Plague *(Yersinia pestis)*

(Also known as Pestis)

Report Immediately

March 2005

1) THE DISEASE AND ITS EPIDEMIOLOGY

A. Etiologic Agent

Plague is a zoonotic disease of rodents and their fleas caused by the bacterium *Yersinia pestis*.

B. Clinical Description and Laboratory Diagnosis

The initial signs and symptoms of plague are usually nonspecific and include fever, chills, malaise, muscle aches (myalgias), nausea, sore throat, headache, and weakness. Bubonic plague, the most common form of the disease, is a syndrome that includes painful swelling of lymph nodes (regional lymphadenitis). Pneumonic plague is a form of the illness resulting from hematogenous spread in bubonic or septicemic cases (secondary pneumonic plague) or inhalation of infectious droplets (primary pneumonic plague). Septicemic plague is a form caused by disseminated infection of the blood stream. Pneumonic plague refers to a form of the illness affecting the lungs. Meningeal plague, or plague affecting the membranes lining the brain and spinal cord, is rare. Both pneumonic and septicemic plague can be primary or they can result from another clinical form of plague. Untreated, bubonic plague is fatal in over 50% of cases, while septicemic and pneumonic plague are fatal in over 90% of cases. Treated septicemic and pneumonic plague is associated with a mortality rate of 14%. Laboratory diagnosis includes culture and identification of the organism from fluid aspirated from diseased lymph nodes, blood, CSF or sputum. The serologic methods include the passive hemagglutination test (PHA) or enzyme-linked immunosorbent assay (ELISA). Also, direct fluorescent antibody (DFA) staining and immunohistochemical staining may be used for direct examination of clinical specimens.

C. Reservoirs

Certain wild rodents and their fleas carry *Y. pestis*. In the United States, ground squirrels, and prairie dogs are the primary reservoirs of *Y. pestis*. Lagomorphs (rabbits and hares), wild carnivores (meat-eating mammals) and domestic cats may also be a source of infection to people.

D. Modes of Transmission

Plague is acquired naturally through the bite of an infected flea or through inhalation of *Y. pestis* contaminated respiratory droplets, either through proximity to a human or animal case of pneumonic plague or by accidental exposure in a laboratory. Plague can also be acquired by handling tissues of infected animals or by being bitten or scratched by an infected animal. Plague might also be acquired through an intentional release of *Y. pestis*; for this reason plague is considered a potential bioterroristic agent (See section H).

E. Incubation Period

The usual incubation period for primary pneumonic plague is estimated to be anywhere from 1 to 4 days (2-6 days for bubonic plague). The incubation period for primary pneumonic plague ranges 1-6 days.

F. Period of Communicability or Infectious Period

Patients with pneumonic plague are considered infectious throughout their symptomatic illness and for 72 hours following initiation of appropriate antibiotic treatment. The discharge from buboes is considered infectious.

G. Epidemiology

Wild rodent plague exists in large areas of South America, Africa, Eastern Europe and Asia. In 1994, an outbreak of pneumonic and bubonic plague occurred among people in Surat, India. In the United States, wild rodent plague occurs primarily in ground squirrels, rabbits and prairie dogs in the western part of the country. Human cases in the western United States occur sporadically, usually following exposure to wild rodents or their fleas. Approximately 10 – 15 people are diagnosed with plague each year in the United States. Only a small percentage (i.e., 2%) of the plague cases that occur in the U.S. are pneumonic. Between 1977 and 2002, 25 people in the United States acquired plague from infected domestic cats. No person-to-person transmission has been documented in the United States since 1925.

H. Bioterrorist Potential

Y. pestis is considered a potential bioterrorism agent. If effectively disseminated, *Y. pestis* could cause serious public health challenges, especially in terms of the public health system's ability to limit casualties and control other repercussions. Several features of *Y. Pestis* contribute to its potential of being used an agent of bioterrorism: 1) *Y. pestis* is distributed worldwide, 2) techniques for mass production and aerosol dissemination are available, and 3) the case fatality ratio of primary pneumonic plague is high with real potential for secondary spread. Therefore, *any* case of plague should be considered as a serious threat to public health. In the event that plague is used as a biological weapon, the first few (especially sporadic) cases will likely be missed or at least not attributed to a deliberate bioterrorist act. To avoid this from happening, any suspect case of plague should be reported immediately by telephone to the local health department. The sudden appearance of many patients presenting with fever, cough, a fulminant disease course and high case-fatality ratio should cause one to consider plague in the differential diagnosis.

2) REPORTING CRITERIA AND LABORATORY TESTING SERVICES

A. New Jersey Department of Health and Senior Services (NJDHSS) Case Definition

CASE CLASSIFICATION

A. CONFIRMED

A clinically compatible case **AND**:

- Isolation of *Yersinia pestis* from a clinical specimen, **OR**
- Fourfold or greater change in serum antibody titer to *Y. pestis* F1 antigen, **OR**
- Positive immunohistochemical (IHC) staining, if confirmation by culture or serology is not possible.

B. PROBABLE

A clinically compatible case **AND:**

- An epidemiologic link to a confirmed case.
- Elevated serum antibody titer to *Y. pestis* F1 antigen (without fourfold or greater change) in a patient with no history of plague vaccination, **OR**
- Detection of F1 antigen in a clinical specimen by fluorescent antibody test, **OR**
- PCR evidence of *Y. pestis,* **OR**
- Immunohistochemical staining

C. POSSIBLE
A clinically compatible case with a smear or isolate form affected tissues with the following characteristics: small, gram-negative and/or bipolar-staining plump rods in single, short chains.

Note: See Section 3 C below for information on how to report a case.

B. Laboratory Testing Services Available

The New Jersey Public Health and Environmental Laboratories (PHEL) provides services for testing clinical specimens for *Y. pestis (. . . . link . . . .)*.

- Specimens or isolates can be sent to PHEL after preliminary consultation with the Infectious and Zoonotic Diseases Program (either the Bioterrorism or Zoonotic Unit) at 609.588.7500.
- Clinical diagnostic specimens that should be collected from patients suspected of having plague include:
  - **Blood:** Blood specimens should be obtained for *Y. pestis* isolation before administration of antibiotics. Two or more sequentially collected samples would be preferred as blood-borne *Y. pestis* is usually low in numbers and multiple sampling provides more opportunity for a successful recovery of the live organism.
  - **Serum:** Serum specimens should be collected for baseline evaluation, followed by a second specimen taken in the convalescent period (at least 14 days apart but preferably 3-4 weeks after onset of symptoms). Plasma and whole blood dried on filter paper are acceptable alternatives to serum.
  - **Respiratory secretions:** Respiratory secretions should be collected for staining, culture and possible DNA amplification from persons with suspected pneumonic plague--this includes pharyngeal swabs, tracheal washes or aspirates, and sputum specimens. Trans-thoracic lung aspirates or collections of pleural fluid should be similarly evaluated.
  - **Tissues (biopsy):** Tissues, including lung and lymph node tissue, spleen and liver may be indicated for culture and other examinations.
- A PHEL submission form (. . . *link* . . .) must accompany all samples.
- Chain of evidence documentation will accompany all specimens (The PHEL submission form will include a chain of custody section). However, during a large-scale incident this would probably only be required for first several cases.
- The mailing address is: New Jersey Department of Health and Senior Services, Division of Public Health and Environmental Laboratories, Specimen Receiving and Records, P.O. Box 361, John Fitch Plaza, Trenton, NJ 08625-0361.
- Call the PHEL at 609.292.8396 for specific microbiologic consultation before submitting samples.
- In certain circumstances, the PHEL may forward clinical specimens to the Centers for Disease Control and Prevention (CDC) for testing.

3) DISEASE REPORTING AND CASE INVESTIGATION

A. Purpose of Surveillance and Reporting

- To identify potential sources of transmission in the United States (such as wild rodents or other animals).
- To identify sources of transmission and geographical areas of risk outside of the United States.
- To stop transmission from such sources.
- To identify cases and clusters of human illness that may be associated with a bioterrorism event.

B. Laboratory and Healthcare Provider Reporting Requirements

The NJDHSS requires that healthcare providers and laboratories report any suspect or known case of plague to the local health officer in the community where the patient resides (preferably by telephone with follow-up

documentation sent via confidential fax, or filed electronically using the secure, web-based Communicable Disease Reporting System (CDRS).

NOTE: NJDHSS requires that cases, or potential exposure that might be bioterrorist in nature, be **immediately reported** to the local health officer where the patient resides. If this is not possible, call the NJDHSS Infectious and Zoonotic Diseases Program at 609.588.7500 (weekdays) or 609.392.2020 (nights/weekends). A case of plague is defined by the reporting criteria in Section 2 A above.

C. Local Departments of Health Responsibilities

(1) Reporting Requirements

The NJDHSS requires that each local health officer immediately report any suspect or known case of plague to the NJDHSS Communicable Disease Service, Infectious and Zoonotic Disease Program by phone at 609.588.7500 (weekdays) or 609.392.2020 (nights/weekends).

(2) Case Investigation

a. **The most important step a local health officer can take if he/she learns of a suspect or confirmed case of plague, or a potential exposure that may be a bioterrorist event, is to immediately call the NJDHSS, any time of the day or night.** The Bioterrorism or Zoonotic Unit of the Communicable Disease Service's Infectious and Zoonotic Disease Program can be reached at (609) 588-7500, Monday through Friday, 8AM to 5PM. During nights, weekend, and holidays call (609) 392-2020.

b. Case investigation of plague in New Jersey residents will be directed by NJDHSS. If a bioterrorism event is suspected, NJDHSS and other public health care partners will work closely with the local health officer/agency and provide instructions/information on how to proceed.

c. After immediately notifying NJDHSS, the local health officer or the LINCS epidemiologist (or their designee) may be asked to assist in investigating patients who live within their communities, including gathering the following:
   (1) The patient's name, age, address, phone number, status (hospitalized, at home, deceased), and parent/guardian information, if applicable.
   (2) The name and phone number of the hospital where the patient is/was hospitalized.
   (3) The name and phone number of the patient's attending physician, if the patient is/was hospitalized.
   (4) The name and phone number of the infection control official at the hospital, if the patient is/was hospitalized.
   (5) The names and phone numbers of additional healthcare facilities (including doctors' offices) where the patient was evaluated or hospitalized for his/her current illness.

d. After immediately notifying NJDHSS, the local health officer or LINCS epidemiologist (or their designee) will be asked to assist in completing the activities listed on the Investigation Checklist and the PLAGUE Investigation Form (attached). Most of the information requested by the form can be obtained from the healthcare provider or the medical record. However, some information may require that an interview with the case-patient (or his/her proxy) be performed. The case report can also be filed electronically via CDRS or faxed as soon as possible to 609-631-4863.

e. Use the following guidelines to assist you in completing the PLAGUE Investigation Form (attached):
   (1) Page 1 of the Form
      (a) Reporting Information
         i. Indicate CDRS number, outbreak number and NJDHSS approval number. The NJDHSS approval number will be given by a DHSS Communicable Disease Service representative.

ii. Indicate if the case-patient is epidemiologically linked to another confirmed or probable case (i.e., has had close contact). If the case-patient is epidemiologically linked, indicate the name and type of contact.
iii. Indicate the date this case-patient was reported to DHSS and the initials of the current DHSS reviewer. Also indicate the case status of the patient.
iv. Indicate the county and municipality in which the patient resides.
v. Indicate the clinical form of plague (e.g., bubonic, pneumonic, septicemic, pharyngeal or other).

(b) Reporting Source
i. Record the date the initial report was made.
ii. Record the name and contact information of the person reporting the case-patient.
iii. Record the name and phone number of the treating physician (if different from ii).

(c) Patient Information
i. Record as much of the patient demographic information as possible. (DK=Don't Know)

(d) Clinical Information
i. Record the case-patient's illness onset date (date of first symptom)
ii. Record case-patient's diagnosis date (date plague diagnosis was made)
iii. Record the illness duration if known
iv. Medical Care for Current Illness
1. Indicate all the places the case-patient may have received medical treatment and if the case-patient was admitted to any of these facilities.
v. Signs and Symptoms
1. Record signs and symptoms experienced by the case-patient (Y=Yes, N=No, DK= Don't Know)
N.B. Fever in this case refers to a temperature ≥101°F.
vi. Clinical Findings
1. Record any clinical finding exhibited by the case-patient

(2) Page 2

(a) Tests Performed
i. Record results (if available) of blood test(s) done and x-rays performed.

(b) Microbiology
i. Indicate if any diagnostic test for *Y. pestis* was performed. (Y=Yes, N=No, DK= Don't Know)
ii. Enter the collection date, specimen type, and result associated with each diagnostic test for *Y. pestis* in the appropriate spaces.

(c) Outcome
i. Indicate if the case-patient survived this illness. If the case-patient survived, list any complications were observed. (Y=Yes, N=No, DK= Don't Know)

(d) Infection Timeline
i. In the bold box, place the onset date.
ii. Count back 7 days from the date of onset. Enter this date in the box to the left of the onset date box. This is the time frame which will be used to determine potential infectious exposures to which the case-patient was exposed.

(e) Travel
i. Indicate if the case-patient traveled, if they attended a social gathering or were present in a crowded setting during the exposure period. (Y=Yes, N=No, DK= Don't Know) If yes, indicate the date(s) and location(s) in the spaces provided.

(3) Page 3

(a) Risk Factors

i. Indicate whether the case-patient had any of the listed exposures during the exposure period calculated on page 2. (Y=Yes, N=No, DK= Don't Know)
ii. Indicate if the case-patient was not able to be interviewed and if so, who provided the information on behalf of the case-patient.

(b) Antibiotic Prophylaxis/Treatment
i. Indicate if antibiotics were taken for this illness (Y=Yes, N=No, DK= Don't Know)
ii. Indicate the name, dose, duration, route of administration (IV= intravenous, IM= intramuscular injection, PO= by mouth), and the start and end date of each course of prophlyaxis/treatment.

(c) Infection Control
i. Indicate the type of infection control precautions taken by the hospital during their management of the case-patient.

(d) Contacts
i. List in the space provided anyone who may have been in close contact (i.e., within 6-7 feet) with the case-patient during the contagious period (i.e., from the time of the case-patient's illness onset and up to 72 hours after appropriate antibiotic treatment was initiated). List the contact's name, age, and relation to patient. Indicate whether the contact is symptomatic (Y=Yes, N=No, DK= Don't Know) and provide his/her contact phone number in the space provided.

(e) Plague Case Definition and Classification
i. This is the NJDHSS current case definition for plague. During an outbreak this definition is subject to change. Be alert for messages form NJDHSS.

(f) Notes
i. Document any additional information pertinent to the investigation in this field.
ii. Copies of any notes taken during the interview should also be attached to this form.

a. Institution of disease control measures is an integral part of case investigation. In consultation with NJDHSS, it is the local health officer responsibility to understand, and, if necessary, institute the control guidelines listed below in Section 4, "Controlling Further Spread."

4) CONTROLLING FURTHER SPREAD

A. Isolation and Quarantine Requirements (N.J.A.C. 8:57-1.10)

Patient Isolation Precautions
Initial decisions regarding patient isolation precautions should be based on the clinical presentation of patients with suspect plague (see Table).

Table. Initial Patient Isolation Precautions for Suspect Plague Patients

Clinical Presentation	Patient Isolation Precautions
Pneumonic or Pharyngeal	Droplet
Septicemic	Droplet (until pneumonia excluded)
Bubonic	Standard

Minimum Period of Isolation of Patient
Droplet precautions are indicated for patients with plague until pneumonia is excluded and appropriate antibiotic therapy has been initiated. In patients with pneumonic plague, droplet precautions should be maintained for 72 hours after starting appropriate antibiotic therapy and until clinical improvement occurs.

Minimum Period of Quarantine of Contacts
See Section 4B, Protection of Contacts, below.

B. Protection of Close Contacts

- Cases with **pneumonic or pharyngeal plague** are considered infectious throughout their symptomatic illness and for at least 72 hours following initiation of appropriate antibiotic treatment. A close contact is defined as known contact with a plague patient at less than 6-7 feet. All close contacts should be referred to their healthcare provider for evaluation and antibiotic prophylaxis. Close contacts should be under surveillance for symptoms suggestive of plague for 7 days; whether this surveillance is passive or active should be based on the availability of public health resources. If a contact of a pneumonic plague case is unable to receive or refuses antibiotic prophylaxis, he/she should be placed under quarantine for a 7-day period (please review the NJDHSS Community Containment of Plague document, --- *link* ---).
- Cases of septicemic plague should be managed as above until pneumonia has been excluded in the case-patient.
- Prophylaxis for contacts of patients with **bubonic plague** is generally not indicated.

C. Managing Special Situations

Reported Incidence Is Higher than Usual/Outbreak Suspected
Plague is not endemic in New Jersey. Cases of plague in New Jersey are most commonly associated with travel to the western part of the United States or another country where plague is endemic. Therefore, all suspected cases identified in New Jersey are considered "special situations," and must be reviewed by the Infectious and Zoonotic Diseases Program (either the Bioterrorism or Zoonotic Unit) at 609.588.7500.

Note: If a bioterrorist event is suspected, the NJDHSS and other response authorities will work closely with local health officers and provide instructions/information on how to proceed.

D. Preventive Measures

Personal Preventive Measures/Education
To avoid cases of plague, people should reduce the likelihood of being bitten by infected fleas or being exposed to patients with pneumonic plague by:

- Understanding the modes of transmission of plague and heeding any plague advisories while visiting the southwest United States.
- Preventing rodent access to food and shelter by ensuring appropriate storage and disposal of food, garbage and refuse.
- Using insect repellents while camping in rural plague-infected areas and reporting dead or sick animals to park rangers or public health authorities.
- Preventing flea infestations of their dogs and cats.
- Avoiding unnecessary contact with rodents or lagomorphs and using protective gloves if handling is necessary.

In a bioterrorism incident, whether overt or covert, the need for opening a Mass Prophylaxis Clinic will be determined as quickly as possible. Decisions made with respect to opening such a clinic will be based on several considerations, including, but not limited to, the number of plague cases and contacts identified.

National and International Travel

- For more information regarding national/international travel and plague, contact the CDC Traveler's Health Office at 877.394.8747 or visit http://www.cdc.gov/travel/

ADDITIONAL INFORMATION

A NJDHSS *Plague Fact Sheet* is available at www.state.nj.us/health/cd.

The CDC surveillance case definition for plague is similar to the criteria outlined in Section 2A of this chapter. CDC case definitions are used by state health departments and CDC to maintain uniform standards for national reporting. For reporting to the NJDHSS, always refer to the criteria in Section 2A.

REFERENCES

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