

- 1 **Chapter 24**
Microbial Diseases of the Respiratory System
- 2 **The Respiratory System**
- 3 **The Upper Respiratory System**
 - Nose
 - Pharynx (throat)
 - Middle ear
 - Eustachian tubes
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- 4 **Structures of Upper Respiratory System**
- 5 **The Lower Respiratory System**
 - Larynx
 - Trachea
 - Bronchial tubes
 - Alveoli
 - Pleura
 -
- 6 **Structures of Lower Respiratory System**
- 7 **Normal Microbiota of Respiratory System**
 - Suppress pathogens by competitive inhibition in upper respiratory system
 - Lower respiratory system is sterile
- 8 **Upper Respiratory System Diseases**
- 9 **Upper Respiratory System Diseases**
 - Pharyngitis
 - Laryngitis
 - Tonsillitis
 - Sinusitis
 - Epiglottitis: *H. influenzae* type b
- 10 **Streptococcal Pharyngitis**
 - Also called strep throat
 - *Streptococcus pyogenes*
 - Resistant to phagocytosis
 - Streptokinases lyse clots
 - Streptolysins are cytotoxic
 - Diagnosis by enzyme immunoassay (EIA) tests
- 11 **Scarlet Fever**
 - *Streptococcus pyogenes*
 - Pharyngitis
 - Erythrogenic toxin produced by lysogenized *S. pyogenes*
- 12 **Diphtheria**
 - *Corynebacterium diphtheriae*: Gram-positive rod

- Diphtheria toxin produced by lysogenized *C. diphtheriae*
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13  **Diphtheria**

- Diphtheria membrane: Fibrin, tissue, bacterial cells

14  **Diphtheria**

- Prevented by DTaP vaccine
 - Diphtheria toxoid
- Cutaneous diphtheria
 - Infected skin wound leads to slow-healing ulcer

15  **Otitis Media**

- *S. pneumoniae* (35%)
- *H. influenzae* (20–30%)
- *M. catarrhalis* (10–15%)
- *S. pyogenes* (8–10%)
- *S. aureus* (1–2%)
- Incidence of *S. pneumoniae* reduced by vaccine

16  **The Common Cold**

- Rhinoviruses (50%)
- Coronaviruses (15–20%)

17  **Diseases in Focus: Diseases of the Upper Respiratory System**

- A patient presents with fever and a red, sore throat. Later, a grayish membrane appears in the throat. Gram-positive rods were cultured from the membrane.
- Can you identify infections that could cause these symptoms?

18  **Lower Respiratory System Diseases**

19  **Lower Respiratory System Diseases**

- Bacteria, viruses, and fungi cause
 - Bronchitis
 - Bronchiolitis
 - Pneumonia

20  **Pertussis (Whooping Cough)**


















- *Bordetella pertussis*
 - Gram-negative coccobacillus
- Capsule
- Tracheal cytotoxin of cell wall damaged ciliated cells
- Pertussis toxin
- Prevented by DTaP vaccine (acellular Pertussis cell fragments)













21  **Pertussis (Whooping Cough)**

- Stage 1: Catarrhal stage, like common cold
- Stage 2: Paroxysmal stage—violent coughing sieges
- Stage 3: Convalescence stage

22  **Tuberculosis**

- *Mycobacterium tuberculosis*
 - Acid-fast rod; transmitted from human to human

- 23  **Tuberculosis**
- *M. bovis*: <1% U.S. cases; not transmitted from human to human
 - *M. avium-intracellulare* complex infects people with late-stage HIV infection
- 24  **Tuberculosis**
- 25  **Tuberculosis**
- 26  **Worldwide Distribution of Tuberculosis**
- 27  **U.S. Distribution of Tuberculosis**
- 28  **The Pathogenesis of Tuberculosis**
- 29  **The Pathogenesis of Tuberculosis**
- 30  **The Pathogenesis of Tuberculosis**
- 31  **The Pathogenesis of Tuberculosis**
- 32  **The Pathogenesis of Tuberculosis**
- 33  **Treatment of Tuberculosis**
- Treatment: Prolonged treatment with multiple antibiotics
 - Vaccines: BCG, live, avirulent *M. bovis*; not widely used in United States
- 34  **A Positive Tuberculin Skin Test**
- 35  **Diagnosis of Tuberculosis**
- Tuberculin skin test screening
 - Positive reaction means current or previous infection
 - Followed by X-ray or CT exam, acid-fast staining of sputum, culturing of bacteria
- 36  **Pneumococcal Pneumonia**
- *Streptococcus pneumoniae*
 - Gram-positive encapsulated diplococci
- 37  **Pneumococcal Pneumonia**
- Symptoms: Infected alveoli of lung fill with fluids; interferes with oxygen uptake
 - Diagnosis: Optochin-inhibition test or bile solubility test; serological typing of bacteria
 - Treatment: Penicillin, fluoroquinolones
 - Prevention: Pneumococcal vaccine
- 38  ***Haemophilus influenzae* Pneumonia**
- Gram-negative coccobacillus
 - Predisposing factors: Alcoholism, poor nutrition, cancer, or diabetes
 - Symptoms: Resemble those of pneumococcal pneumonia
 - Diagnosis: Isolation; special media for nutritional requirements
 - Treatment: Cephalosporins
- 39  **Mycoplasma Pneumonia**
- Primary atypical pneumonia; walking pneumonia
 - *Mycoplasma pneumoniae*
 - Pleomorphic, wall-less bacteria
 - Common in children and young adults
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- 40  ***Mycoplasma pneumoniae***
- 41  **Mycoplasmal Pneumonia**
- Symptoms: Mild but persistent respiratory symptoms; low fever, cough, headache
 - Diagnosis: PCR and serological testing
 - Treatment: Tetracyclines
- 42  **Legionellosis**
- *Legionella pneumophila*
 - Gram-negative rod
 - Found in water
 - Transmitted by inhaling aerosols; not transmitted from human to human
- 43  **Legionellosis**
- Symptoms: Potentially fatal pneumonia that tends to affect older men who drink or smoke heavily
 - Diagnosis: Culture on selective media, DNA probe
 - Treatment: Erythromycin
- 44  **Psittacosis (Ornithosis)**
- *Chlamydophila psittaci*
 - Gram-negative intracellular bacterium
 - Transmitted to humans by elementary bodies from bird droppings
 - Reorganizes into reticulate body after being phagocytized
- 45  **Psittacosis (Ornithosis)**
- Symptoms: Symptoms, if any, are fever, headache, chills
 - Diagnosis: Growth of bacteria in eggs or cell culture
 - Treatment: Tetracyclines
- 46  **Psittacosis (Ornithosis)**
- 47  **Chlamydial Pneumonia**
- *Chlamydophila pneumoniae*
 - Transmitted from human to human
- 48  **Chlamydial Pneumonia**
- Symptoms: Mild respiratory illness common in young people; resembles mycoplasmal pneumonia
 - Diagnosis: Serological tests
 - Treatment: Tetracyclines
- 49  **Q Fever**
- Causative agent: *Coxiella burnetii*
 - Reservoir: Large mammals
 - Tick vector
 - Can be transmitted via unpasteurized milk
- 50  ***Coxiella burnetii*, the Cause of Q Fever**
- 51  **Q Fever**
- Symptoms: Mild respiratory disease lasting 1–2 weeks; occasional complications such as endocarditis occur

- Diagnosis: Growth in cell culture
- Treatment: Doxycycline and chloroquine
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52 **Melioidosis**

- Causative agent: by *Burkholderia pseudomallei*
- Reservoir: Soil
- Mainly in southeast Asia and northern Australia
- Symptoms: Pneumonia, or tissue abscesses and severe sepsis
- Diagnosis: Bacterial culture
- Treatment: Ceftazidime

53 **Diseases in Focus:**

Common Bacterial Pneumonias

- A 27-year-old man with a history of asthma was hospitalized with a 4-day history of progressive cough and 2 days of spiking fevers. Gram-positive cocci in pairs were cultured from a blood sample.
- Can you identify infections that could cause these symptoms?
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54 **Lower Respiratory System Diseases**

55 **Viral Pneumonia**

- Viral pneumonia occurs as a complication of influenza, measles, or chickenpox
- Viral etiology suspected if no other cause is determined

56 **Respiratory Syncytial Virus (RSV)**

- Common in infants; 4500 deaths annually
- Causes cell fusion (syncytium) in cell culture
- Symptoms: Pneumonia in infants
- Diagnosis: Serological test for viruses and antibodies
- Treatment: Ribavirin, palivizumab
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57 **Influenza (Flu)**

- Symptoms: Chills, fever, headache, and muscle aches
 - No intestinal symptoms
- 1% mortality, very young and very old
- Treatment: Zanamivir and oseltamivir inhibit neuraminidase
- Prophylaxis: Multivalent vaccine

58 **The Influenza Virus**

- Hemagglutinin (HA) spikes used for attachment to host cells
- Neuraminidase (NA) spikes used to release virus from cell

59 **The Influenza Virus**

- Antigenic shift
 - Changes in HA and NA spikes
 - Probably due to genetic recombination between different strains infecting the same cell
- Antigenic drift
 - Point mutations in genes encoding HA or NA spikes
 - May involve only 1 amino acid

- Allows virus to avoid mucosal IgA antibodies

60  **Influenza Serotypes**

61  **Lower Respiratory System Diseases**


62  **Histoplasmosis**


- *Histoplasma capsulatum*, dimorphic fungus

63  **Histoplasmosis Distribution**

64  **Coccidioidomycosis**

- Causative agent: *Coccidioides immitis*
- Reservoir: Desert soils of Southwest U.S.
- Symptoms: Fever, coughing, weight loss
- Diagnosis: Serological tests
- Treatment: Amphotericin B
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65  **The Life Cycle of *Coccidioides immitis***

66  **U.S. Endemic Area for Coccidioidomycosis**

67  ***Pneumocystis* Pneumonia**

- Causative agent: *Pneumocystis jirovecii*
- Reservoir: Unknown; possibly humans or soil
- Symptoms: Pneumonia
- Diagnosis: Microscopy
- Treatment: Trimethoprim
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69  **Blastomycosis**

- Causative agent: *Blastomyces dermatitidis*
- Reservoir: Soil in Mississippi valley area
- Symptoms: Abscesses; extensive tissue damage
- Diagnosis: Isolation of pathogen
- Treatment: Amphotericin B
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70  **Other Fungi Involved in Respiratory Disease**

- Systemic
- Predisposing factors:
 - Immunocompromised state
 - Cancer
 - Diabetes
- *Aspergillus fumigatus*
- *Mucor*
- *Rhizopus*

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