

Plague

1. DISEASE REPORTING

A. Purpose of Reporting and Surveillance

1. To identify the source of infection and determine the risk of transmission from that source to others.
2. To determine whether the source of infection is a major public health concern (e.g., intentional release of the organism, increased human exposure due to wildlife epizootics, etc.) and to stop transmission from such a source.
3. To identify other cases, facilitate treatment and in the case of pneumonic plague, prevent person-to-person spread.

B. Laboratory and Physician Reporting Requirements

1. Laboratories and physicians are required to **immediately (day or night)** report any suspect plague case to the local health department or to Oregon Health Services.

C. Local Health Department Reporting and Follow-Up Responsibilities

1. Report all confirmed, presumptive and suspect cases (see definitions below) of plague to Oregon Health Services **immediately (day or night)**.
2. Begin follow-up investigation immediately. Use the CDC Plague Case Investigation Report (CDC 56.37 5-85), available from Oregon Health Services.

2. THE DISEASE AND ITS EPIDEMIOLOGY

A. Etiologic Agent

Yersinia pestis is a non-spore-forming, Gram-negative, non-motile cocco-bacillus. It exhibits bipolar staining, giving it a characteristic “safety pin” appearance. *Y. pestis* is viable for weeks under moist conditions. At near-freezing temperatures it is viable for months to years. However, sunlight and heat readily kill the organism.

B. Description of Illness

Yersinia pestis infection in humans occurs in one of three primary clinical forms that are discussed below.

1. Bubonic Plague

Bubonic plague occurs in 80 to 90% of naturally occurring plague cases in the United States and has a case-fatality rate of 50 to 60% if untreated. Bubonic plague results from being bitten by an infected flea or contamination of an open skin lesion with plague-infected material. After an incubation period of 2 to 6 days, patients typically experience a sudden onset of fever, shaking chills, malaise and pain in the lymph nodes closest to the bite. Symptoms progress rapidly, with development of lymphadenitis, which becomes very painful. These swollen lymph nodes are known as buboes. Bubonic plague can progress to the septicemic form.

2. Septicemic Plague

Primary septicemic plague occurs in about 10% of plague cases in the United States and has a case-fatality rate of 50%. Buboes are not seen in primary septicemic plague, making diagnosis more difficult. Septicemic plague can also occur secondary to bubonic plague. Patients develop endotoxic-shock, disseminated intravascular coagulation (DIC), multiple organ failure (MOF), adult respiratory distress syndrome (ARDS), mental confusion, and death. Hemorrhage and tissue necrosis may be seen with DIC.

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3. Pneumonic Plague

There have been only 7 cases of primary pneumonic plague cases in the United States in the last 50 years. The case-fatality rate of untreated pneumonic plague is nearly 100 percent. This is the form that would be seen in the event of an intentional aerosol release. Onset of symptoms usually occurs within 1 to 6 days, usually 24 to 48 hours of exposure. The patient initially exhibits an acute onset of fever, chills, headache, malaise and myalgias, followed within 24 hours by cough with the production of bloody sputum. Gastrointestinal signs, including nausea, vomiting, diarrhea and abdominal pain, may also be present. The pneumonia progresses rapidly, resulting in dyspnea, stridor, and cyanosis, terminating in respiratory failure, circulatory collapse and death.

C. Reservoirs

Wild rodents are the natural reservoir of *Y. Pestis*. Feeding fleas transmit the organism, maintaining the disease in the wild rodent population. In the United States, the major reservoir species include the prairie dog *Cynomys gunnisoni* and the rock squirrel *Spermophilus variegatus*. The most important reservoir on the Pacific coast is the California ground squirrel *Spermophilus beecheyi*. Others include chipmunks, the California vole and the golden-mantled ground squirrel *Spermophilus lateralis*.

Infection from the wild reservoir can spill over into peridomestic and commensal (domestic) rodents who are more susceptible to the disease and are important in transmitting the disease to man.

D. Sources and Routes of Transmission

1. Flea bites

The most common means of transmission to humans is through bites from fleas infected with *Y. pestis*. Fleas become infected by feeding on plague-infected rodents and can remain infective for months.

2. Infected animals

Handling tissues of infected animals is also a source of human infection.

Natural infection in domestic cats occurs and is believed to be due to consumption of infected rodents. Cats have been a source of human infection in some instances, especially in the Southwestern United States, where plague is endemic. Transmission from an infected cat to man has resulted from direct contact, bites and scratches, and from bites by plague-infected fleas carried by cats.

3. Infected humans

Individuals with bubonic plague are communicable when buboes or other cutaneous lesions are draining. Person-to-person transmission occurs from patients with pneumonic plague through respiratory droplet spread.

4. Intentional Dissemination

Intentional dissemination of plague would most likely occur as an aerosol release of the organism, resulting in pneumonic plague. Individuals who develop pneumonic plague would then be a source of person-to-person transmission.

E. Incubation Period

- Bubonic plague — ranges from 2 to 6 days.
- Primary pneumonic plague — ranges from 1 to 6 days (usually 2 to 4 days).
- Primary septicemic plague — similar to bubonic form.

F. Period of Communicability

Exudates from buboes contain viable *Y. pestis* organisms and patients with draining buboes are communicable until lesions are surgically excised or heal. Patients with pneumonic plague are communicable at the onset of symptoms, usually within 24 to 48 hours of exposure. The infection generates an intense cough reflex, which readily disperses fine respiratory droplets capable of exposing close contacts (usually within 1 meter). Patients are infectious until completion of 72 hours of appropriate antibiotic therapy.

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Treatment Recommendations for Treatment of Patients with Pneumonic Plague in Contained and Mass Casualty Settings and for Postexposure Prophylaxis*

Patient Category	Recommended Therapy
Contained Casualty Setting	
Adults	<p>Preferred Choices Streptomycin 1 g IM twice daily Gentamicin, 5 mg/kg IM or IV once daily or 2 mg/kg loading dose followed by 1.7 mg/kg IM or IV 3 times daily</p> <hr/> <p>Alternative choices Doxycycline, 100 mg IV twice daily or 200 mg IV once daily Ciprofloxacin, 400 mg IV twice daily Chloramphenicol, 25 mg/kg IV 4 times daily</p>
Children	<p>Preferred choices Streptomycin, 15 mg/kg IM twice daily (maximum daily dose, 2 g) Gentamicin, 2.5 mg/kg IM or IV 3 times daily</p> <hr/> <p>Alternative choices Doxycycline, If ≥ 45 kg, give adult dosage If < 45 kg, give 2.2 mg/kg IV twice daily (maximum, 200 mg/d) Ciprofloxacin, 15 mg/kg IV 4 times daily Chloramphenicol, 24 mg/kg IV 4 times daily</p>
Pregnant Women	<p>Preferred choice Gentamicin, 5 mg/kg IM or IV once daily or 2 mg/kg loading dose followed by 1.7 mg/kg IM or IV 3 times daily</p> <hr/> <p>Alternative choices Doxycycline, 100 mg IV twice daily or 200 mg IV once daily Ciprofloxacin, 400 mg IV twice daily</p>
Mass Casualty Setting and Postexposure Prophylaxis	
Adults	<p>Preferred choices Doxycycline, 100 mg orally twice daily Ciprofloxacin, 500 mg orally twice daily</p> <hr/> <p>Alternative choice Chloramphenicol, 25 mg/kg orally 4 times daily</p>
Children	<p>Preferred choices Doxycycline, If ≥ 45 kg, give adult dosage If < 45 kg, then give 2.2 mg/kg orally twice daily Ciprofloxacin, 20 mg/kg orally twice daily</p> <hr/> <p>Alternative choice Chloramphenicol, 25 mg/kg orally 4 times daily</p>
Pregnant women	<p>Preferred choices Doxycycline, 100 mg orally twice daily Ciprofloxacin, 500 mg orally twice daily</p> <hr/> <p>Alternative choice Chloramphenicol, 25 mg/kg orally 4 times daily</p>

*Recommendations of the Working Group on Civilian Biodefense, JAMA. 2000;283:2281-2290

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3. CASE DEFINITIONS, DIAGNOSIS AND LABORATORY SERVICES

Rapid diagnostic tests are not currently available for plague. Diagnosis is based primarily on clinical suspicion.

A. Confirmed Case

- Isolate from a clinical specimen identified as *Y. pestis* by phage lysis; **or**
- a four-fold increase in serum antibody titer to *Y. pestis* F1 antigen in acute and convalescent serum specimens; **or**
- an antibody titer of >1:128 to *Y. pestis* F1 antigen on a single serum specimen, not explainable on the basis of prior infection or immunization.

B. Presumptive Case

- *Yersinia pestis* F1 antigen detected in clinical materials by direct fluorescent antibody testing; **or**
- isolate from a clinical specimen that demonstrates biochemical reactions consistent with *Y. pestis*, or PCR positivity; **or**
- an antibody titer of >1:10 to *Y. pestis* F1 antigen on a single serum specimen, not explainable on the basis of prior infection or immunization.

C. Suspect Case

- Compatible clinical and epidemiological features; **and**
- small gram-negative and/or bipolar-staining coccobacilli are seen in clinical specimens.

D. Services Available at the Public Health Laboratory

Consult the Oregon State Public Health Laboratory (OSPHL) prior to specimen preparation and shipment. OSPHL conducts culture of clinical specimens. OSPHL provides direct fluorescent antibody testing on clinical specimens or smears from clinical specimens. For antibody testing, 5 ml of serum should be sent to OSPHL, and will be forwarded to CDC for testing.

4. CASE INVESTIGATION

Interview the case and others who may be able to provide pertinent information using the CDC Plague Case Investigation Report (CDC 56.37 5-85), available from Oregon Health Services. For a possible intentional aerosol release (bioterrorist event), see section 6 below.

A. Identify Source of Infection

For the 1 to 6 days prior to onset, obtain histories of:

- bites by fleas;
- contact with wild or commensal rodents;
- direct contact with a "sick" cat (holding, petting, being bitten or scratched);
- contact with individuals with confirmed, presumptive or suspect plague;
- exact whereabouts of cases with pneumonic plague during the 1 to 6 days prior to onset of symptoms.

B. Identify Other Potentially Exposed Persons

Identify and contact persons who may have had the same exposures as the case. Identify and contact any acquaintances or household members with similar illnesses. Asymptomatic persons having household, hospital or other close contact (<2 meters) with pneumonic plague cases should receive post-exposure antibiotic prophylaxis for 7 days and be watched for fever and cough (see table for treatment guidelines, page 3).

C. Environmental Evaluation

1. If the source of infection appears to be wild rodents, the public should be informed of the risk of and how to avoid contact with potentially plague infected rodent populations.
2. If the source appears to be contact with plague-infected commensal rodents or domestic cats, it can be assumed that this is due to spill over from a wild rodent population, and further investigation of the animal source is warranted.

5. CONTROLLING FURTHER SPREAD

1. Reduce bites from infected fleas by flea and rodent control.
 2. In the face of an enzootic, insecticides should be employed before or at the same time as rodenticides, but never after as fleas, abandon dead animals in search of new hosts, including humans.
 3. Reduce direct contact with infective tissues and exudates by wearing gloves when hunting and handling wildlife or dead animals.
 4. Reduce exposure to patients with pneumonic plague by:
 - a. use of Droplet Precautions in addition to Standard Precautions (see Guideline for Isolation Precautions in Hospitals, *American Journal of Infection Control*, June 1996, Vol 24, Number 1, <http://www.apic.org/resc/gdisolat.cfm#item264>).
 - b. avoiding unnecessary close contact with pneumonic plague patients until at least 48 hours after initiation of antibiotic therapy.
 - c. cohorting multiple cases.
- A. Educaton**
- Educate the public regarding:
1. where enzootic areas and wild rodent populations are;
 2. modes of human and domestic animal exposures and how to avoid them;
 3. the importance of commensal rodent and flea control;
 4. wearing gloves when handling wildlife.
- B. Isolation and Work or Day Care Restrictions**
1. Standard precautions should be applied to management of all suspected plague patients.
 2. In addition, patients with pneumonic plague should be specifically managed under respiratory droplet precautions, and placed under isolation for the first 48 hours of antibiotic therapy.
- C. Case Follow-up**
- Appropriate antibiotic therapy (see table, page 3) should be started immediately when plague is suspected.
- D. Protection of Contacts**
- All close contacts of confirmed, presumptive or suspected cases with plague pneumonia (including medical personnel) should be provided with chemoprophylaxis (see table, page 3).
- E. Environmental Measures**
- None. *Yersinia pestis* does not form spores and does not survive long outside the host. In the case of an intentional aerosol release, the organism will have dissipated long before the first case of pneumonic plague occurs.

6. MANAGING SPECIAL SITUATIONS

A. Bioterrorist Event

Yersinia pestis has been classified as a "Category A" agent for bioterrorism because it can be easily disseminated by aerosol, can be transmitted from person to person (pneumonic plague) and has the capacity to cause severe illness and death. An intentional release (bioterrorist event) should be suspected if unusual clusters of pneumonia are seen in otherwise healthy individuals or in people in buildings with common ventilation systems. Call the Acute and Communicable Disease Prevention Section of Oregon Health Services **immediately, day or night** if plague is suspected.