Introduction:

Epidemic Typhus, Trench Fever, & Louse-borne relapsing fever

- Epidemic Typhus
  - *Rickettsia prowazkeii*
- Trench Fever
  - *Bartonella quintanta*
- Louse-borne relapsing fever
  - *Borrelia recurrentis*

Commonality: vector
Introduction: Vector

- *Pediculus humanus humanus* or
- *Pediculus humanus corporis* (the human body louse)

Figure 1. *Pediculus humanus* humanus feeding.

Figure 2. Body lice and their role on clothing.

Introduction: Vector (cont.)

Figure 4. The three types of lice.

Figure 5. Life cycle of *Pediculus humanus humanus*.

Figure 6. Transmission cycle of head lice, which is very similar to that of body lice.

Epidemic Typhus: Taxonomy

Class: α-Proteobacteria
Order: Rickettsiales
Family: Rickettsiaceae
Genus: Rickettsia
Species: prowazekii

*Rickettsia prowazekii*

Figure 7. Tree of bacterial pathogens (Ecker et al. 2005).
Epidemic Typhus: Parasite

- *Rickettsia prowazekii*
  - Obligate, intracellular
  - Small (0.3-1.0 μm)
  - Cocccobacilli
  - Outer Membranes
    - Sca family: surface-exposed proteins

Figure 8. *R. prowazekii* in cytoplasm of host endothelial cell.

Epidemic Typhus: History & Epidemiology

- Plague of Athens (430 BC)
  - Peloponnesian War
  - Bubonic Plague vs. Epidemic Typhus
  - Black Assize
    - 500 Dead

- Napoleonic Wars
  - Early 19th century
    - WWI and WWII
      - WWII: 3 million deaths and 20-30 million infections over 4 years
        - WWI: Epidemic in Nazi concentration camps especially Bergen-Belsen and Theresienstadt
          - ~33,000 deaths

- Currently
  - Jails: "Jail fever"
  - Refugee Camps
  - Poor/Unsanitary regions: "Urban Typhus"

Figure 9. Plague of Athens

Figure 10. Mass grave at the Bergen-Belsen concentration camp during WWII which was the "spark" that led to concern about typhus.

Epidemic Typhus: Transmission Cycle

Figure 11. Transmission cycle of epidemic typhus.

Figure 12. Phagocytosis of *R. prowazekii* by an endothelial cell.
Epidemic Typhus: Additional vector

- Epidemic Typhus
  - North America
  - Eastern U.S.
    - Glaucomys volans
    - Southern Flying Squirrel
    - Orchopeas howardii
    - Flea

Epidemic Typhus: Symptoms & Diagnosis

- Severe Headache
- Arthralgia (joint pain)
- Myalgia (Severe muscle pain)
- Rash
  - Starts on trunk—Can progress into petechiae (small areas of bleeding into the skin)
- Without treatment:
  - Renal insufficiency
  - Pneumonia
  - Central Nervous System damage
  - Brill-Zinsser disease

- Complete blood count (CBC)
  - Low platelets/High level of typhus antibodies

**Typhus vaccine available.

Trench Fever: Taxonomy

Class: Alpha-Proteobacteria
Order: Rhizobiales
Family: Bartonellaceae
Genus: Bartonella
Species: quintana

**Tree of bacterial pathogens (Ecker et al. 2005).**
Trench Fever: Parasite

- *Bartonella quintana*
  - Facultative, intracellular
  - Transmitted by an arthropod vector
  - Small (1-1.7 µm)
  - Short rod
  - Gram-negative
  - Endothelial cells and RBC’s

Figure 17. Laser confocal microscopy showing the intraerythrocytic location of *Bartonella quintana*.

Trench Fever: History & Epidemiology

- World War I
  - 1 million people infected
  - Russia & Europe fronts
- World War II
  - Approx. ¼ of British troops infected
- Currently
  - Worldwide
  - Homeless
  - Refugees
  - Immunosuppressed
    - AIDS

Figure 18. Trench fever in WWI.

Figure 18. *B. quintana* nodules in an HIV+ male.

Trench Fever: Transmission

- Similar to Epidemic Typhus
- Except only reservoir is humans

Figure 20. Transmission cycle of Epidemic Typhus, which is similar to Trench Fever.
### Trench Fever: Symptoms/Diagnosis

- Serological Test
  - Weil-Felix test
- PCR
- Immunofluorescence

![Figure 21. Symptoms of Trench Fever.](image)

### Louse-borne relapsing fever (LBRF): Taxonomy

- **Class:** Spirochaetes
- **Order:** Spirochaetales
- **Family:** Spirochaetaceae
- **Genus:** Borrelia
- **Species:** recurrentis

**Borrelia recurrentis**

- Wavy, filamentous
- Transmitted by an arthropod vector
- Free living
- Large (3-25 µm)
- Spiral shaped
- Gram-negative
- Flagella at each end

![Figure 22. Tree of bacterial pathogens (Ecker et al. 2005).](image)

### LBRF: Parasite

- **Borrelia recurrentis**
  - Wavy, filamentous
  - Transmitted by an arthropod vector
  - Free living
  - Large (3-25 µm)
  - Spiral shaped
  - Gram-negative
  - Flagella at each end

![Figure 23. Light microscopy showing B. recurrentis.](image)
LBRF: History & Epidemiology

- Documented since Hippocrates (~400 BC)
- Otto Obermeier
  - Berlin outbreak
  - Spirochetal agent
- 1871- last outbreak in US
- Currently
  - Developing world: Ethiopia and Sudan
  - Refugees
  - Famine and war
  - WWI & II

Figure 24. Sketch of Hippocrates.

LBRF: Transmission Cycle

LBRF: Symptoms/Diagnosis

- Recurrent high fever
- Headaches
- Chills
- Abdominal pain
- Nausea/Vomiting
- Photophobia
- Jaundice

- Blood smear
  - Wright or Giemsa
  - Immunofluorescence
  - Dark-field microscopy

Figure 25. Blood smear which shows spirochetes.
**Treatment & Prevention**

**Treatment**
- Tetracycline
- Doxycycline
- Chloramphenicol
- Erythromycin
- LBRF
- Trench Fever
- Bacillary angiomatosis

**Prevention**
- Stay away from endemic regions
- Poor sanitation
- Practice good hygiene
- Wear proper clothing
- Insect repellent & Insecticide
- DDT

Figure 26. Application of DDT on US beaches.

**Conclusion**

**Introduction**

**For each disease/infection:**
- Taxonomy
- History & Epidemiology
- Transmission
- Symptoms & Diagnosis
- Treatment & Prevention
- Conclusion

**References**
