Chapter 14
Principles of Disease and Epidemiology

Pathology, Infection, and Disease

Pathology, Infection, and Disease
- Pathology: The study of disease
- Etiology: The study of the cause of a disease
- Pathogenesis: The development of disease
- Infection: Colonization of the body by pathogens
- Disease: An abnormal state in which the body is not functioning normally

What are the objectives of pathology?
14-1

Normal Microbiota

Normal Microbiota and the Host
- Transient microbiota may be present for days, weeks, or months
- Normal microbiota permanently colonize the host
- Symbiosis is the relationship between normal microbiota and the host

Representative Normal Microbiota

Symbiosis
- In commensalism, one organism benefits, and the other is unaffected
- In mutualism, both organisms benefit
- In parasitism, one organism benefits at the expense of the other
- Some normal microbiota are opportunistic pathogens

Normal Microbiota on the Human Body

Normal Microbiota and the Host
- Microbial antagonism is a competition between microbes.
- Normal microbiota protect the host by
  - Occupying niches that pathogens might occupy
  - Producing acids
  - Producing bacteriocins
- Probiotics: Live microbes applied to or ingested into the body, intended to exert a beneficial effect

How do normal microbiota differ from transient microbiota? 14-2
Give several examples of microbial antagonism. 14-3
How can opportunistic pathogens cause infections? 14-4

The Etiology of Infectious Diseases

Koch’s Postulates
1. The same pathogen must be present in every case of the disease
2. The pathogen must be isolated from the diseases host and grown in pure culture
3. The pathogen from the pure culture must cause the disease when it is inoculated into a healthy, susceptible lab animal
4. The pathogen must be isolated from the inoculated animal and must be shown to be
Koch’s Postulates

Koch’s postulates are used to prove the cause of an infectious disease
- Some pathogens can cause several disease conditions
- Some pathogens cause disease only in humans

Explain some exceptions to Koch’s postulates. 14-5

Classifying Infectious Diseases

Symptom: A change in body function that is felt by a patient as a result of disease
Sign: A change in a body that can be measured or observed as a result of disease
Syndrome: A specific group of signs and symptoms that accompany a disease

Communicable disease: A disease that is spread from one host to another
Contagious disease: A disease that is easily spread from one host to another
Noncommunicable disease: A disease that is not transmitted from one host to another

Occurrence of a Disease

Incidence: Fraction of a population that contracts a disease during a specific time
Prevalence: Fraction of a population having a specific disease at a given time
Sporadic disease: Disease that occurs occasionally in a population

Endemic disease: Disease constantly present in a population
Epidemic disease: Disease acquired by many hosts in a given area in a short time
Pandemic disease: Worldwide epidemic
Herd immunity: Immunity in most of a population

Severity or Duration of a Disease

Acute disease: Symptoms develop rapidly
Chronic disease: Disease develops slowly
Subacute disease: Symptoms between acute and chronic
Latent disease: Disease with a period of no symptoms when the causative agent is inactive

Extent of Host Involvement

Local infection: Pathogens are limited to a small area of the body
Systemic infection: An infection throughout the body
Focal infection: Systemic infection that began as a local infection

Sepsis: Toxic inflammatory condition arising from the spread of microbes, especially bacteria or their toxins, from a focus of infection
Bacteremia: Bacteria in the blood
Septicemia: Growth of bacteria in the blood
Toxemia: Toxins in the blood  
Viremia: Viruses in the blood  
Primary infection: Acute infection that causes the initial illness  
Secondary infection: Opportunistic infection after a primary (predisposing) infection  
Subclinical disease: No noticeable signs or symptoms (inapparent infection)

- Does *Clostridium perfringens* cause a communicable disease? 14-6
- Distinguish the incidence from the prevalence of a disease. 14-7
- List two examples of acute and chronic diseases. 14-8
- How does herd immunity develop? 14-9

**Patterns of Disease**

**Predisposing Factors**
- Make the body more susceptible to disease
  - Short urethra in females
  - Inherited traits, such as the sickle cell gene
  - Climate and weather
  - Fatigue
  - Age
  - Lifestyle
  - Chemotherapy

**The Stages of a Disease**

- What is a predisposing factor? 14-10
- The incubation period for a cold is 3 days, and the period of disease is usually 5 days. If the person next to you has a cold, when will you know whether you contracted it? 14-11

**The Spread of Infection**

**Reservoirs of Infection**
- Continual sources of infection
  - Human: AIDS, gonorrhea
    - Carriers may have inapparent infections or latent diseases
  - Animal: Rabies, Lyme disease
    - Some zoonoses may be transmitted to humans
  - Nonliving: Botulism, tetanus
    - Soil

**Transmission of Disease**
- Contact
  - Direct: Requires close association between infected and susceptible host
  - Indirect: Spread by fomites
  - Droplet: Transmission via airborne droplets

**Transmission of Disease**

**Vehicle Transmission**
- Transmission by an inanimate reservoir (food, water, air)
Vectors

- Arthropods, especially fleas, ticks, and mosquitoes
- Transmit disease by 2 general methods:
  - Mechanical transmission: Arthropod carries pathogen on feet
  - Biological transmission: Pathogen reproduces in vector

Why are carriers important reservoirs of infection? 14-12
How are zoonoses transmitted to humans? 14-13
Give an example of contact transmission, vehicle transmission, mechanical transmission, and biological transmission. 14-14

Nosocomial (Hospital-Acquired) Infections

Nosocomial Infections
- Are acquired as a result of a hospital stay
- Affect 5–15% of all hospital patients

Common Causes of Nosocomial Infections

- MRSA (Methicillin-resistant Staphylococcus aureus)
  - USA100: 92% of health care strains
  - USA300: 89% of community-acquired strains

Which Procedure Increases the Likelihood of Infection Most?

- What interacting factors result in nosocomial infections? 14-15
- What is a compromised host? 14-16
- How are nosocomial infections primarily transmitted, and how can they be prevented? 14-17, 14-18

Emerging Infectious Diseases

Emerging Infectious Diseases
- Diseases that are new, increasing in incidence, or showing a potential to increase in the near future

Emerging Infectious Diseases
- Contributing factors
  - Genetic recombination
    - E. coli O157, avian influenza (H5N1)
  - Evolution of new strains
    - V. cholerae O139
  - Inappropriate use of antibiotics and pesticides
    - Antibiotic-resistant strains
  - Changes in weather patterns
    - Hantavirus
- Modern transportation
  - West Nile virus
- Ecological disaster, war, and expanding human settlement
  - Coccidioidomycosis
- Animal control measures
  - Lyme disease
- Public health failure
  - Diphtheria

### Crossing the Species Barrier

✓ Give several examples of emerging infectious diseases. 14-19

### Epidemiology

- The study of where and when diseases occur
- Centers for Disease Control and Prevention (CDC)
  - Collects and analyzes epidemiological information in the United States
  - Publishes *Morbidity and Mortality Weekly Report (MMWR)*
  - [www.cdc.gov](http://www.cdc.gov)

### Epidemiology

- Descriptive: Collection and analysis of data
  - Snow
- Analytical: Comparison of a diseased group and a healthy group
  - Nightingale
- Experimental: Controlled experiments
  - Semmelweis

### Epidemiology

- Case reporting: Health care workers report specified disease to local, state, and national offices
- Nationally notifiable diseases: Physicians are required to report occurrence

### The CDC

- Morbidity: Incidence of a specific notifiable disease
- Mortality: Deaths from notifiable diseases
- Morbidity rate: Number of people affected in relation to the total population in a given time period
- Mortality rate: Number of deaths from a disease in relation to the population in a given time

✓ After learning that 40 hospital employees developed nausea and vomiting, the hospital
infection control officer determined that 39 ill people ate green beans in the hospital cafeteria, compared to 34 healthy people who ate in the cafeteria the same day but did not eat green beans in the hospital cafeteria. What type of epidemiology is this? 14-20

✓ What is the CDC’s function? 14-21
✓ In 2003, the morbidity of hemolytic uremic syndrome was 176, and the mortality was 29. The morbidity of listeriosis was 696; the mortality was 33. Which disease is more likely to be fatal? 14-22