Chapters 21-26:
Microorganisms and Human Disease
Categories of Human Diseases:

Chapter 21: Diseases of Skin and Eyes
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Chapter 23: Diseases of Cardiovascular and Lymphatic System
Chapter 24: Diseases of Respiratory System
Chapter 25: Diseases of Digestive System
Chapter 26: Diseases of Urinary and Reproductive System
Structure of Human Skin

- Stratum corneum
- Sweat pore
- Hair shaft
- Hair erector muscle
- Epidermis
- Dermis
- Subcutaneous layer
- Blood vessel
- Oil gland (produces sebum)
- Duct of sweat gland
- Sweat gland (produces perspiration)
- Hair follicle
- Adipose tissue (fat)
- Nerve

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Lesions of Human Skin

(a) Vesicle

(b) Bulla

(c) Macule

(d) Pustule (papule)
Chapter 21: Diseases of Skin and Eyes

1. Staphylococcal Infections

- Gram-positive cocci in irregular clusters
- Coagulase negative strains make up to 90% of skin microbiota (*S. epidermidis*). Only pathogenic when skin is broken or through invasive entry.
- Coagulase positive strains tend to be pathogenic. Almost all pathogenic *S. aureus* strains make coagulase. High correlation between ability to produce coagulase and production of damaging toxins:
  - Leukocidin: Destroys phagocytic white blood cells.
  - Exfoliative toxin: Responsible for scalded skin syndrome.
  - Enterotoxins: Affect gastrointestinal tract.
- *S. aureus* is commonly found in nasal passages.
1. Staphylococcal Infections (Continued)

Common staphylococcal diseases

A. Folliculitis: Infection of hair follicles (pimples).

B. Sty: Infected eyelash follicle.

C. Boil (Abscess or Furuncle): More serious infection of hair follicle in which pus is surrounded by inflamed tissue. Usually painful and firm.

D. Carbuncle: Aggregate of several infected follicles (boils). May cause fever, chills, malaise, and death if not treated. Forms a round, hard, deep area of inflammation, typically on neck and back. Damages surrounding tissue, with extensive scarring. May need to lance and drain surgically.
Sty: Staphylococcal Eyelash Follicle Infection

Source: Diagnostic Picture Tests in Infectious Diseases, 1994
Abscess, Boil, or Furuncle

Source: Color Guide to Infectious Diseases, 1992
E. Impetigo: Problem in hospital nurseries and day care centers. Thin walled vesicles on skin rupture and crust over.

Caused by *S. aureus*, *S. pyogenes*, or both.

- Highly contagious, spread through direct contact and fomites.
- Occurs almost exclusively in children.
- Rarely produces fever and easily treated with penicillin.
Impetigo is Caused by *Staphylococcus aureus* and/or *Streptococcus pyogenes*
Staphylococcal diseases (continued)

6. Scalded skin syndrome: Caused by toxemia from *S. aureus* strains with two different exfoliative toxins.

- Large sheets of bright red skin peel off.
- Usually observed in children under 2, but may occur in adults.
- Bacteremia and septicemia may occur, and can lead to death within 36 hours.
- Require vigorous antibiotic treatment.
- Exfoliative toxins are highly antigenic, preventing recurrence.
Scalded Skin Syndrome

Source: Color Guide to Infectious Diseases, 1992

- Presently about 25 cases per year reported.
- Most cases are associated with use of superabsorbent tampons.
- Males with boils or other staphylococcal infections are at risk.
- A few cases associated with use of contraceptive sponge.
- 5-15% of women have *S. aureus* in vaginal microflora.
- Only a small percentage of these strains produce TSS.
Toxic Shock Syndrome: Exfoliation

Source: Medical Microbiology, 1998
2. Streptococcal Infections

- Gram-positive cocci in chains.
- Cause many disease including meningitis, pneumonia, sore throat, otitis media, endocarditis, childbirth fever, and dental caries.
- Produce multiple toxins and virulence factors.
  - **Streptokinases:** Dissolve blood clots.
  - **Proteases:** Destroy proteins.
  - **Hyaluronidase:** Breaks down connective tissue.
  - **Hemolysins:** Lyse red blood cells. Alpha, beta, and gamma hemolysis.
- Beta hemolytic streptococci are often associated with human disease.
- *Streptococcus pyogenes* = Group A β-hemolytic streptococci.
- Infections are often localized, but can produce great damage when they reach deeper tissue.
Common streptococcal skin diseases

- **Erysipelas**: From Greek erythos = red, and pella = skin. Also called St. Anthony’s fire. Common skin infection associated with *S. pyogenes*.
  - Spread through contact or insect bites.
  - Skin erupts into reddish patches with raised margins.
  - High fever is common.
  - Organisms can spread through lymphatics and cause septicemia, abscesses, pneumonia, endocarditis, arthritis, and even death if untreated.
  - Mortality was high before use of antibiotics.
  - Responds well to antibiotic (β-lactams) treatment.
Erysipelas on face due to *S. pyogenes* infection

Source: Color Guide to Infectious Diseases, 1992
Common streptococcal skin diseases

- **Flesh eating bacterial infections:**
  - Caused by *invasive* group A streptococci.
  - 15,000 cases per year in U.S.
  - Exotoxin A acts as superantigen causing damage by the immune system.
  - Attacks and destroys muscle (myositis), muscle covering (fasciitis), and solid tissue (cellulitis).
  - Can destroy several inches of tissue per hour.
  - Antibiotics are not effective because dead tissue has no circulation.
  - Requires amputation or surgical removal of tissue.
  - Mortality rate up to 40%.

- **Impetigo:** Refer to previous description.
Necrotizing fasciitis with blood filled vesicles.

Source: Perspectives in Microbiology, 1995
3. Pseudomonads Infections

- Aerobic, gram-negative rods that are widespread in soil and water.
- Can survive in any moist environment (soap, water containers, flower vases, mop water, etc.).
- Resistant to many antibiotics and disinfectants.
- *Pseudomonas aeruginosa* is the most important species.
- *P. aeruginosa* is an important opportunistic pathogen in:
  - **Immunosuppressed patients:** Respiratory infections, especially in cystic fibrosis patients.
  - **Burn patients:** Particularly in second and third degree burns. Produces blue-green pus due to pigment (pyocyanin).
4. Acne

- **Characteristics:** Infections of sebaceous glands in hair follicles on face, chest, and back.
  
  **Cystic acne:** Severe inflammation with cysts that rupture and produce scarring.

- **Pathogens:** *Propionibacterium acne*, *S. aureus*, and *Corynebacterium* spp.

- **Reservoir:** Humans

- **Transmission:** Direct contact

- **Incubation period:** Variable, usually 4-10 days.

- **Epidemiology:** Most common skin disease in humans. Affects 17 million Americans, 85% of teenagers.

- **Control:** Good personal hygiene

- **Treatment:** Local benzoyl peroxide or salicylic acid. Systemic antibiotics and Retin A.
5. Measles (Rubeola or “Hard Measles”)

- **Characteristics:** Fever, upper respiratory infection, coughing, Koplik’s spots in mouth (early), light sensitivity, and raised red blotchy skin rash (face first, then trunk and extremities).

- **Pathogen:** Measles (rubeola) virus.

- **Reservoir:** Humans

- **Transmission:** Inhalation of droplets.

- **Incubation period:** Usually 14 days for rash to appear; contagious before and up to 4 days after rash appears.

- **Epidemiology:** In 2004, 45 cases reported to CDC.

- **Control:** Immunization with MMR vaccine protects over 95% of recipients, but only effective after age of 15 months.

- **Treatment:** Bed rest, fluids, and preventive care, short-term high dose vitamin A may be helpful.

- **Complications:** Bronchitis, pneumonia, conjunctivitis, otitis media, encephalitis, and autoimmune disorders (subacute sclerosing panencephalitis). Fatal in 1 in 3000
Measles: Rash, conjunctivitis, and rhinitis

Source: Color Guide to Infectious Diseases, 1992
6. German Measles (Rubella)

- **Characteristics:** Milder disease than measles, *flat* pink rash spreading from face, and low-grade fever. May be asymptomatic.

- **Pathogen:** Rubella virus.

- **Reservoir:** Humans

- **Transmission:** Inhalation of droplets or fomites.

- **Incubation period:** Usually 14-21 days.

- **Epidemiology:** Less than 10 cases/year reported to CDC.

- **Control:** Immunization with MMR (measles-mumps-rubella) protects over 90% of recipients for 15 years+

- **Treatment:** Bed rest and fluids if needed.

- **Complications:** Rare except in pregnant women. 
  
  **Congenital rubella syndrome:** Infection during first trimester carries 35% chance of serious damage to fetus including mental retardation, deafness, cataracts, heart defects, and death. Less than 10 cases/year in U.S. now.
Other serious defects are usually present. Mortality is about 30%.
Source: Diagnostic Picture Tests in Infectious Diseases, 1987
German Measles: Infantile Rubella Rash

Source: Color Guide to Infectious Diseases, 1992
Chapter 22: Diseases of Nervous System

1. Tetanus

- **Characteristics:** Convulsions, severe muscle spasms (lockjaw, risus sardonicus, and ophistotonus), respiratory failure, and death caused by neurotoxin (tetanospasmin).

- **Pathogen:** *Clostridium tetani* (strict anaerobe, spores).

- **Reservoir:** Soil and animal intestines

- **Transmission:** Spores are introduced into a wound and germinate under anaerobic conditions. Not contagious.

- **Incubation period:** 3-21 days or longer.

- **Epidemiology:** In the U.S., fewer than 50 cases/year. Worldwide over 1 million cases/year (50% are newborns)

- **Control:** Immunization with tetanus toxoid (DPT) and boosters every 10 years.

- **Treatment:** Clean wounds. Penicillin kills organisms. Antitoxin neutralizes exotoxin.

- **Recovery from disease does not confer immunity.**
Tetanus Patient with Severe Spasms

http://bimari-jankari.mla.iitk.ac.in/html/tetanus.htm
Neonatal Tetanus (Wrinkled brow and risus sardonicus)  
Source: Color Guide to Infectious Diseases, 1992
2. Botulism

 Derived from Latin word *botulus* for sausage.

 **Characteristics:** Progressive *flaccid* paralysis (1-10 days), nausea, blurred vision, difficulty swallowing, brain damage, coma, and if untreated, death from cardiac or respiratory failure caused by several toxins (Type A, B, and E).

 **Infant botulism:** “Floppy baby syndrome”. Infant loses ability to suck and swallow. Caused by intestinal growth of ingested bacteria. Most cases associated with raw honey consumption (10% honey jars sold in California contain *C. botulinum* endospores). Fatality is rare, but children usually must be hospitalized for several months.

 **Wound Botulism:** Very rare (less than 1 case/year in U.S.). Seen in deep wounds. 25% mortality rate.

 **Pathogen:** *Clostridium botulinum* (strict anaerobe, spores).

 **Reservoir:** Soil and freshwater sediments.
Infant with Flaccid Paralysis caused by Botulism

http://www.imcworldwide.org/cbr/L1C_files/image017.jpg
2. Botulism (Continued)

- **Transmission**: Ingestion of dirty foods, honey, improperly canned foods, neutral pH foods, and homemade sausage (blood sausage). Acidic foods don’t support growth (tomatoes).

- **Incubation period**: 12 to 36 hours.

- **Epidemiology**: In a typical year 250 cases of infant botulism (the most common type) are reported to CDC. A smaller number of cases of other types of botulism are reported every year.

- **Control**: Careful washing, canning, processing, and cooking of food. Never feed raw honey to infants.

- **Treatment**: Antitoxin neutralizes exotoxin. Treatment of respiratory failure.

- Recovery from disease does **not** confer immunity.
3. Rabies

- **Characteristics:** Acute, usually fatal infection of brain and spinal cord of mammals. Depression, headache, fever, malaise, hydrophobia (fear of water), salivation, convulsions, paralysis, and death by respiratory failure.

- **Furious rabies:** Excitability and biting (80% of cases).

- **Paralytic rabies:** Minimal excitability (20% of cases).

- **Pathogen:** Rabies virus.

- **Reservoir:** Wild and domestic animals: Cats, dogs, rats, coyotes, skunks, raccoons, and bats.

- **Transmission:** Bite of rabid animal with virus in saliva.

- **Incubation period:** 2 to 8 weeks or longer (up to 6 years).

- **Epidemiology:** Every year 1-6 human cases and 7000-8000 animal cases reported to CDC.

- **Control:** Vaccinate all pets. Avoid contact with wild animals.

- **Treatment:** Wash wounds well and treat with rabies antiserum. Vaccinate bite victims.
Furious Rabies in 14 Year Old Boy Despite Vaccination

Source: Tropical Medicine and Parasitology, 1995
Rabies with Hypersalivation, Bloody Vomit, and Sweating

Source: Tropical Medicine and Parasitology, 1995
Hydrophobia in Rabies Patient

Source: Diagnostic Pictures in Infectious Diseases, 1995
4. Leprosy (Hansen’s Disease)

Characteristics: Two forms of the disease:

- **Neural, tuberculoid (anesthetic) form**: Lesions on skin and peripheral nerves. Loss of pigment and sensation.

- **Cutaneous, lepromatous form**: Progressive disfiguring nodules (lepromas) in skin, invades body. Destroys skin, mucous membranes, and bone.

- **Pathogen**: *Mycobacterium leprae*, the only bacterium known to grow in peripheral nervous system. Acid-fast bacillus. Only cultured in lab animals.

- **Reservoir**: Humans.

- **Transmission**: Prolonged exposure through skin or mucous membranes. Droplet transmission.

- **Incubation period**: 2 to 12 years or longer.
Tuberculoid Leprosy Lesions with Depigmentation

Source: Tropical Medicine and Parasitology, 1995
Lepromatous Leprosy Lesions

Source: Tropical Medicine and Parasitology, 1995
4. Leprosy (Hansen’s Disease)

- **Epidemiology:** Every year 100-150 cases reported to CDC. Millions of cases in Asia, Africa, and Brazil.

- **Control:** Detection and treatment. Vaccine available in India since 1998 used along with chemotherapy. BCG vaccine offers partial protection.

- **Treatment:** Long term treatment with antimicrobials (Dapsone, rifampin, and clofazimine).
Severe Bone Destruction in Advanced Leprosy

Source: Diagnostic Picture Tests in Infectious Diseases, 1994
Chapter 23: Diseases of Circulatory System

1. Malaria

- Characteristics: Systemic infection with recurring high fever (104°F), chills, sweating, headache, vomiting, and anemia. Patients may feel normal during asymptomatic periods (every 2-3 days). May progress to shock, liver and kidney failure, and death.

- Pathogen: Pathogenic protozoa from genus *Plasmodium*. *Plasmodium vivax* is most common, *P. falciparum* is most deadly.

- Reservoir: Humans.


- Incubation period: 12 to 30 days or longer.
1. Malaria (Continued)

- **Epidemiology:** In the U.S. 1000-2000 cases/year reported to CDC, most are imported.

**Worldwide:** One of the world’s biggest health problems. Endemic in the tropics, nearly all adults in India and Africa have been infected.

Over 300 million infections and 2-4 million deaths. Highest mortality occurs in young children.

- **Control:** Mosquito control and use of insect repellent.

- **Treatment:** Quinine, chloroquine, and others.

  Drug resistance is becoming a serious problem in the treatment of malaria.

- **Comment:** Infection gives partial immunity. People with sickle cell trait are resistant to infection. Vaccine development is currently in progress.
Worldwide Distribution of Malaria

++: Frequent transmission
+: Infrequent transmission.
O: Eradicated or never existed.
Malaria Cases in the United States

(a) Areas where malaria was endemic as recently as 1912

(b) Graph showing reported cases of malaria in the United States, 1967 to (*) the first 26 weeks of 2005

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2. Lyme Disease

- **Characteristics:** Disease occurs in three stages.
  - **Early local stage:** Large lesions at site of tick bite.
  - **Early disseminated stage:** Skin blotches, malaise, fatigue, arthritis, carditis, meningitis, encephalitis.
  - **Late stage:** Prolonged arthritis, severe fatigue, loss of memory and numbness, facial palsy.

- **Pathogen:** *Borrelia burgdorferi*, a spirochete.

- **Reservoir:** Carried by ticks that feed on mice, deer, dogs, horses, cattle, and humans.

- **Transmission:** Bite of infected *Ixodes spp.* tick.
  No person to person transmission.

- **Incubation period:** 3 to 33 days after tick bite.
  First stage may be asymptomatic.

- **Epidemiology:** In the U.S. about 20,000 cases/year are reported to CDC.
Lyme Disease: Early Bull’s-Eye Lesion at Tick Bite

Source: Medical Microbiology, 1998
2. Lyme Disease (Continued)

- **Control**: Avoid tick infested areas and animals. Use of light clothing and tick repellent. Check for ticks every 4 hours and remove completely with tweezers.

- **Treatment**: Antibiotics for 10 to 30 days.

Cases per 100,000 persons
- 0.01–0.99
- 10–99.99
- 1–9.99
- ≥100

*The total number of cases from these counties represented 90% of all cases reported in 2003.
3. Gangrene

- **Characteristics**: Death (necrosis) of soft tissue (skin, muscle, connective tissue) due to an interruption in blood flow and anaerobic growth of bacteria.
  - Foul odor, high fever, shock, and blackening of skin.
  - In gas gangrene fermentation products (CO$_2$ and H$_2$) swell tissue.
  - May invade bloodstream and produce systemic illness.

- **Pathogens**: *Clostridium perfringens* (80%+) and others.

- **Reservoir**: Soil, feces.

- **Transmission**: Contamination of deep wounds.
  - Illegal abortions are common cause.

- **Incubation period**: 12 to 48 hours after injury.

- **Control**: Open and thoroughly clean wounds. Cover lightly to prevent contamination.

- **Treatment**: Antibiotics (penicillin), removal of dead tissue, amputation, and hyperbaric chambers.
Extensive Lesions Due to Gas Gangrene

Source: Infectious Diseases, 1987
Severe Gangrene of the Feet

Source: Tropical Medicine and Parasitology, 1997
Chapter 24: 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.
Chest X-Ray of a Patient with Tuberculosis
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 (amantidin)
Antigenic Variation of Influenza Virus

1918–1928
Swine
H_{SW}N_{1}
N spike
H spike
RNA
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

1968 Hong Kong flu
pandemic (has been
circulating since 1968)

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Chapter 25: Diseases of Digestive System

1. Cholera

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

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

- **Reservoir:** Humans, contaminated water, and seafood.

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

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

- **Epidemiology:** Less than 50 cases/year in U.S. Large outbreaks are common in developing countries.
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. Sewage and water treatment. Prophylactic antibiotics for exposed individuals.

- **Treatment**: Prompt fluid and electrolyte replacement. Tetracycline and chemotherapy may shorten duration of disease.
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 26: 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 gonorrhoea*.

- **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

*First 26 weeks of 2005

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2. Syphilis

- **Characteristics:** Disease occurs in three stages:
  - **Primary stage:** Painless lesion (*chancre*).
  - **Secondary stage:** Skin rash with fever and mucous membrane lesions. Typically followed by a long latent period.
  - **Tertiary stage:** 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
Syphilis, Gumma: Large Rubbery Ulceration of Tongue in a Patient with Tertiary Syphilis

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

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

2. Syphilis (Continued)

- **Epidemiology**: About 20,000 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 (VDRL) for high risk individuals.

- **Treatment**: Antibiotics, long acting penicillin G, tetracycline, etc.
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

*First 26 weeks of 2005

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3. Chlamydia-Nongonococcal Urethritis (NGU)

- **Characteristics:** Painful urination, watery discharge, and pelvic inflammation in women. Symptoms may be mild or absent, especially in women. Common cause of sterility in both men and women. Newborns may develop eye infections and pneumonia.

- **Pathogens:** *Chlamydia trachomatis*.

- **Reservoir:** Humans.

- **Transmission:** Direct sexual contact or mother to infant transmission during childbirth.

- **Incubation period:** 2 to 3 weeks. May be asymptomatic.

- **Epidemiology:** Up to 3-4 million new cases/year in U.S. Most common sexually transmitted disease in U.S.

- **Control:** Use of condoms, avoid sexual contact with infected individuals. Prophylactic treatment of contacts and pregnant women.

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