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)
- Droplets from infected animal or human (pneumonic)
- Exposure to laboratory aerosols (pneumonic)

Infectious dose
10-500 organisms

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

Contagious up to 48 hrs after Tx (pneumonic)

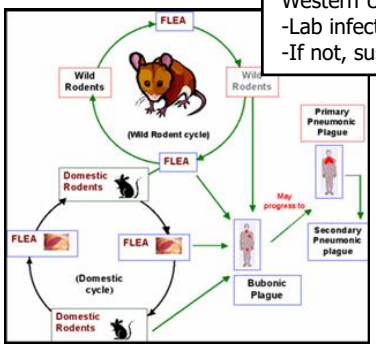
Clinical case definition
Abrupt onset of fever, chills, headache, malaise
-Bubonic: swollen lymph nodes (buboes) esp. in inguinal, axillary, cervical regions.
-Septicemic: hypotension, acute respiratory distress, intravascular coagulopathy
-Pneumonic: cough, fever, dyspnea, hemoptysis

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

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

Mortality: Asia=54%, Africa=34%, Americas=11%.

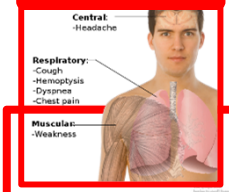
Complications: sepsis with renal failure, acute respiratory distress syndrome, hemo-dynamic instability, diffuse intravascular coagulation, necrosis of distal extremities
Morbidity: 50% bubonic and septicemic, 90% pneumonic if treatment is not started within 18 hrs.



Xenopsylla cheopis

A flea infected with *Yersinia pestis*, shown as a dark mass. The foregut of this flea is blocked by a *Y. pestis* biofilm, which is a prerequisite for efficient transmission.

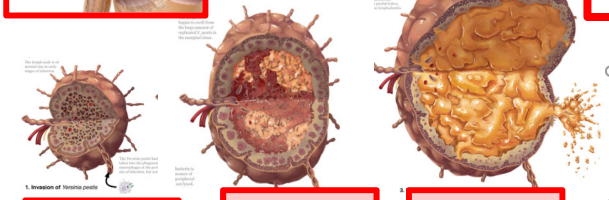
PNEUMONIC



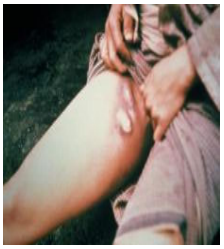
SEPTICEMIC

- Attacked the blood system (Blood Poisoning)
- Fevers
- Skin turns deep shades of purple due to DIC (disseminated intravascular coagulation)

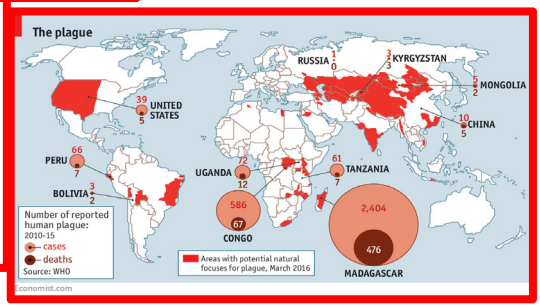
BUBONIC



Invasion of a lymph node → Pus formation in the marginal sinuses → Lymph node → enlarged & bursts open



ENVIRONMENTAL 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.



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
- **Immunoflourescence -** 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.

Suspect: Clinically compatible case
Probable: Clinically compatible
-Elevated serum antibody titers to *Y. pestis* F1 antigen,
-F1 antigen by fluorescent assay

Confirmed:
-Isolation of *Y. pestis*
-Detection by PCR,
-Fourfold change in serum antibody titer to *Y. pestis* F1 antigen

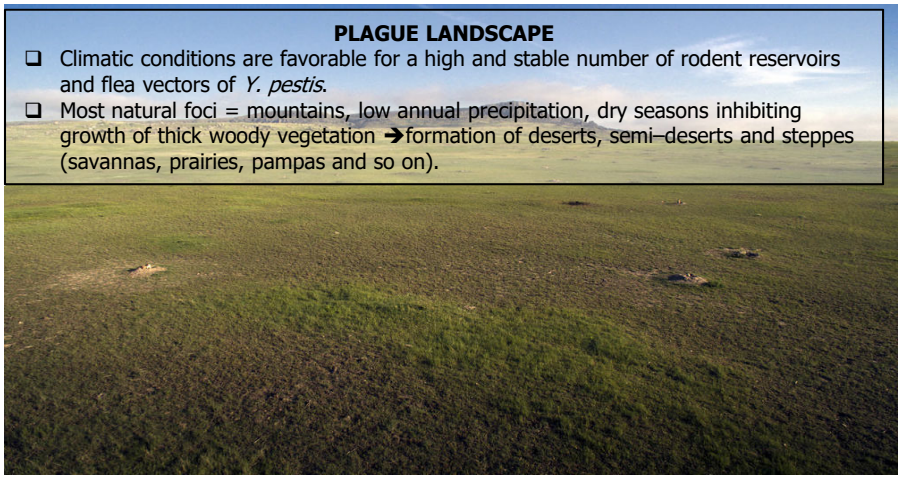
Control

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

PLAGUE LANDSCAPE

- ❑ Climatic conditions are favorable for a high and stable number of rodent reservoirs and flea vectors of *Y. pestis*.
- ❑ Most natural foci = mountains, low annual precipitation, dry seasons inhibiting growth of thick woody vegetation ➔formation of deserts, semi–deserts and steppes (savannas, prairies, pampas and so on).



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.

Introduction into a highly plague-susceptible species to plague, an epizootic may reach considerable magnitude with high mortality

FLEA SPECIES

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

Fleas specific to commensal rodents with wide distribution found in several endemic areas:

- ❑ *Xenopsylla cheopis* (Oriental rat flea) has a wide distribution,
- ❑ *X. brasiliensis* and *Nosopsylla fasciatus* is more limited
- ❑ Restricted distribution, *X. astia*.
- ❑ Flea species common in the environment of commensal rodents, not specific for them. *Echidnophaga gallinacean, Pulex irritans*, and the cat flea, *Ctenocephalides feli.*

EPIDEMIOLOGIC INVESTIGATION

An epidemiological investigation should be performed for each human case to determine **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, Prophylaxis

Standard & Droplet Precautions (until 24 hrs after treatment)

TREATMENT

- **Streptomycine:** 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
- **Sulfamide:** Higher mortality
- **Gentamycin:** 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/day), IM
- Pneumonic plague = Streptomycin
- Alternative drugs: Tetracycline, doxycycline, chloramphenicol, trimethoprim-sulfamethoxazole, ciprofloxacin Alternative drugs.
- 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 >38.5ºC fever or any other symptoms
- Children: trimethoprim-sulfamethoxazole, 40mg/kg, 2 doses/day, PO
- Adults: doxycycline, ciprofloxacin, trimethoprim-sulfa Adult 1-6g/day,2 doses/day, PO
- Given for 7 days in usual therapeutic doses

Household contacts or anyone with face-to-face exposure to a plague patient should report fever >38.5ºC or other signs of illness to their physician.

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.