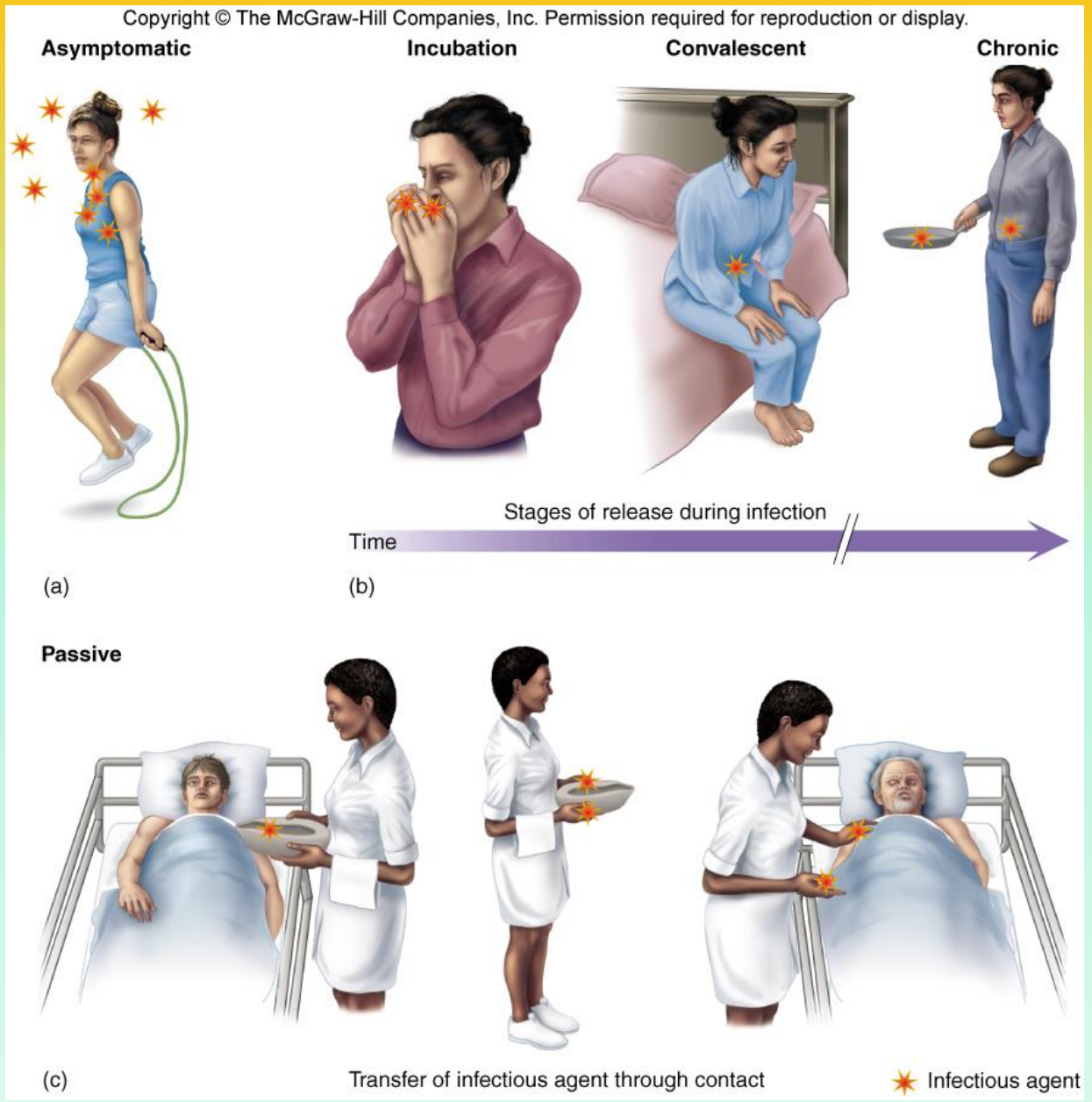
13.3 Sources and Transmission of Microbes

- **Reservoir** – primary habitat of pathogen in the natural world
  - Human or animal carrier, soil, water, plants
- **Source** – individual or object from which an infection is actually acquired

Living Reservoirs

- Carrier – an individual who inconspicuously shelters a pathogen and spreads it to others; may or may not have experienced disease due to the microbe
- **Asymptomatic carrier** – show no symptoms
  - **Incubation carriers** – spread the infectious agent during the incubation period
  - **Convalescent carriers** – recuperating without symptoms
  - **Chronic carrier** – individual who shelters the infectious agent for a long period
- **Passive carrier** – contaminated healthcare provider picks up pathogens and transfers them to other patients

Figure 13.16


Copyright © The McGraw-Hill Companies, Inc. Permission required for reproduction or display.
Asymptomatic
Incubation
Convalescent
Chronic
Stages of release during infection
Time
(a)
(b)
Passive
(c)
Transfer of infectious agent through contact
Infectious agent

Animals as Reservoirs and Sources

- A live animal (other than human) that transmits an infectious agent from one host to another is called a **vector**
- Majority of vectors are arthropods – fleas, mosquitoes, flies, and ticks
- Some larger animals can also spread infection – mammals, birds, lower vertebrates
- **Biological vectors** – actively participate in a pathogen's life cycle
- **Mechanical vector** – not necessary to the life cycle of an infectious agent and merely transports it without being infected

- An infection indigenous to animals but naturally transmissible to humans is a **zoonosis**
- Humans don’t transmit the disease to others
- At least 150 zoonoses exist worldwide; make up 70% of all new emerging diseases worldwide
- Impossible to eradicate the disease without eradicating the animal reservoir

TABLE 13.10 Common Zoonotic Infections

Disease/Agent	Primary Animal Reservoirs
Viruses	
Rabies	All mammals
Yellow fever	Wild birds, mammals, mosquitoes
Viral fevers	Wild mammals
Hantavirus	Rodents
Influenza	Chickens, swine
West Nile virus	Wild birds, mosquitoes
Bacteria	
Rocky Mountain spotted fever	Dogs, ticks
Psittacosis	Birds
Leptospirosis	Domestic animals
Anthrax	Domestic animals
Brucellosis	Cattle, sheep, pigs
Plague	Rodents, fleas
Salmonellosis	Variety of mammals, birds, and rodents
Tularemia	Rodents, birds, arthropods
Miscellaneous	
Ringworm	Domestic mammals
Toxoplasmosis	Cats, rodents, birds
Trypanosomiasis	Domestic and wild mammals
Trichinosis	Swine, bears
Tapeworm	Cattle, swine, fish
Scabies	Domestic animals

Nonliving Reservoirs

- Soil, water, and air

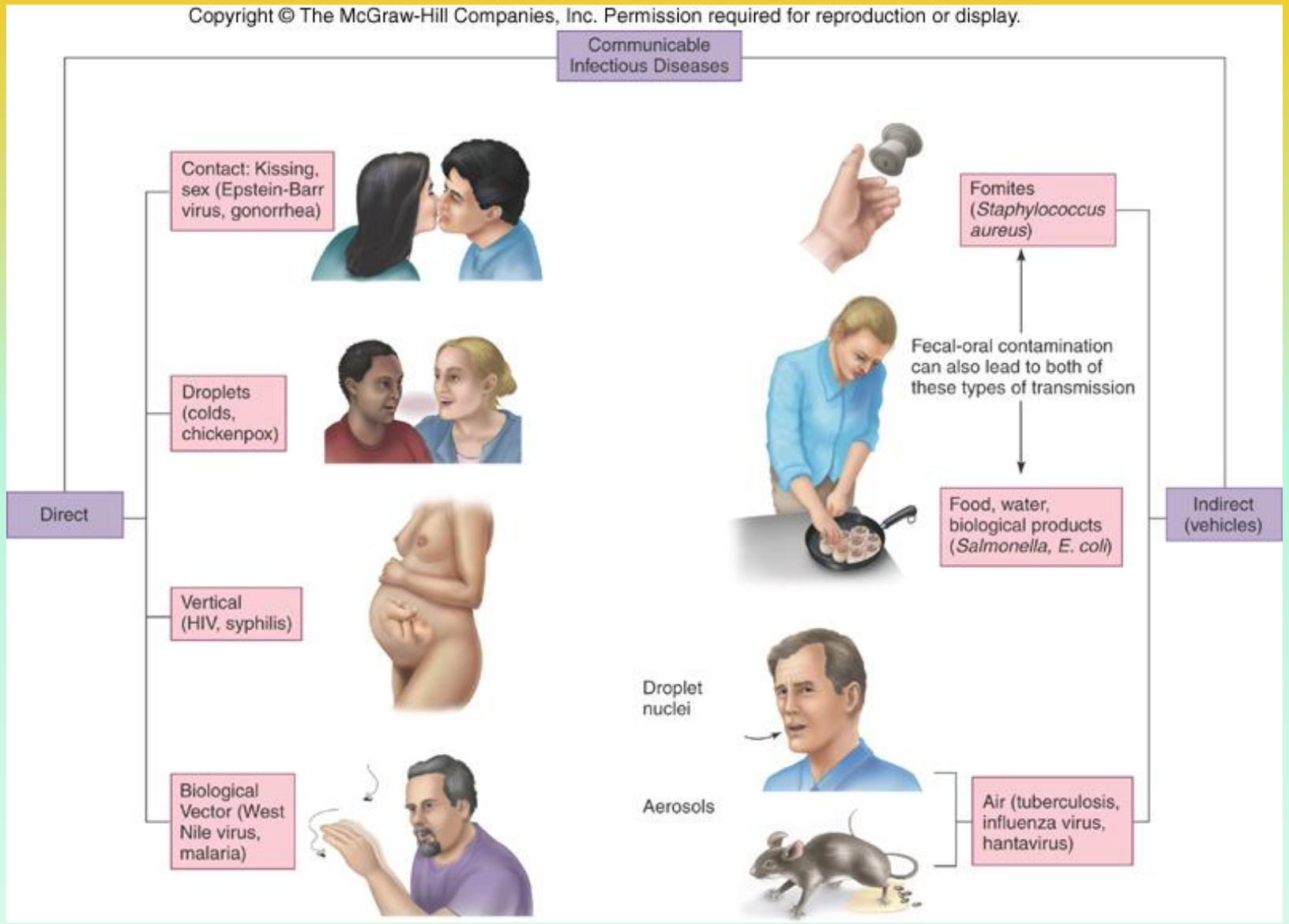
Acquisition and Transmission of Infectious Agents

- **Communicable disease** – when an infected host can transmit the infectious agent to another host and establish infection in that host
- Highly communicable disease is **contagious**
- **Non-communicable** infectious disease does not arise through transmission from host to host
  - Occurs primarily when a compromised person is invaded by his or her own normal microflora
  - Contact with organism in natural, non-living reservoir

Patterns of Transmission

- Direct contact – physical contact or fine aerosol droplets
- Indirect contact – passes from infected host to intermediate conveyor and then to another host
  - Vehicle – inanimate material, food, water, biological products, fomites
  - Airborne – droplet nuclei, aerosols

Figure 13.17 How communicable diseases are acquired



© Marshall W. Jennison, Massachusetts Institute of Technology, 1940

Nosocomial Infections

- Diseases that are acquired or developed during a hospital stay
- From surgical procedures, equipment, personnel, and exposure to drug-resistant microorganisms
- 2 to 4 million cases/year in U.S. with approximately 90,000 deaths
- Most commonly involve urinary tract, respiratory tract, and surgical incisions
- Most common organisms involved: Gram-negative intestinal flora
  - *E. coli*, *Pseudomonas*, *Staphylococcus*

Figure 13.19 Common nosocomial infections

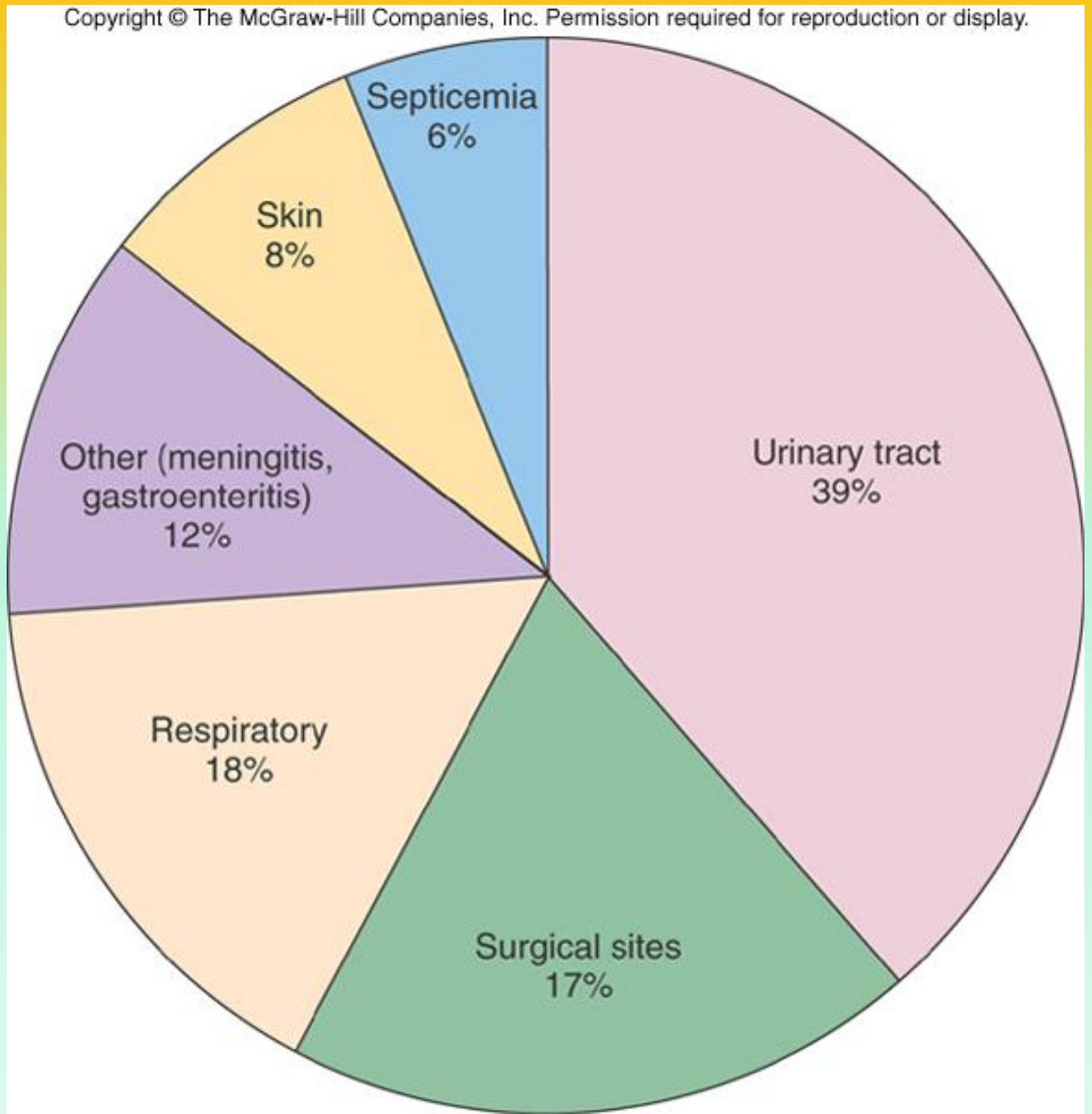


TABLE 13.11 Levels of Isolation Used in Clinical Settings

Type of Isolation*	Protective Measures**	To Prevent Spread of
Enteric Precautions	Gowns and gloves must be worn by all persons having direct contact with patient; masks are not required; special precautions are taken for disposing of feces and urine.	Diarrheal diseases; *Shigella, Salmonella,* and *Escherichia coli* gastroenteritis; cholera; hepatitis A; rotavirus; and giardiasis
Respiratory Precautions	Private room with closed door is necessary; gowns and gloves are not required; masks are usually indicated; items contaminated with secretions must be disinfected.	Tuberculosis, measles, mumps, meningitis, pertussis, rubella, chickenpox
Drainage and Secretion Precautions	Gowns and gloves are required for all persons; masks are not needed; contaminated instruments and dressings require special precautions.	Staphylococcal and streptococcal infections; gas gangrene; herpes zoster; burn infections
Strict Isolation	Private room with closed door is required; gowns, masks, and gloves must be worn by all persons; contaminated items must be wrapped and sent to central supply for decontamination.	Mostly highly virulent or contagious microbes; includes diphtheria, some types of pneumonia, extensive skin and burn infections, disseminated herpes simplex and zoster
Reverse Isolation (Also Called Protective Isolation)	Same guidelines as for strict isolation are required; room may be ventilated by unidirectional or laminar airflow filtered through a high-efficiency particulate air (HEPA) filter that removes most airborne pathogens; infected persons must be barred.	Used to protect patients extremely immunocompromised by cancer therapy, surgery, genetic defects, burns, prematurity, or AIDS and therefore vulnerable to opportunistic pathogens

*Precautions are based upon the primary portal of entry and communicability of the pathogen.

**In all cases, visitors to the patient's room must report to the nurses' station before entering the room; all visitors and personnel must wash their hands upon entering and leaving the room.

Universal Blood and Body Fluid Precautions

- Stringent measures to prevent the spread of nosocomial infections from patient to patient, from patient to worker, and from worker to patient – **universal precautions**
- Based on the assumption that all patient specimens could harbor infectious agents, so must be treated with the same degree of care

13.4 Epidemiology

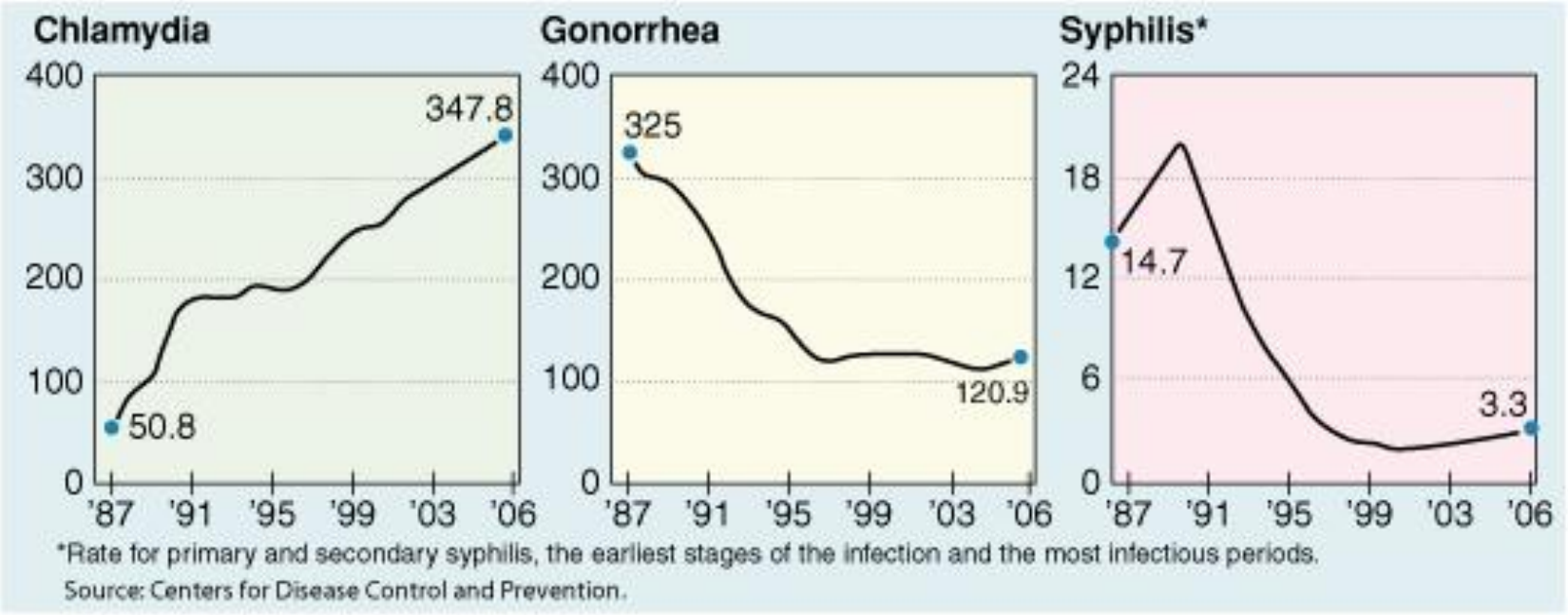
- The study of the frequency and distribution of disease and health-related factors in human populations
- Surveillance – collecting, analyzing, and reporting data on rates of occurrence, mortality, morbidity and transmission of infections
- Reportable, notifiable diseases must be reported to authorities

- Centers for Disease Control and Prevention (CDC) in Atlanta, GA – principal government agency responsible for keeping track of infectious diseases nationwide
- http://www.cdc.gov

Frequency of Cases

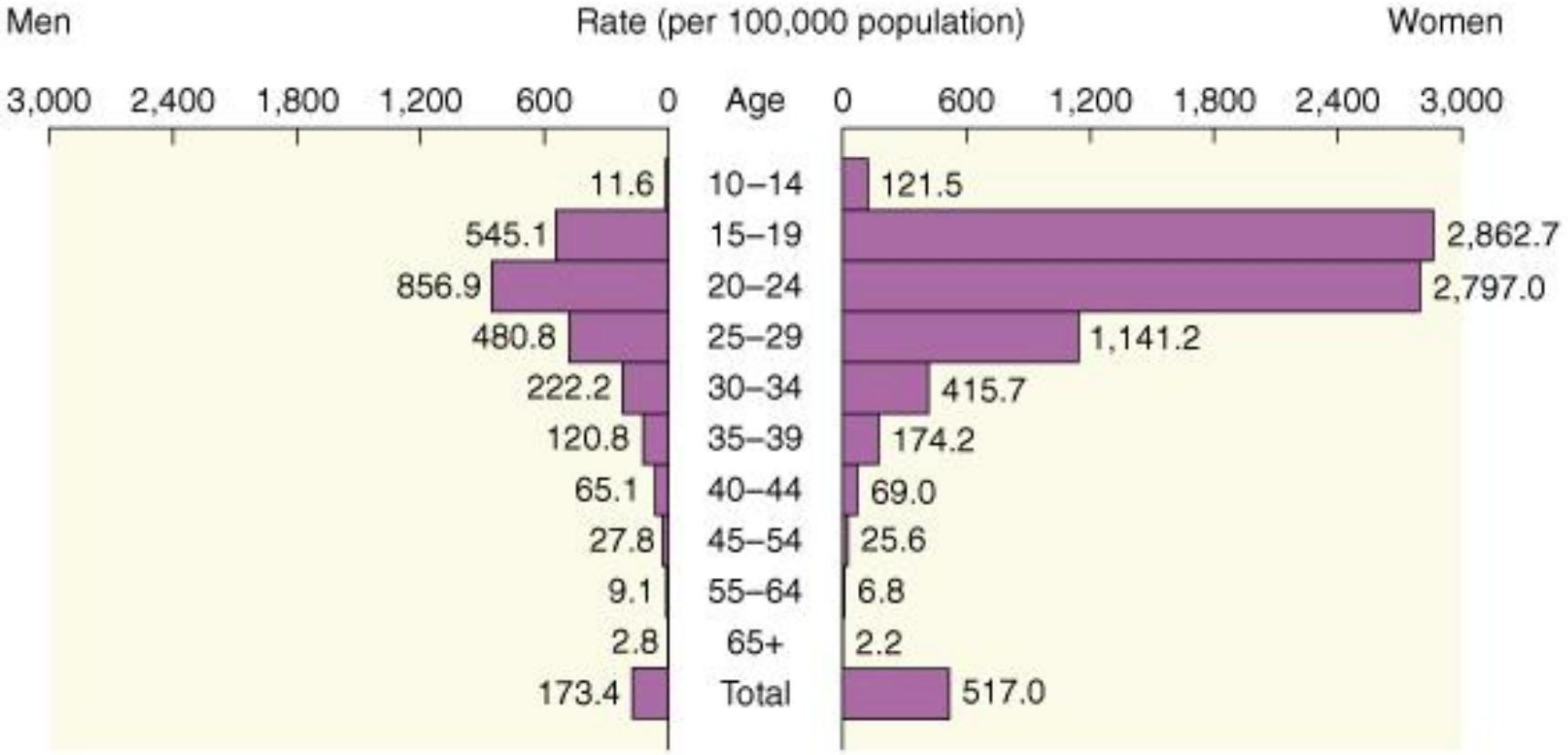
- **Prevalence** – total number of existing cases with respect to the entire population usually represented by a percentage of the population
- **Incidence** – measures the number of new cases over a certain time period, as compared with the general healthy population

Figure 13.30 (a)



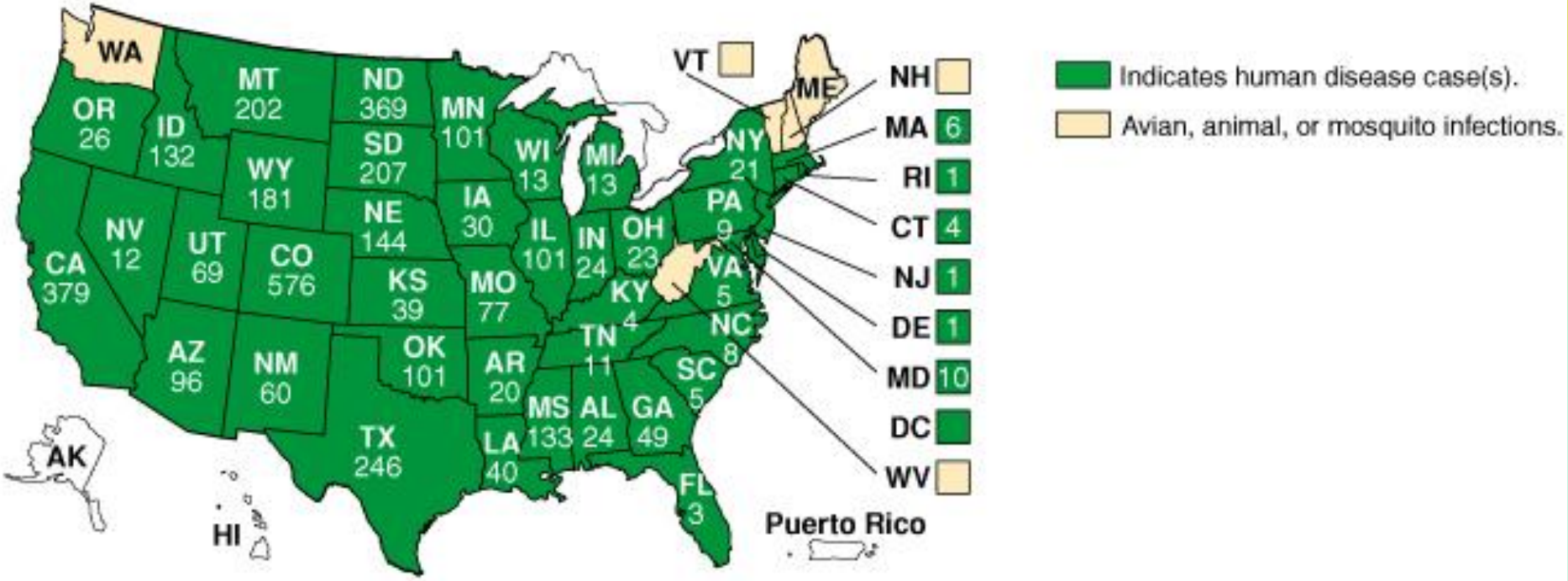
(a) Overall rates of chlamydia, gonorrhea and syphilis have risen for the second year in a row, raising concerns among public health officials. Rates per 100,000 people:

Figure 13.30 (b)



(b) Chlamydia — Age- and sex-specific rates: United States, 2006

Figure 13.30 (c)

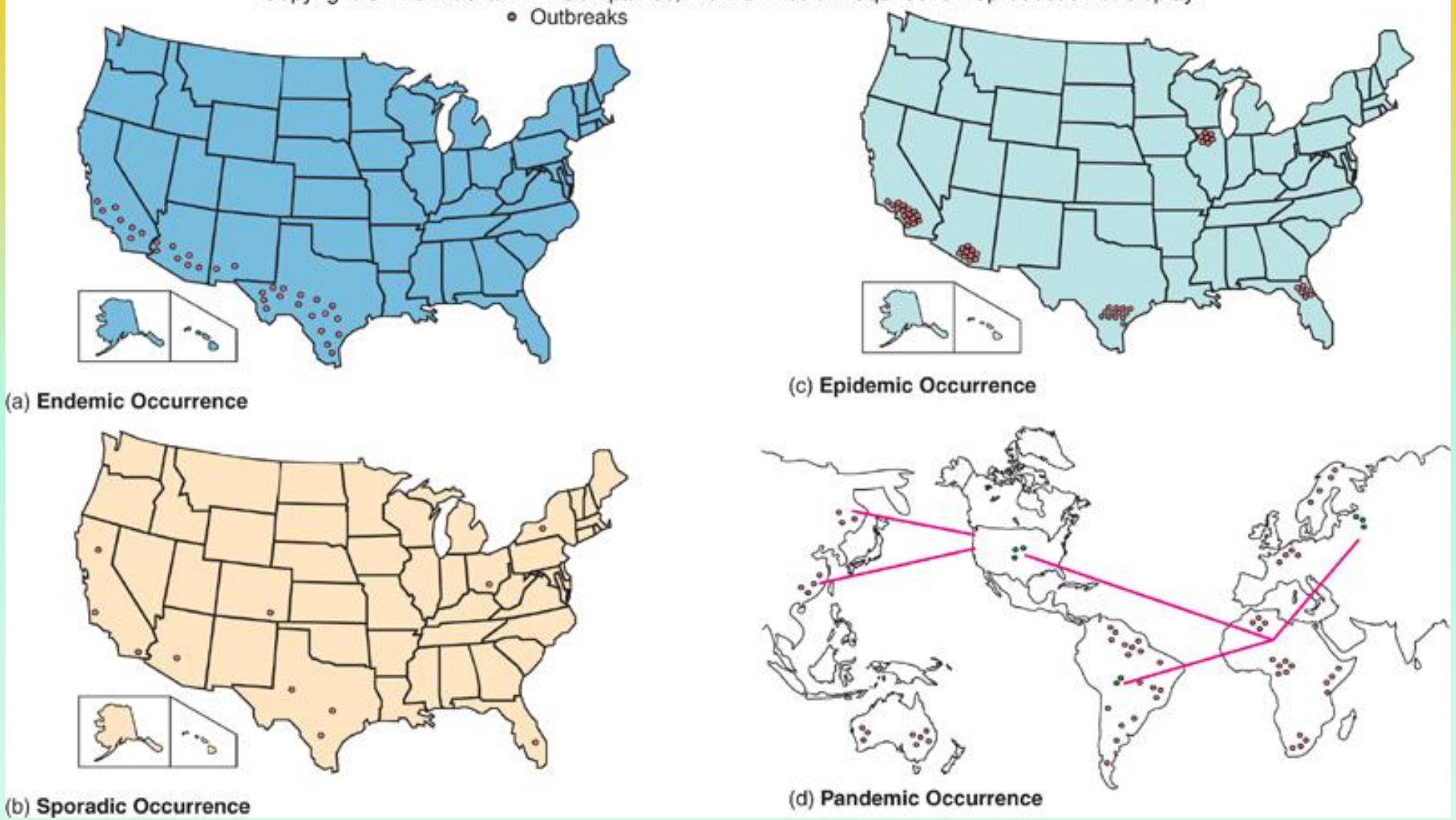


(c) West Nile virus — Activity by state, 2007

- **Mortality rate** – the total number of deaths in a population due to a certain disease
- **Morbidity rate** – number of people afflicted with a certain disease

- **Endemic** – disease that exhibits a relatively steady frequency over a long period of time in a particular geographic locale
- **Sporadic** – when occasional cases are reported at irregular intervals
- **Epidemic** – when prevalence of a disease is increasing beyond what is expected
- **Pandemic** – epidemic across continents

Figure 13.21 Patterns of infectious disease occurrence



Koch's Postulates

Determining the causative or **etiologic** agent of infectious disease:

- Find evidence of a particular microbe in every case of a disease
- Isolate that microbe from an infected subject and cultivate it artificially in the laboratory
- Inoculate a susceptible healthy subject with the laboratory isolate and observe the resultant disease
- Reisolate the agent from this subject