PLAGUE

Epidemiology

**Source:**
Rodents, carnivores, & their fleas

**Transmission**
- Bites of infected rodent fleas
- Bites from infected human fleas (Pulex irritans)
- Direct contact with tissues/fluid of infected animals (bubonic, septicemic)
- Exposure to laboratory aerosols (pneumonic)

**Infectious dose**
10-500 organisms

Not in Louisiana
- Imported from Western US or foreign
- Lab infection
- If not, suspect BT

**Incubation**
- Bubonic: 2-8 d
- Septicemic: 1-6 d
- Pneumonic: 1-3 d

**Communicability**
- Bubonic: by fleas, infectious for weeks by contact with pus while symptomatic
- Septicemic: blood & body fluid exposure
- Pneumonic: droplet while symptomatic

**Contagious** up to 48 hrs after Tx (pneumonic)

**Clinical case definition**
- Bubonic: swollen lymph nodes (buboes) esp. in inguinal, axillary, cervical regions.
- Septicemic: hypotension, acute respiratory distress, intravascular coagulopathy
- Pneumonic: cough, fever, dyspnea, hemothysis

**Infectious dose**
10-500 organisms

**Mortality:**
- Asia=54%, Africa=34%, Americas=11%

**Complications:**
- sepsis with renal failure, acute respiratory distress syndrome, hemodynamic instability, diffuse intravascular coagulation, necrosis of distal extremities

**Morbidity:**
- 50% bubonic and septicemic, 90% pneumonic if treatment is not started within 18 hrs.

**Diagnosis**

_Yersinia pestis_ is a nonmotile, gram-negative bacillus that belongs to the _Enterobacteriacea_ family.

**Lab Diagnosis**
- **Culture**- Culture of _Y. pestis_ confirmed from blood, bubo aspirate (bubonic), sputum or tracheal wash (pneumonic), and CSF.
  - Gram stain shows organism with bipolar (safety-pin) morphology.
  - Direct fluorescent assay (FA) shows bacilli
- **Immunofluorescence** - positive for _Y. pestis_ F1 antigen.
- **Serologic test**- 4-fold difference in antibody titer between 2 serum specimens (4 wk apart)
- **Polymerase chain reaction** -for rapid diagnosis.
- Microbiology lab should be informed of suspected cases to minimize risks of transmission.

**ENVIROMENTAL RESISTANCE**
- Low resistance to environmental factors.
- Sunlight, high temperatures and desiccation have a destructive effect,
- Ordinary disinfectants as Lysol® & chlorine preparations kill it within 1 to 10 minutes.
An epidemiological investigation should be performed for each human case to determine:

- Drainage of abscessed buboes may be necessary.
- Duration 7-10 days or until several days after lysis of fever.

Alternatively, sulfamethoxazole, ciprofloxacin, or other antibiotics might be considered:

- Pneumonic plague: Streptomycin intramuscularly or Gentamycin
- Children: doxycycline, ciprofloxacin, trimethoprim-sulfamethoxazole

Adults: doxycycline, ciprofloxacin, trimethoprim-sulfamethoxazole, 40mg/kg, 2 doses/day, PO

Given for 7 days in usual therapeutic doses.

**FLEA SPECIES**

To understand epidemiology and transmission it is essential to determine the flea species involved:

- Xenopsylla cheopis (Oriental rat flea) has a wide distribution, not specific for them.
- X. astia.
- Flea species common in the environment of commensal rodents, not specific for them.

- Echidnophaga gallinacea, Pulex irritans, and the cat flea, Ctenocephalides felis.

**VACCINATION**

- Worldwide, live attenuated and formalin-killed *Y. pestis* vaccines are variously available for human use.
- Variably immunogenic and moderately to highly reactogenic.
- No protection against primary pneumonic plague.
- In general, vaccinating communities against epizootic and enzootic exposures rarely feasible; little use during human plague outbreaks, since a month or more is required to develop a protective immune response.
- Indicated for persons whose work routinely brings them into close contact with *Y. pestis*, such as laboratory technicians in plague reference and research laboratories and persons studying infected rodent colonies.

**EPIDEMIOLOGIC INVESTIGATION**

An epidemiological investigation should be performed for each human case to determine the source of infection and risk of additional human cases. Reports of these investigations should include:

- Complete history of the patients' activities and travel during the incubation period of the infection;
- Results of field studies to determine which animal and flea species are likely sources of infection or pose a continuing threat to humans;
- Proximity of infected rodents and fleas to human dwellings or workplaces;
- Estimated number of people involved in activities that place them at high risk of plague infection;
- Information on possible exposure to *Y. pestis* infection of patient contacts (especially important for pneumonic plague cases).

**TREATMENT**

- Streptomycin: 30mg/kg Max 2g/day, IM, div in 2 doses/day, 10 days
- Tetracycline: Oral loading dose 15mg/kg, max 1g, then 25-50mg/kg (max 2g), PO
- Doxycycline: 200mg/day, 1 or 2 doses, PO
- Gentamicin: 3mg/kg/day, 3 divided doses, IM or IV
- Children: streptomycin (30 mg/kg per day in 2 or 3 divided doses given intramuscularly) or gentamicin (6-7.5 mg/kg/day), IM
- Pneumonic plague = Streptomycin
- Alternative drugs: Tetracycline, doxycycline, chloramphenicol, trimethoprim-sulfamethoxazole, ciprofloxacin
- Duration 7-10 days or until several days after lysis of fever.
- Drainage of abscessed buboes may be necessary.

**PROPHYLAXIS**

- Indicated for people with close exposure (<2m) to a patient with pneumonic plague
- Anyone exposed to pneumonic plague with a >38.5°C fever or any other symptoms
- Children: trimethoprim-sulfamethoxazole, 40mg/kg, 2 doses/day, PO
- Adults: doxycycline, ciprofloxacin, trimethoprim-sulfamethoxazole, 40mg/kg, 2 doses/day, PO
- Given for 7 days in usual therapeutic doses.

- **RODENT SPECIES**

  Many species of rodents / other small mammals are susceptible to infection but only occasionally infected and not necessarily important reservoirs of infection.

  - Enzootic (maintenance) hosts: rodents from genera that are relatively resistant to plague, low mortality, positive antibody rate up to 100%. Die-offs rare.
  - Epizootic (amplification) hosts. Introductions into a highly plague-susceptible area. Echidnophaga gallinacea, Pulex irritans, and the cat flea, Ctenocephalides felis.

  **EPIDEMICS**

  - Human infection most frequently occurs when an epizootic develops among synanthropic rats in centers of human population, following contact with infected wild rodents.
  - Commensal rat fleas, including plague–infected fleas, leave the bodies of rats killed by plague seeking a blood meal
  - Following the death of rodents during an epizootic in a natural focus. The fleas can accumulate at the entrance to and the ground surface around burrows. The fleas are not strictly species–specific.
  - Exposure to droplets from a pneumonic plague
  - Bioterrorism possible

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