

Plague

24-Hour Reportable Disease

1) THE DISEASE AND ITS EPIDEMIOLOGY

A. Etiologic Agent

Plague is a zoonotic infection of rodents, rabbits, and their fleas, caused by the bacterium *Yersinia pestis*, a gram-negative bacillus.

B. Clinical Description

Plague is a severe bacterial infection characterized by the abrupt onset of high fever, chills, malaise, myalgia, nausea, and weakness. Three clinical forms of plague are recognized. The most common form is the bubonic plague characterized by the development of painful, unilateral regional lymphadenopathy within 24-48 hours of fever onset. The affected lymph nodes drain the point of entrance of the bacteria, typically involving the inguinal, axillary or cervical nodes. Septicemic plague may develop secondary to the bubonic form, or may be the primary presentation if the bacteria are directly inoculated into the blood stream. This presents as a gram-negative bacterial sepsis. Pneumonic plague can develop as a primary infection from inhalation of respiratory droplets or secondarily from hematogenous dissemination. Pneumonic plague can result in human-to-human transmission via spread through respiratory droplets. Untreated bubonic plague has a fatality rate approaching 70%; septicemic and pneumonic plague are invariably fatal without prompt treatment.

C. Reservoirs

Plague is maintained in a natural rodent-flea cycle involving multiple wild rodents and their fleas. Other wild and domestic species may be infected, particularly lagomorphs (e.g. rabbits) and felids (e.g. cats), that have been implicated in human transmission. The most common animal species implicated in the transmission of plague to humans in Colorado include rock squirrels, wood rats, prairie dogs and domestic cats.

D. Modes of Transmission

Approximately 85% of human plague cases are acquired through the bite of an infected flea. Direct contact with infected carcasses (i.e. rabbit hunting) or infectious tissues and exudates (draining abscesses) account for most remaining cases. Infected cats have also transmitted plague via bites or scratches. Pneumonic spread by inhaling the airborne bacteria contained in respiratory droplets expelled by people or cats with pneumonic plague, is a serious, though rare, medical and public health problem.

E. Incubation Period

The incubation period averages 2-3 days, ranging from 1 to 7 days for bubonic plague and 1 to 4 days for primary pneumonic plague

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F. Period of Communicability or Infectious Period

Patients remain infectious throughout their symptomatic illness. Tissues, drainage from buboes and respiratory secretions in pneumonic cases are considered infectious until 48 hours after initiation of appropriate antimicrobial therapy.

G. Epidemiology

Plague is endemic throughout the western United States; New Mexico, Colorado, Arizona, and California report the majority of human cases. Human plague cases occur sporadically in association with increased epizootic activity among ground squirrels and other wild rodents. Large-scale die-offs of rodents and rabbits, resulting in the release of infected fleas into the environment, often precede human cases. Most exposures occur among persons living, working or recreating in rural and semi-rural areas. Peridomestic exposure is common. Free-roaming domestic pets have been increasingly implicated in human cases through transport of fleas into the home. In the United States, plague is a rural disease, urban transmission involving rats of the genus *Rattus* have not been observed in recent history, although die-offs of urban tree squirrels (*Sciurus niger*) are reported and thought to be due to plague. Person-to-person pneumonic transmission has not been documented in the United States since 1924.

Colorado plague statistics are available at the CDPHE Plague website:

<http://www.cdphe.state.co.us/dc/zoonosis/plague/plaguehom.html>

H. Bioterrorism Potential

Due to its short incubation period, potential high case fatality rate and ability for person-to-person pneumonic spread, *Yersinia pestis* is listed as a Class A bioterrorism agent. As such, *Y. pestis* is a select agent covered by federal regulations regarding its possession, handling and transport.

2) CASE DEFINITION

Clinical Description

- *Bubonic plague*: [most common form] abrupt onset of high fever, chills, prostration and unilateral enlarged, extremely tender lymph node(s) usually inguinal, axillary or cervical
- *Septicemic plague*: septic shock syndrome with disseminated intravascular coagulation (DIC) and small vessel necrosis; may develop secondary to bubonic form or as primary gram-negative bacterial sepsis without noticeable bubo
- *Pneumonic plague*: [least common form] fever, cough, dyspnea, chest pain and hemoptysis; may be primary or develop secondary to bubonic and/or septicemic forms.

Laboratory Criteria for Diagnosis

Presumptive:

- Elevated serum antibody titers to *Y. pestis* fraction 1 (F1) antigen (without documented fourfold or greater change) in a patient with no history of plague vaccination or
- Detection of F1 antigen in a clinical specimen by direct fluorescent antibody (DFA) assay or
- Polymerase chain reaction (PCR) assay in a clinically appropriate specimen or
- Time Released Fluorescent (TRF) assay in a clinically appropriate specimen

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Confirmatory:

- Isolation of *Y pestis* from a clinical specimen or
- Fourfold or greater change in serum antibody titer to *Y pestis* F1 antigen

Clinical specimens appropriate for testing:

- Any culture isolates
- Aspirate from bubo
- Blood cultures (obtained before initiation of antibiotic treatment)
- A whole blood sample in a purple-top tube for PCR
- Sputum, bronchial wash or respiratory secretions in patients with x-ray evidence of pneumonic involvement
- Serum for acute and convalescent antibody titers

Case Classification

Suspect: A clinically compatible case without presumptive or confirmatory laboratory results

Probable: A clinically compatible case with presumptive laboratory results.

Confirmed: A clinically compatible case with confirmatory laboratory results.

3) REPORTING CRITERIA

What to Report to the Colorado Department of Public Health and Environment (CDPHE) or local health agency

Human cases

- Plague is a 24-hour reportable condition
- Report should be made on any suspected cases of plague based on the healthcare provider's clinical impression or preliminary laboratory results
- Suspect cases should be reported **immediately** by telephone. In addition, confirmed and probable plague cases should also be reported through the Colorado Electronic Disease Reporting System (CEDRS) or through fax to CDPHE

Animal plague

- Rodent/rabbit die-offs should be reported to the local public health agency or Communicable Disease Program when detected. Specimens for testing should be retained to evaluate the plague activity in the area.
- Veterinarians should report feline cases to the local health agency or the Communicable Disease Program when a diagnosis of plague is suspected

Purpose of Surveillance and Reporting

- To identify exposed individuals and implement fever-watch or prophylaxis
- To identify areas of plague activity and institute control and prevention measures
- To monitor trends in disease incidence and potential bioterrorism events

Important Telephone and Fax numbers

- CDPHE Communicable Disease Epidemiology Program

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- Phone: 303-692-2700 or 800-866-2759
- Fax: 303-782-0338
- After hours: 303-370-9395
- CDPHE Microbiology laboratory: 303-692-3480
- Communicable Disease Manual website:
http://www.cdphe.state.co.us/dc/Epidemiology/dc_manual.html
- Zoonotic disease website:
<http://www.cdphe.state.co.us/dc/zoonosis/zoonosis.asp>

4) STATE LABORATORY SERVICES

Laboratory Testing Services Available

*The services listed below are for public health purposes; clinical laboratories are **not** charged for these services.*

- All isolates and appropriate clinical specimens from suspected human plague cases must be sent to the CDPHE laboratory for confirmation. There are no charges to clinical laboratories submitting human specimens for plague testing.
- Veterinarians should submit specimens to the CDPHE laboratory on any suspected feline cases. There is no charge for plague diagnostic services. Plague negative specimens are automatically tested for tularemia. Refer to the document: **Diagnosis, Management and Treatment of Suspected Feline Plague** available on the state website at:
http://www.cdphe.state.co.us/dc/zoonosis/plague/plague_feline_policy.pdf

5) CASE INVESTIGATION

All reports of suspected plague cases must be investigated. Investigation of confirmed or probable cases will be conducted as a joint effort of the local health agency, CDPHE and CDC. An investigation team(s) will be assembled to conduct patient and family interviews, assess potential contacts and identify persons at risk of exposure, to conduct an environmental assessment of plague activity in the area(s) where the patient may have been exposed and institute prevention and control measures.

On an initial report of a suspected plague case, the local agency or regional epidemiologist should collect the following information and contact CDPHE immediately:

- Onset date
- Clinical presentation and current patient status
- Presence of respiratory symptoms and results of radiographic evaluations. If a chest x-ray has not been performed it should be recommended in all suspect plague cases even in absence of signs of respiratory involvement on examination.
- White blood cell count including differential
- Laboratory specimens available for testing.
 - Blood cultures should be initiated and maintained by the hospital laboratory
 - Appropriate clinical samples should be forwarded overnight to CDPHE.

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For probable or clinically compatible cases, investigation will be initiated prior to laboratory confirmation. The patient and/or family members will be interviewed for activities, travel and potential exposures in the week prior to onset

A. Case Investigation/ Forms

- Enter case into CEDRS including any travel, hunting, pet disease or flea bite history information into CEDRS under "Case Notes" for all confirmed and probable cases and update other CEDRS record information as appropriate
- Complete [CDC's Plague Case Investigation Report Form](#) which can be found on the CD manual website. ***Please contact CDPHE at 303-692-2700 before completing this form!***

B. Identify and Evaluate Contacts

Family members, medical personnel and other persons with close contact to a plague patient should be evaluated for potential exposure. Depending on the type and timing of the exposure, contact recommendations would include: no action necessary, fever watch or antibiotic prophylaxis.

1) No Action Necessary

Aside from prevention education and increasing awareness, most persons associated with a human or feline case or living in an area with an active plague epizootic in progress will not require any medical or public health intervention. This would apply to any asymptomatic persons who do not meet any of the criteria outlined under Fever Watch or Prophylaxis.

2) Fever Watch

Persons recommended for fever watch should actively take their temperature at least once per day until seven (7) days have passed since their last exposure. Any person with a temperature above 37.8° (100 °F) or who develops plague compatible symptoms should immediately contact their physician or seek medical attention. Persons to recommend for fever watch include:

- Household and social contacts exposed to a suspect bubonic or septicemic case without other known exposures.
- First responders or medical personnel who worked directly with a suspect bubonic or septicemic plague patient with no unprotected contact with bubo exudates, blood or tissues.
- Household members and veterinary staff that directly handled a cat with suspect plague AND for which pneumonic involvement has been ruled out by chest x-ray.

3) Prophylaxis

Antibiotic prophylaxis is recommended for close contacts and medical/veterinary personnel with high-risk contact with plague infected patients or cats. However, it is common for many people to initiate or expect antibiotic prophylaxis. Large scale or blanket prophylaxis is rarely indicated and concerned persons with limited or no risk (office receptionist, neighbors, hospital janitors, etc.) should be recommended to initiate fever watch. Persons recommended for antibiotic prophylaxis include:

- Household and social contacts, first responders and medical staff in direct contact with a suspect pneumonic plague patient confirmed by chest x-ray or highly suspected

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based on physical examination. Direct contact is defined as close interaction (within 6 ft) with a pneumonic plague patient.

- Persons exposed to bubo exudates, blood or tissues from an infected patient without using barrier precautions.
- Household members or veterinary staff exposed to a pneumonic plague confirmed cat. Exposed veterinary staff is usually limited to staff that directly handled and examined the animal.
- Any person bitten or scratched by an infected cat.
- Any person caring for an infected cat in which the lymph node has ruptured or an abscess has formed and there was unprotected contact with draining exudates.
- Persons bitten by fleas while in a known plague epizootic area or in a household with a plague positive cat.
- Symptomatic (febrile) contacts or persons in a plague epizootic area should be referred for immediate medical evaluation.

Adults including pregnant women

Preferred:

Doxycycline 100 mg orally twice a day for 7 days (tetracycline can also be used)

Ciprofloxacin 500 mg orally twice a day for 7 days

Alternative:

Chloramphenicol 25 mg/kg four times a day for 7 days

Children

Preferred:

Doxycycline (tetracycline can also be used)

If ≥ 45 kg use adult dosage

If < 45 kg, give 2.2 mg/kg orally twice a day for 7 days

Ciprofloxacin 20 mg/kg orally twice a day for 7 days (dose cannot exceed 1 gm/day)

Alternative:

Chloramphenicol 25 mg/kg four times a day for 7 days (children less than 2 years should not receive chloramphenicol)

6) DISEASE CONTROL MEASURES

A. Education

People living in active enzootic areas should be advised of the presence of plague, educated on the modes of transmission and preventative measures to take. Public notification can include:

- Press releases
- Door-to-door canvassing of homes in an area to distribute pamphlets or notices
- Posting warning signs at trailheads, parks and on campground bulletin boards
- Notification to local physicians, veterinarians and park service staff

Preventative messages should include:

- Don't feed rodents. If you feed birds you are likely also feeding rodents.

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- Keep pets confined and don't allow them to roam freely.
- Treat pets for fleas.
- Conduct rodent control measures around the house and outbuildings including rodent proofing structures, eliminating food sources and harborage and conducting rodent control.
- Monitor rodent and rabbit populations around the home and notify public health officials of a large, rapid die-off of rodents. Prairie dog colonies make an excellent sentinel system and the rapid (2-4 week) disappearance of a previously health colony is likely due to plague and should be reported.
- Prevent fleabites by using repellents or protective clothing.
- Do not handle dead rodents or rabbits with bare hands.
- Monitor cats for signs of illness including high fever (panting, open mouth breathing), severe lethargy, swelling around the neck or draining abscesses. Seek veterinarian consultation immediately.

B. Environmental Measures

In most cases, widespread environmental control is not practical or cost effective. Limited resources are usually best directed at public education and awareness efforts. However, there are specific situations in which more direct control efforts should be considered. This generally includes areas with high human density (subdivisions, campgrounds) or traffic (parks and recreation areas, school grounds) in which plague is actively circulating among the rodent/rabbit population.

Large-scale rodent extermination in rural areas is expensive, labor intensive and usually has limited impact on the incidence of plague in an area or the human risk. Plague is **not** a justification for exterminating prairie dog colonies. Done incorrectly, rodent extermination can increase human risk by releasing infected fleas into the environment in search of new hosts. Plague will effectively eliminate the colony and prevention of human cases should focus on flea control and keeping people and their pets out of an area with an active die-off in progress. Basically, let nature run its course in areas where there is limited human interaction.

There are circumstances where limited rodent control should be considered. Most environmental control, however, will focus on elimination of the flea vector usually by treating rodents or rodent burrows with an insecticide. Control measures to consider include:

- Rodent control in limited areas where rodents are encroaching on human habitat. Examples include woodrats living in homes and other buildings, a prairie dog colony spreading into a park, playground or yard, a large infestation of rats in a greenbelt drainage, etc.
- Flea control in areas with high rodent/human interaction.
 - Apply an insecticide ("dusting") into rodent burrows along bike trails, prairie dogs colonies abutting a subdivision, picnic areas and campgrounds. Usually dusting a 100-foot buffer off of trails and property fence lines provides a sufficient barrier to flea movement.
 - Use bait tubes where burrows are not readily visible or to treat tree squirrels in urban areas.
 - Encourage flea treatment of all pet dogs and cats in the area.
- Temporarily close trails, parks or campgrounds experiencing epizootic plague activity.
- Enforce leash laws

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C. Special Consideration for Pets

In the past decade, pet dogs and cats have been implicated in approximately 50% of human plague cases. In most cases this is the result of free-roaming pets bringing infected fleas into the home environment. This is easily controlled by keeping pets confined and on appropriate flea control. Canids (dogs, fox, coyotes) in a plague epizootic area are readily infected, but highly resistant to plague and rarely become ill or die. Infected dogs do not transmit plague directly but are involved in human cases via the transport of infected fleas or carcasses.

Felids (cats, bobcats, lynx) are highly susceptible to plague, develop a clinical illness very similar to humans and have a high death rate if untreated. In addition to flea transport, cats can transmit plague directly to humans via pneumonic spread, bites, scratches, and exposure to exudates from ruptured buboes and abscesses. Ill cats in a plague epizootic area should be referred to a veterinarian for examination and be considered infectious until a minimum of 48 hours of appropriate antibiotic therapy has been administered. For guidance on feline plague refer to the CDPHE document: Recommendations For the Management, Diagnosis and Treatment of Suspected Feline Plague Cases at:

http://www.cdphe.state.co.us/dc/zoonosis/plague/plague_feline_policy.pdf

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