Chapter 20 - Pathogenic Gram-Negative Cocci and Bacilli

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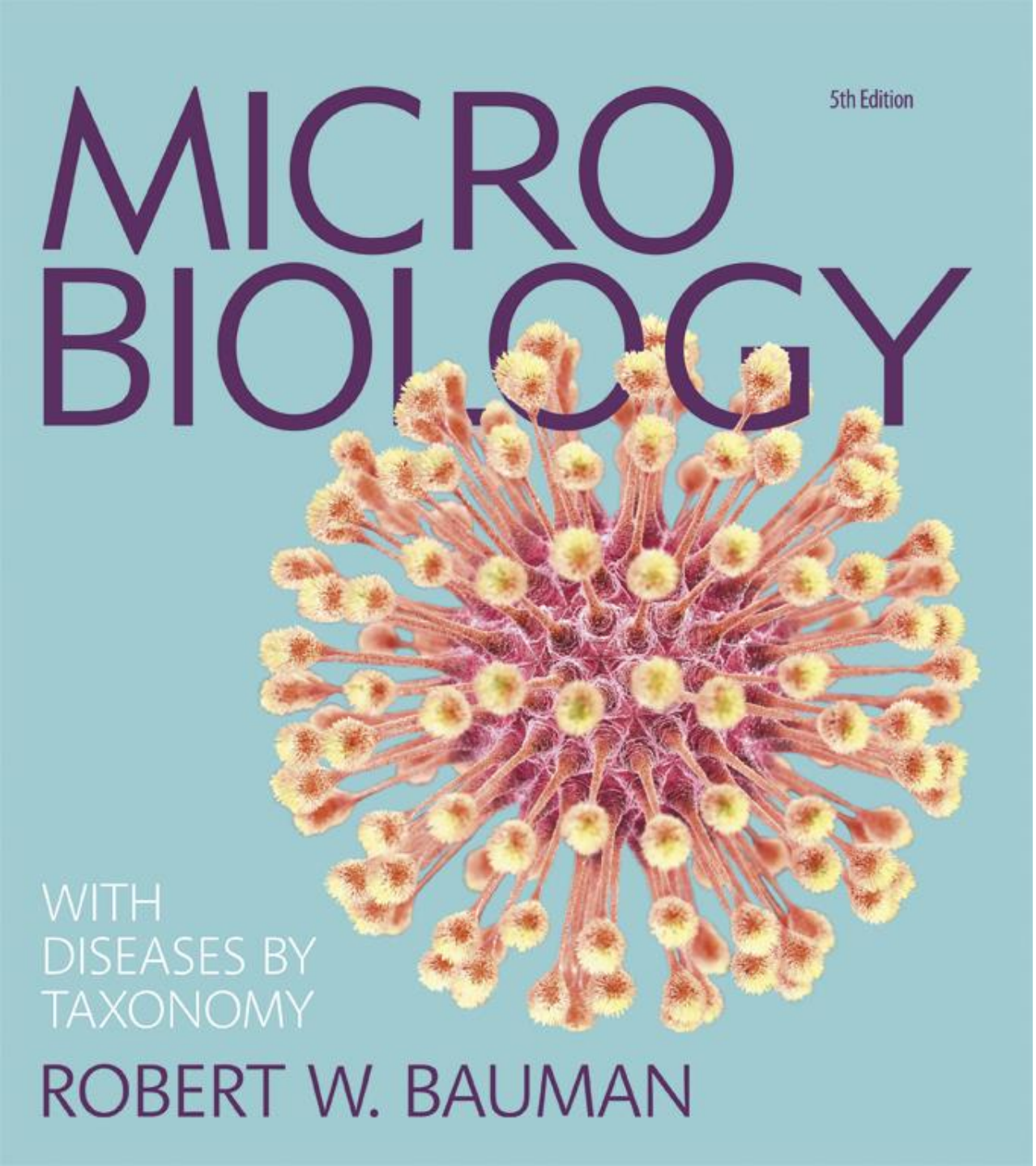


PowerPoint® Lecture Presentations prepared by Mindy Miller-Kittrell, North Carolina State University

CHAPTER 20

Pathogenic Gram-Negative Cocci and Bacilli

Pathogenic, Gram-Negative, Aerobic Bacilli

- ***Bartonella***
  - Aerobic bacilli
  - Found in animals but causes disease only in humans
  - Three species are pathogenic:
    - *Bartonella bacilliformis*
      - **Bartonellosis**
        - Causes fever, anemia, headache, muscle and joint pain, and chronic skin infections
        - Often fatal
        - Transmitted by bloodsucking sand flies
        - Endemic in Peru, Ecuador, and Columbia

Pathogenic, Gram-Negative, Aerobic Bacilli

- ***Bartonella***
  - *Bartonella quintana*
    - Trench fever (***five-day fever***)
      - Common during World War I
      - Transmitted by human body lice
      - Causes headaches, fever, and pain in the long bones
    - Causes two diseases in immunocompromised patients
      - Bacillary angiomatosis
        - Fever, skin lesions, and proliferating blood vessels
      - Bacillary peliosis hepatis
        - Blood-filled pockets in the liver

Pathogenic, Gram-Negative, Aerobic Bacilli

- ***Bartonella***
  - *Bartonella henselae*
    - **Cat-scratch disease**
      - Transmitted through cat scratches and bites
      - Common disease in children in the United States
      - Causes fever, malaise, and swelling at infection site
  - *Bartonella* infections are treated with various antimicrobials

Figure 20.21 Cat scratch disease.

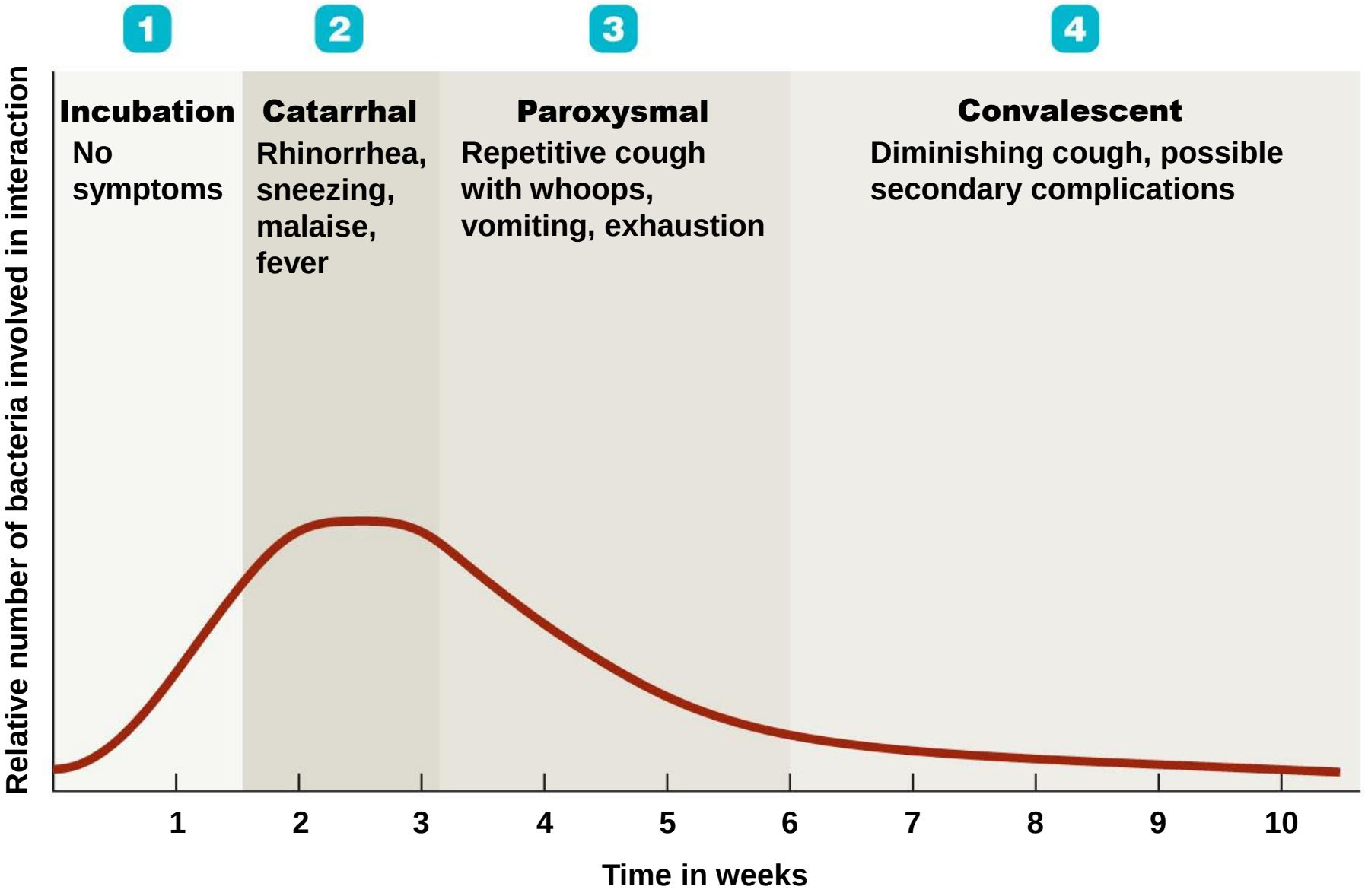
Pathogenic, Gram-Negative, Aerobic Bacilli

- ***Brucella***
  - Small, nonmotile, aerobic coccobacilli
  - Can infect animals or humans
  - *Brucella melitensis* causes **brucellosis (*Bang's disease* and *undulant fever*)**
    - Often an asymptomatic or mild disease
    - Illness is characterized by a fluctuating fever
    - Human infection due to contact with contaminated dairy products or infected animal blood, urine, or placentas
    - Vaccine available for use in domesticated animals
      - Not used in humans since it can cause disease.

Pathogenic, Gram-Negative, Aerobic Bacilli

- ***Bordetella***
  - Pathogenesis, Epidemiology, and Disease
    - Small, aerobic, nonmotile coccobacillus
    - ***B. pertussis* is the most important**
      - Causes pertussis (whooping cough)
      - Most cases of disease are in children - ciliated epithelial cells of the trachea are damaged
      - Adhesins and toxins mediate the disease
        - *Pertussis toxin*
        - *Adenylate cyclase toxin*
        - *Dermonecrotic toxin*
        - *Tracheal cytotoxin*
      - Bacteria inhaled in aerosols multiply in epithelial cells

Figure 20.25 The approximate time course for the progression of pertussis.



Pathogenic, Gram-Negative, Aerobic Bacilli

- ***Bordetella***
  - Diagnosis, Treatment, and Prevention
    - Diagnosis
      - Pertussis symptoms usually diagnostic
    - Treatment
      - Primarily supportive
    - Prevention
      - Immunization with diphtheria, tetanus, attenuated pertussis (DTaP) or Tdap vaccine
        - Tdap - a reduced dose of the diphtheria and pertussis vaccines

Pathogenic, Gram-Negative, Aerobic Bacilli

- ***Burkholderia***
  - *Burkholderia cepacia*
    - Aerobic, flagellated betaproteobacterium
    - Can decompose a broad range of organic molecules
    - Assists in cleanup of contaminated environmental sites
    - Used by farmers to reduce fungal infection of plant crops
    - Opportunistic pathogen of cystic fibrosis patients
    - Resistant to many antimicrobial drugs
  - *Burkholderia pseudomallei*
    - Causes melioidosis (Whitmore's disease), an Asian and Australian tropical disease that is emerging as a threat in other locales
    - **CDC has identified as a potential bioweapon**

Pathogenic, Gram-Negative, Aerobic Bacilli

- ***Burkholderia: Bioterrorism***

  Why might germs that cause melioidosis be used as a weapon?

  - They are found in nature in certain parts of the world (https://www.cdc.gov/melioidosis/risk.html)
  - They cause a disease that can make people very sick. Without prompt treatment with specific antibiotics, people sick with melioidosis can die
  - In the past, some countries that have used bioweapons during war have used germs closely related to the one that causes melioidosis

Source: https://www.cdc.gov/melioidosis/bioterrorism/threat.html

Pathogenic, Gram-Negative, Aerobic Bacilli

- ***Burkholderia: Bioterrorism***

  How dangerous is melioidosis?

  - Naturally resistant to many commonly used antibiotics
  - Without treatment, up to 9 out of every 10 people who get it die.
  - When people with melioidosis get treatment with the correct antibiotics, fewer than 4 out of 10 people die.
  - Medical treatment in an intensive care facility can decrease deaths even more. Only 2 out of 10 people die when they get this level of medical treatment.

Source: https://www.cdc.gov/melioidosis/bioterrorism/threat.html

Pathogenic, Gram-Negative, Aerobic Bacilli

- **Pseudomonads**
  - Aerobic bacilli
  - Ubiquitous in soil, decaying organic matter, and moist environments
  - **Problematic in hospitals**
  - Opportunistic pathogens

Pathogenic, Gram-Negative, Aerobic Bacilli

- **Pseudomonads**
  - *Pseudomonas aeruginosa*
    - Rarely part of normal human microbiota
    - Rarely causes disease in healthy individuals
      - Despite producing various virulence factors
        - Fimbriae, adhesins, capsule, toxins, and enzymes
    - Opportunistic infections in immunocompromised patients
      - Can colonize almost any organ or system
    - Also infects the lungs of cystic fibrosis patients
      - Biofilm protects bacteria from phagocytosis
    - Treatment is difficult due to drug resistance

Figure 20.26 A *Pseudomonas aeruginosa* infection.

Pathogenic, Gram-Negative, Aerobic Bacilli

- **Pseudomonads**
  - *Moraxella* and *Acinetobacter*
    - Aerobic, short, plump bacilli
    - Rarely cause disease in humans
    - ***Moraxella catarrhalis***
      - Opportunistic infections of the sinuses, bronchi, ears, and lungs
      - Susceptible to most antibacterial drugs
    - ***Acinetobacter***
      - Grows in soil, water, and sewage
      - Opportunistic infections of the respiratory, urinary, and central nervous systems
      - Often resistant to antibiotics

Pathogenic, Gram-Negative, Aerobic Bacilli

- ***Francisella***
  - *Francisella tularensis*
    - Nonmotile, strictly aerobic coccobacillus
    - Intracellular parasite of animals and amoebae in water
    - Diverse range of hosts
    - Reservoirs in the United States include rabbits, muskrats, and ticks

Pathogenic, Gram-Negative, Aerobic Bacilli

- ***Francisella***
  - *Francisella tularensis*
    - **Tularemia** *(rabbit fever* or *tick fever)*
      - Zoonotic disease
      - Spread through bite of an infected tick or contact with an infected animal
      - Also spread by bacteria in meat, water, and in aerosols
      - The bacteria is highly infectious
      - Tularemia may be misdiagnosed
        - Symptoms are similar to other diseases
      - Treated with antimicrobial drugs
      - Infection prevented by avoiding reservoirs of *Francisella*

Pathogenic, Gram-Negative, Aerobic Bacilli

- ***Legionella***
  - Pathogenesis, Epidemiology, and Disease
    - Aerobic, slender, pleomorphic bacteria
    - Universal inhabitants of water
    - **Humans inhale bacteria in aerosols from water sources**
    - Intracellular parasites
    - *L. pneumophila* causes most disease in humans

Pathogenic, Gram-Negative, Aerobic Bacilli

- ***Legionella***
  - Pathogenesis, Epidemiology, and Disease
    - Legionnaires' disease *(Legionellosis)*
      - *Causative agent: Legionella pneumophila*
      - Transmitted in aerosols such as those produced by air-conditioning systems, vaporizers, and grocery store misters
      - Results in pneumonia
      - Can be fatal
        - Particularly immunocompromised individuals
    - Pontiac fever
      - Similar to Legionnaires' disease
      - Doesn't produce pneumonia and is not fatal

Pathogenic, Gram-Negative, Aerobic Bacilli

- ***Legionella***
  - Diagnosis, Treatment, and Prevention
    - Diagnosis
      - Identification of *Legionella* by antibody staining or other serological tests
    - Treatment
      - Pontiac fever is self-limiting
      - Fluoroquinolone and azithromycin used to treat Legionnaires' disease
    - Prevention
      - Elimination of the bacteria is not feasible

Pathogenic, Gram-Negative, Aerobic Bacilli

- ***Coxiella***
  - *Coxiella burnetii*
    - Extremely small, aerobic bacteria
    - Obligate intracellular parasite
    - Originally thought to be a virus
    - Infective body enables survival in harsh environment
    - Human disease associated with farm animals and pets
    - Transmitted mainly by inhalation of the infective bodies

Pathogenic, Gram-Negative, Aerobic Bacilli

- ***Coxiella***
  - *Coxiella burnetii*
    - **Q fever**
      - Causes fever, headache, chills, muscle pain, and mild pneumonia
      - Chronic Q fever can cause endocarditis years later
    - Chronic Q fever treated with long-term antimicrobials
    - Vaccine developed but not available in the United States and Canada
    - Prevent by avoiding inhalation of contaminated dust

Pathogenic, Gram-Negative, Anaerobic Bacilli

- Predominant microbiota of the gastrointestinal, urinary, reproductive, and lower respiratory tracts
- Important for human health
  - Inhibit the growth of most pathogens
  - Synthesize vitamins and vitamin precursors
  - Aid in digestion of food
- Cause disease when introduced into other parts of the body

Pathogenic, Gram-Negative, Anaerobic Bacilli

- ***Bacteroides***
  - Normal microbiota of the intestinal and upper respiratory tracts
  - *Bacteroides fragilis*
    - Most important pathogen of this genus
    - Produces various virulence factors (e.g., lipid A)
    - Involved in a variety of conditions
      - Abdominal infections
      - Genital infections in women
      - Wound infections of the skin
    - Infections can be treated with metronidazole

Pathogenic, Gram-Negative, Anaerobic Bacilli

- ***Prevotella***
  - Normal microbiota of urinary, genital, and upper respiratory tracts
  - Differ from *Bacteroides* in their sensitivity to bile
  - Produce several virulence factors (e.g., capsule)
  - Involved in various conditions
    - **Sinus and ear infections**
    - **Almost all periodontal infections**
    - Gynecological infections
    - Brain abscesses
    - Abdominal infections
  - Treat by surgical removal of infected tissue and carbapenem