Chapters 22-24:
Microorganisms and Human Disease
Categories of Infectious Diseases:

Chapter 22: Diseases of Respiratory System

Chapter 23: Diseases of Digestive System

Chapter 24: Diseases of Urinary and Reproductive System
Chapter 22: Diseases of Respiratory System

1. Common Cold

◆ Characteristics: Sneezing, sore throat, watery nose, congestion, and bronchitis.

◆ Pathogens: Over 200 different viruses: rhinovirus (50%), adenovirus, coronavirus, and others.

◆ Reservoir: Human respiratory system.

◆ Transmission: Respiratory secretions via hands, direct contact, air-borne droplets, and fomites.

◆ Incubation period: 1 to 3 days.

◆ Epidemiology: Millions of cases/year in U.S.
  
  Children: About 4 colds/year
  
  Adults: About 1 cold/year  Disinfect eating utensils.  Avoid contact with infected individuals.

◆ Control: Sanitary disposal of nasal discharges.

◆ Treatment: Antiviral agents. Avoid antibiotics unless secondary bacterial infection develops.
2. Tuberculosis

Tuberculosis is the leading killer among the world’s infectious diseases.

- **Characteristics:** Acute or chronic infection of lungs. May invade lymph nodes and disseminate throughout body. May remain dormant for years. Active infections cause coughing, weight loss, fatigue, and death.

- Infected individuals display hypersensitivity to tuberculin and pulmonary tubercles on X ray.

- **Pathogens:** *Mycobacterium tuberculosis*, occasionally *M. bovis*.

- **Reservoir:** Human respiratory system.

- **Transmission:** Prolonged direct contact, air-borne droplets, milk and contact with infected cattle.

- **Incubation period:** 4 to 12 weeks or longer.
Positive Tuberculosis Skin Test and Chest X Ray

Source: Microbiology with Diseases by Body System, 2009
Tuberculosis with multiple fistulous tracts secondary to lymph node necrosis in patient with scrofula.
Photo by Dr. I. Small
2. Tuberculosis

- **Epidemiology**: About 20,000 new cases/year in U.S. and 2,000 deaths/year. In U.S. minorities are heavily affected. Serious health problem in AIDS patients. One third of human population is infected. Causes over 3 million deaths/year.

- **Control**: Tuberculin testing of humans and cattle. Chest X ray and treatment of infected individuals. BCG vaccine offers limited protection, not widely used in U.S.

- **Treatment**: Up to 18 months combination antibiotic regimen. Multi-drug resistant strains are increasingly common.
Distribution of Tuberculosis in the U.S. by State and Race (2003)

(a) Tuberculosis incidence in the United States, per 100,000 population
Source: CDC, 2003

(b) Tuberculosis rates among American ethnic groups in 2003

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3. Influenza

- **Characteristics:** Acute disease with fever, chills, headache, watery nose, and muscle pain. In severe cases pneumonia, bronchitis, and death may occur (less than 1%).
- **Pathogens:** Influenza virus, types A, B, and C.
- **Reservoir:** Humans.
- **Transmission:** Respiratory secretions, direct contact, air-borne droplets, hands, and fomites.
- **Incubation period:** 1 to 4 days.
- **Epidemiology:** Pandemics occurred in 1889, 1918, 1957, and 1968. Type A epidemics occur every year; type B epidemics (milder) every 2 to 3 years in U.S.
- **Control:** Yearly immunization (70-90% effective). Good hygiene. Avoid contact with crowds and infected individuals.
- **Treatment:** Antiviral (amantidine)
Antigenic Variation of Influenza Virus

1918–1928
Swine
H_{sw}N_{1}

1918 pandemic (H antigen unknown but related to H_{sw} in swine influenza)

1929–1946
H_{0}N_{1}

First isolate identified serologically (H_{0} may be a variant of H_{1})

1947–1956
1977–H_{1}N_{1}

Has been circulating since 1977

1957–1967
H_{2}N_{2}

1957 Asian flu pandemic

1901–1917
1968–H_{3}N_{2}

1968 Hong Kong flu pandemic (has been circulating since 1968)
Chapter 23: Diseases of Digestive System

1. Cholera

- **Characteristics:** Acute diarrhea with explosive, watery stools (rice-water stools), vomiting, abdominal cramps, shock, dehydration, loss of blood volume, collapse and death (25-50% of cases) within hours if untreated.

- **Pathogens:** *Vibrio cholerae* type 1 that secretes an enterotoxin.

- **Reservoir:** Humans, contaminated water (found in both fresh and salt-water), and seafood.

- **Transmission:** Fecal-oral route, contaminated water, food, and hands.

- **Incubation period:** 1 to 5 days.

- **Epidemiology:** Last epidemic started in early 1990s and infected over 1 million people over several years. Less than 50 cases/year in U.S.
Rice-water Stool of Cholera

Source: Tropical Medicine and Parasitology, 1995
Cholera Cot in Ecuador

www.oucom.ohiou.edu/tdi/ecuador2000/Macara.html
1. Cholera (Continued)

◆ **Control:**
  - Isolate infected patients, disinfect eating utensils, vomitus, feces, and fomites.
  - Good hygiene. Sewage and water treatment.
  - Prophylactic antibiotics for exposed individuals.
  - There is a vaccine against the O1 El Tor strain of *V. cholerae*, but protection is short lived.

◆ **Treatment:** Prompt fluid and electrolyte replacement. Mortality in treated patients drops to 1%. Tetracycline and chemotherapy may shorten duration of disease.
Cholera Pandemic Caused by V. cholerae O1 El Tor

Source: Microbiology with Diseases by Body System, 2009
2. Staphylococcal Food Poisoning

- **Characteristics:** Acute onset of cramps, vomiting, nausea, occasional diarrhea, low body temperature and blood pressure. Recovery is usually complete within 24 hours. Mortality is low in healthy individuals, higher among immunosuppressed individuals.

- **Pathogens:** *S. aureus* strain that produces an enterotoxin.

- **Reservoir:** Human skin, nasal secretions, and cow milk.

- **Transmission:** Ingestion of contaminated foods, particularly meats, creamy, or starchy foods. Toxin is heat stable and can survive 30 minutes of boiling.

- **Incubation period:** 1 to 7 hours, rapid onset.

- **Epidemiology:** Very common, poor reporting.

- **Control:** Sanitary food preparation and adequate refrigeration.

- **Treatment:** Fluid replacement.
Typical Events Leading to Staphylococcal Food Poisoning

1. Food containing protein is cooked (bacteria usually killed).
2. Then food is contaminated by worker with staphylococci on hands (competing bacteria have been eliminated).
3. Organisms incubate in food (temperature abuse) long enough to form and release toxins. (Reheating will eliminate staphylococci but not the toxin.)
4. Food containing toxins is eaten.
5. In one to six hours, intoxication occurs.
3. Salmonella Food Poisoning

- **Characteristics:** Moderate fever, nausea, abdominal pains, diarrhea, and cramps.
- Recovery may take several days. Mortality is less than 1% in healthy individuals, higher among infants and elderly people.
- **Pathogens:** *Salmonella* spp. All strains are pathogenic.
- **Reservoir:** Intestinal tracts of many animals. Pet reptiles.
- **Transmission:** Ingestion of contaminated foods, particularly meats, poultry, and eggs.
- **Incubation period:** 12 to 36 hours.
- **Epidemiology:** Poor reporting. Estimate 2-4 million cases/year with 500-2000 deaths in U.S.
- **Control:** Sanitary food preparation, adequate refrigeration and cooking. No raw or undercooked eggs.
- **Treatment:** Oral fluid replacement.
Incidence of Salmonella & Typhoid Fever in the U.S.

*First 26 weeks of 2005

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Chapter 24: Reproductive System Diseases

1. Gonorrhea

- **Characteristics:** Acute infection of urethra, anus, vagina, cervix, and fallopian tubes.
  - Yellow foul discharge (more common in men).
  - Causes pelvic inflammatory disease (PID) in women.
  - Causes infertility in both men and women.
  - May also result in throat and eye infections.
  - In a large percentage of cases, symptoms are mild or absent.

- **Pathogens:** *Neisseria gonnorrhoea*.

- **Reservoir:** Humans.

- **Transmission:** Direct sexual or mucous membrane contact.
  - Mother to infant transmission during childbirth.

- **Incubation period:** 2 to 7 days.
Typical discharge in male with gonorrhea.
Source: Tropical Medicine and Parasitology, 1995
Both Chlamydia and *Neisseria gonorrhea* Cause Salpingitis
Ophtalmia neonatorum caused by *Neisseria gonorrhoeae*
Source: Microbiology Perspectives, 1999
1. Gonorrhea (Continued)

- **Epidemiology**: Up to 500,000 new cases/year in U.S.
- **Control**: Use of condoms, avoid sexual contact with infected individuals. Vaginal and cervical cultures of pregnant women.
- **Treatment**: Antibiotics. Erythromycin for pregnant women.
Incidence and Distribution of Gonorrhea in U.S.

(a) Incidence of gonorrhea in the United States from 1942 through the first 26 weeks of 2005

(b) Geographical distribution of cases in 2004

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2. Syphilis

- **Characteristics:** Disease occurs in several stages:
  
  **Primary stage:** Painless lesion (*chancre*).
  
  **Secondary stage:** Skin rash with fever and mucous membrane lesions. Typically followed by a long **latent period** in which disease is inactive (latent stage can last 10 years or more).
  
  **Tertiary stage:** Complications from inflammation and immune damage to central nervous system, cardiovascular system, bones, sense organs, visceral organs, and other sites.

- **Pathogens:** *Treponema pallidum*.

- **Reservoir:** Humans.

- **Transmission:** Direct contact with lesions, body secretions, blood, semen, saliva, vaginal discharges; usually during sexual contact. Mother to infant transplacental transmission (*congenital syphilis*). Blood transfusions.

- **Incubation period:** 10 days to several weeks.
Primary Syphilitic Chancre and Secondary Rash

Source: Tropical Medicine and Parasitology, 1997
Secondary Syphilitic Rash

Source: Tropical Medicine and Parasitology, 1997
Tertiary Syphilis with Gumma: Large Rubbery Lesions

Source: A textbook of oral pathology, 1983.
Severe Lesions in Tertiary Syphilis

Source: Tropical Medicine and Parasitology, 1997
Congenital Syphilis with Hutchinson Incisors

2. Syphilis (Continued)

- **Epidemiology:**
  - Worldwide WHO estimates there are 12 million new cases every year.
  - About 10,000 new cases/year in U.S. Incidence has declined significantly since introduction of antibiotics.

- **Control:** Use of condoms, avoid sexual contact with infected individuals. Blood tests (MHA-TP or VDRL) for high risk individuals. Spirochetes can be observed microscopically, but only if viewed immediately after collection. Prophylactic treatment of all sexual partners of infected individuals.

- **Treatment:** Antibiotics, long acting penicillin G, and tetracycline are effective against primary, secondary, latent, and congenital syphilis.
Incidence and Distribution of Syphilis (2004)

(a) Incidence of syphilis in the United States from 1942 through the first 26 weeks of 2005

(b) Geographical distribution of cases in 2004

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3. Chlamydia-Nongonococcal Urethritis (NGU)

- **Characteristics:** Painful urination, watery discharge, and pelvic inflammation in women. Inflammation of the epididymis, testis, rectum, fallopian tubes, and uterus. Pelvic inflammatory disease (PID). There are three strains that can cause a severe form of the disease known as lymphogranuloma venereum.

- **Symptoms may be mild or absent.**
  - 85% of women are asymptomatic
  - 75% of men have symptoms

Common cause of sterility in both men and women.

Newborns may acquire infections while passing through birth canal that can lead to blindness and pneumonia.

- **Pathogens:** *Chlamydia trachomatis*.
- **Reservoir:** Humans.
- **Transmission:** Direct sexual contact or mother to infant transmission during childbirth. Ocular infections can be spread through droplets, hands, flies, or fomites.
- **Incubation period:** 2 to 3 weeks. May be asymptomatic.
Fertilization Occurs in the Oviducts

1. Fertilization
2. Cleavage starts
3. Cleavage continues
4. Blastocyst implants

(a) From ovulation to implantation
(b) Blastocyst (6 days after conception)
Ectopic pregnancies occur in about 1% of pregnancies in U.S. and usually require surgical removal of embryos.
Chlamydia-Nongonococcal Urethritis

- **Epidemiology**: 934,337 cases were reported to the CDC in 2006. Epidemiologists estimate that up to 3-4 million new cases/year go unreported in U.S. Women under the age of 20 are physiologically more susceptible to infection.

  Most common sexually transmitted bacterial disease in U.S.

  Chlamydial eye infections are endemic in the Middle East, North Africa, and India. Estimate that over 500 million people worldwide, particularly children contract ocular infections.

- **Control**: Use of condoms, avoid sexual contact with infected individuals. Prophylactic treatment of contacts and pregnant women. Routine screening of pregnant women and use of antimicrobial eye treatments in newborns.

- **Treatment**: Antibiotics (tetracycline and azithromycin).