Animal- and arthropod-transmitted diseases

Dec 6, 2006

Ch. 27

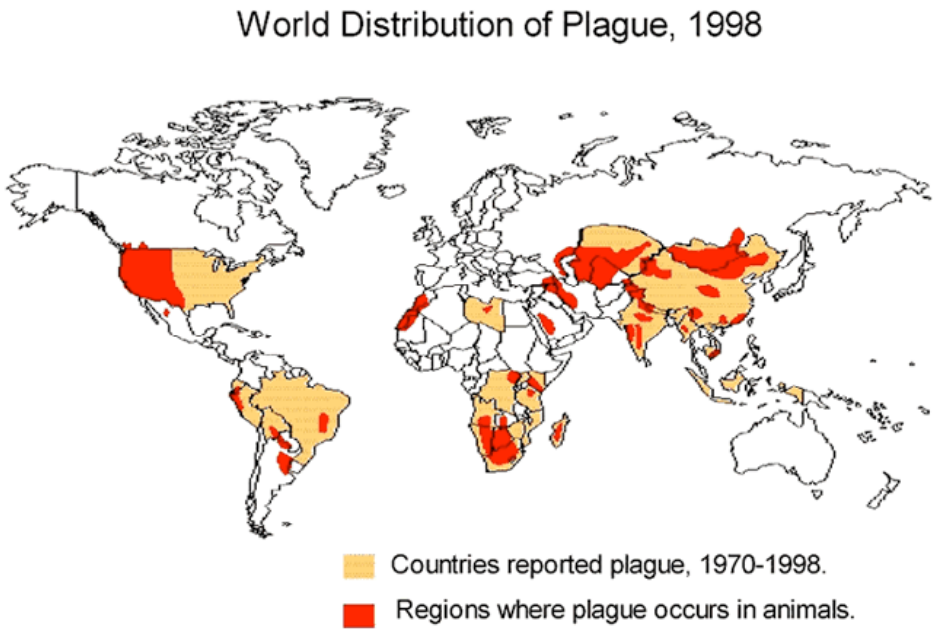
Galán and Wolf-Watz review

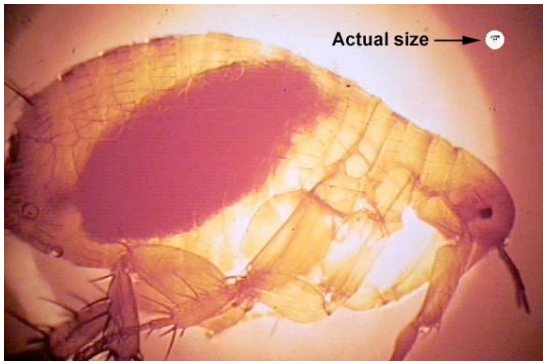
Plague

- Infectious disease of animals and humans
- Caused by a bacterium named *Yersinia pestis*
- People usually get plague from being bitten by a rodent flea that is carrying the plague bacterium
- Antibiotics are effective against plague, but if an infected person is not treated promptly, the disease is likely to cause illness or death

Epidemiology

- Wild rodents in certain areas are infected with plague
- Outbreaks usually associated with infected rats and rat fleas (*Xenopsylla cheopis)*
- Globally, the WHO reports 1,000 to 3,000 cases of plague each year





http://www.cdc.gov/ncidod/dvbid/plague

History of plague

- First pandemic spread from Egypt to Europe, Africa, and Asia 542-600
- Second pandemic known as the Black Death spread from Asia to Europe in the 1300s

http://bubonicplague.quickseek.com/

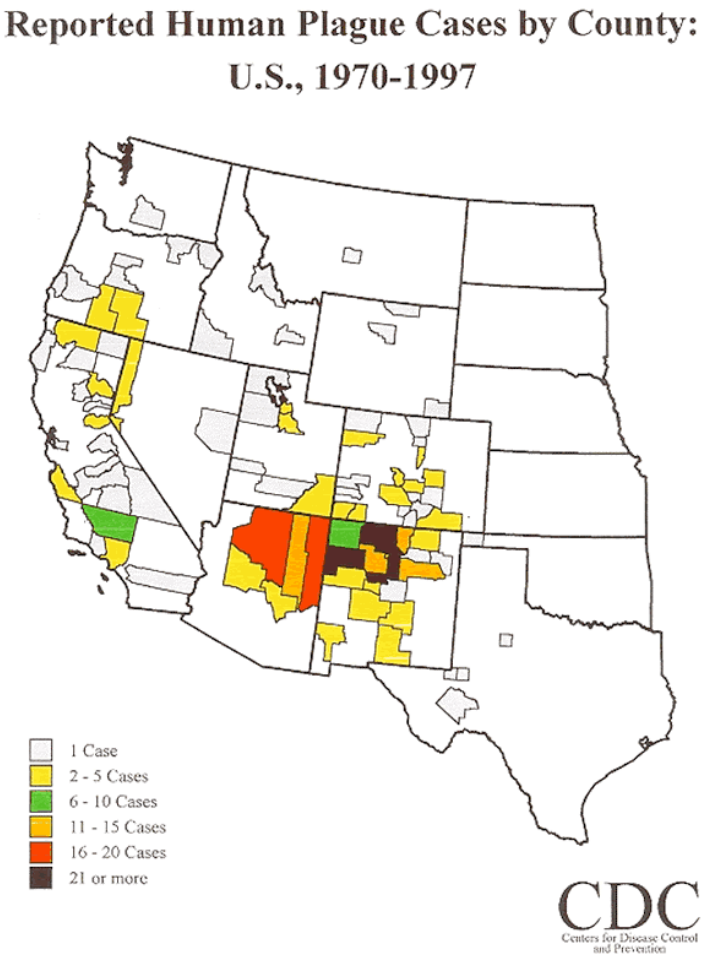
Natural history

- Epidemics usually involve rats
- Last rat-borne epidemic in the US occurred in Los Angeles in 1924-25
- Since then, all human cases in the U.S. have been sporadic cases acquired from wild rodents
- Rock squirrels and their fleas are the most frequent sources of human infection in the southwestern states

Courtesy of Diliff.

Geographic distribution

- Averages about 18 cases per year in US
- Mostly in people < 20 years of age
- About 1 in 7 persons will die
- Epidemic plague occurs Africa, Asia, & South America associated with domestic rats



Forms of disease

- Bubonic plague
  - enlarged, tender lymph nodes, fever, chills and prostration
- Septicemic plague
  - fever, chills, prostration, abdominal pain, shock and bleeding into skin and other organs
- Pneumonic plague
  - fever, chills, cough and difficulty breathing; rapid shock and death if not treated early

www.cdc.gov/ncidod/dvbid/plague

Diagnosis of plague

- Painful, swollen lymph node, called a bubo
- Onset usually 2-6 days after exposure
- Disease progresses rapidly and bacteria invade the bloodstream, producing severe illness, called plague septicemia
- Progression leads to lung infection or plague pneumonia
- Incubation period of primary pneumonic plague is 1-3 days
  - Characterized by overwhelming pneumonia with high fever, cough, bloody sputum, and chills
  - Mortality rate > 50%

Treatment

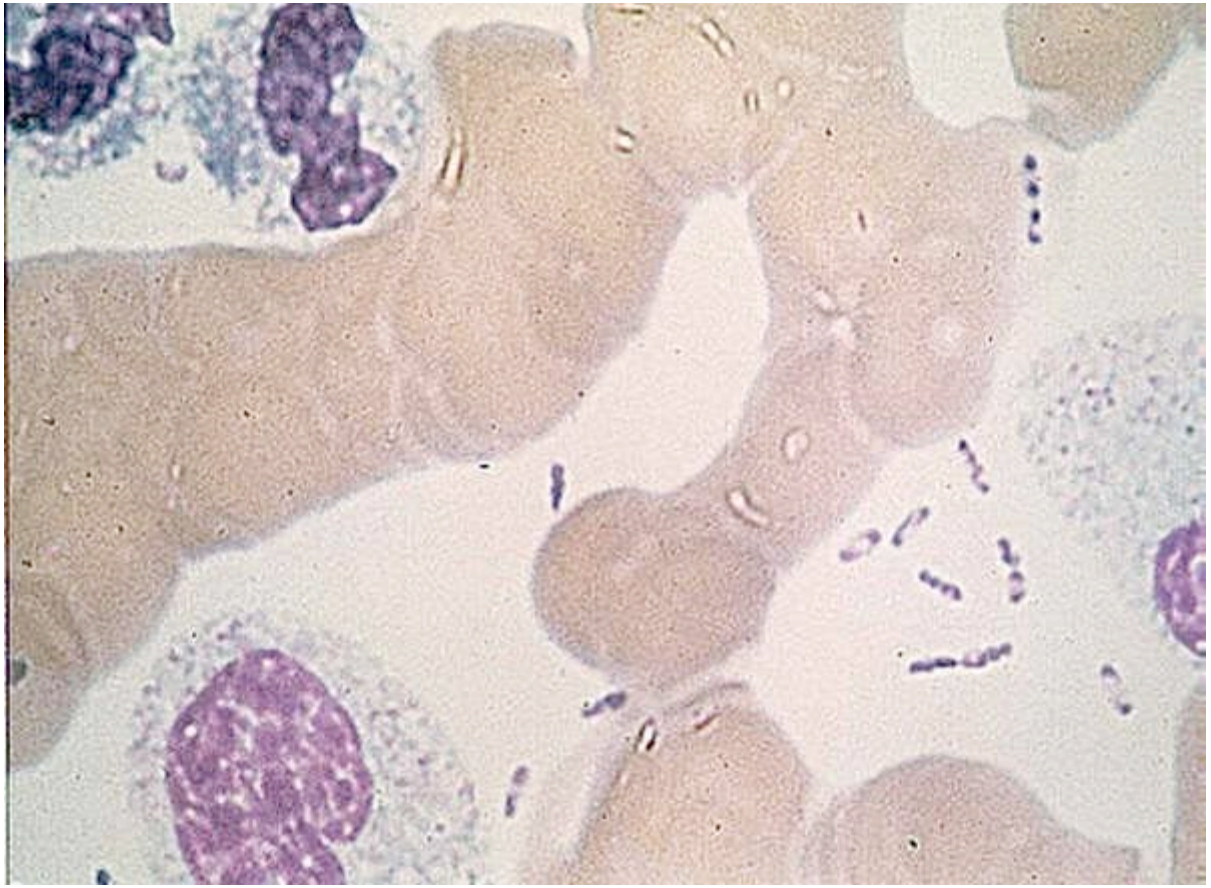
- As soon as a diagnosis of suspected plague is made, the patient should be isolated, and local and state health departments should be notified
- The drugs of choice are streptomycin or gentamicin, but a number of other antibiotics are also effective
- Those individuals closely associated with the patient, particularly in cases with pneumonia, should be traced, identified, and evaluated

Prevention

- Epidemic plague is best prevented by controlling rat populations in both urban and rural areas
- In regions where plague is widespread in wild rodents, the greatest threat is to people living, working, or playing in areas where the infection is active
  - Eliminate food and shelter for rodents
  - Surveillance in wild rodent populations
  - Use of appropriate insecticides to kill fleas

The bacterium

- Gram negative facultative anaerobe
- Formerly classified in the family *Pasteurellaceae*, but based on DNA-DNA hybridization member of the *Enterobacteriaceae* family
- 11 named species, but only 3 are human pathogens
  - *Y. pestis*, the etiologic agent of plague
  - *Y. pseudotuberculosis* and *Y. enterocolitica*



http://www.cdc.gov/ncidod/dvbid/plague

Diagram removed due to copyright restrictions.

Zhou et al. Microbes Infect 6:1226-34, 2004.

Invasion

- Enteropathogenic *Yersinia* species invade cultured mammalian cells
- Mediated by *inv* gene product invasin
- Outer membrane protein binds β_1 integrins

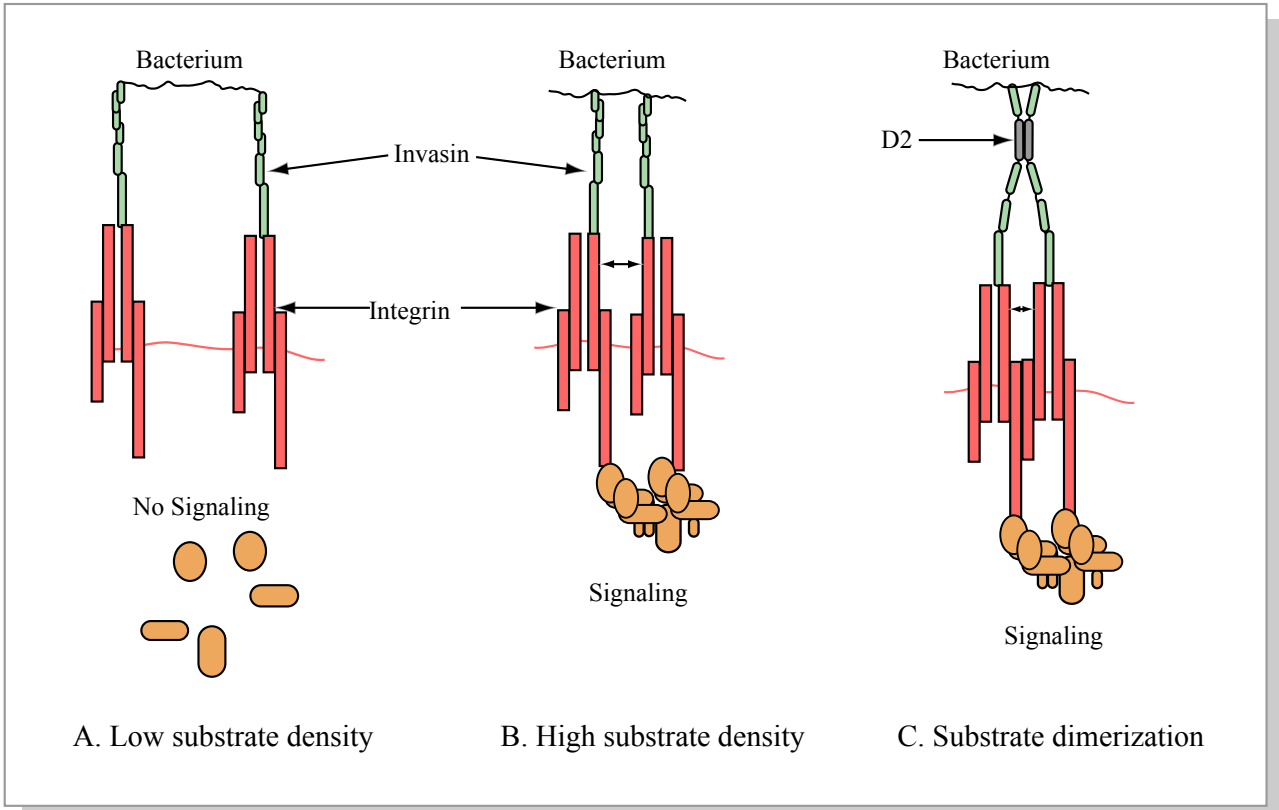
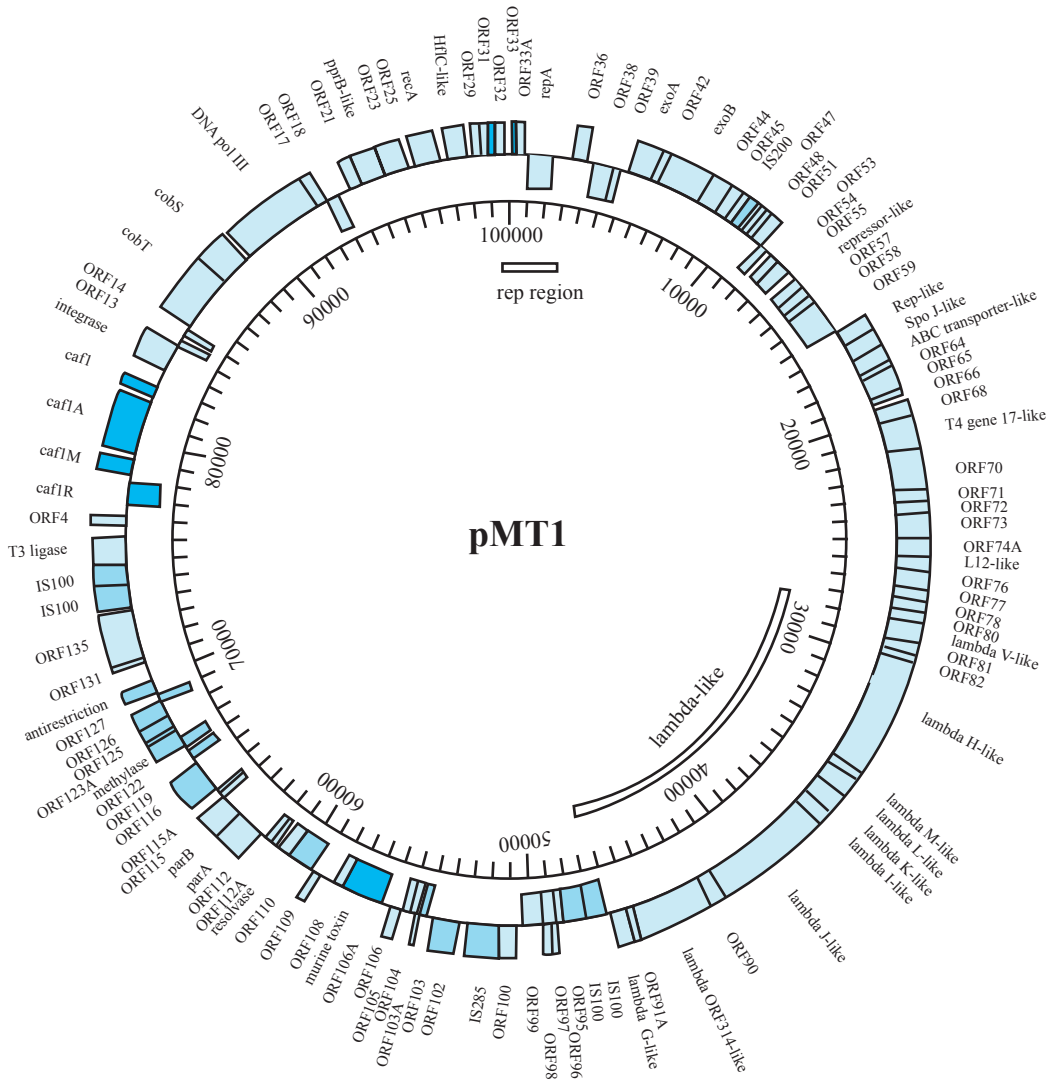


Figure by MIT OCW.

Isberg and Barnes, J Cell Sci 114:21-28, 2001.

Image removed due to copyright restrictions.

Neutra et al. Nature Immunol **2**:1004-9, 2001.



Hu et al. J Bacteriol 180:5192-5202, 1998

Figure by MIT OCW.

Images removed due to copyright restrictions.

Jarrett et al. J Infect Dis 190:783-92, 2004.

Image removed due to copyright restrictions.

Hu et al. J Bacteriol 180:5192-5202, 1998

Images removed due to copyright restrictions.
Figures 1 and 2 in "THE YERSINIA YSC–YOP 'TYPE III' WEAPONRY," *Nature Reviews Molecular Cell Biology* 3, 742-754 (2002).