Preparing for and Responding to Bioterrorism
Information for the Public Health Workforce

Plague and Botulism

Developed by
Jennifer Brennan Braden, MD, MPH
Preparing for and Responding to Bioterrorism:
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*This manual and the accompanying MS Powerpoint® slides are current as of Dec 2002. Please refer to http://nwcphp.org/bttrain/ for updates to the material.*
Acknowledgements

This manual and the accompanying MS PowerPoint® slides were prepared for the purpose of educating the public health workforce in relevant aspects of bioterrorism preparedness and response. Instructors are encouraged to freely use portions or all of the material for its intended purpose.

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Preparing for and Responding to Bioterrorism: Information for the Public Health Workforce is intended to provide public health employees with a basic understanding of bioterrorism preparedness and response and how their work fits into the overall response. The course was designed by the Northwest Center for Public Health Practice in Seattle, Washington, and Public Health – Seattle & King County’s Communicable Disease, Epidemiology & Immunization section. The target audience for the course includes public health leaders and medical examiners, clinical, communicable disease, environmental health, public information, technical and support staff, and other public health professional staff. Health officers may also want to review the more detailed modules on diseases of bioterrorism in Preparing for and Responding to Bioterrorism: Information for Primary Care Clinicians: Northwest Center for Public Health Practice (available at http://nwcphp.org/bttrain). Public health workers are a very heterogeneous group, and the level of detailed knowledge needed in the different aspects of bioterrorism preparedness and response will vary by job description and community. Therefore, the curriculum is divided into modules, described in Appendix A.
The course incorporates information from a variety of sources, including the Centers for Disease Control and Prevention, the United States Army Medical Research Institute in Infectious Disease (USAMRIID), the Working Group on Civilian Biodefense, the Federal Emergency Management Agency, Public Health – Seattle & King County, and the Washington State Department of Health, among others (a complete list of references is given at the end of the manual). The curriculum reflects the core competencies and capacities outlined in the following documents:


Center for Health Policy, Columbia University School of Nursing. Core public health worker competencies for emergency preparedness and response, April 2001: http://cpmcnet.columbia.edu/dept/nursing/institute-centers/chphsr/


The course is not copyrighted and may be used freely for the education of public health employees and other biological emergency response partners.

Course materials will be updated on an as-needed basis with new information (e.g., guidelines and consensus statements, research study results) as it becomes available. For the most current version of the curriculum, please refer to: http://nwcphp.org/bttrain.
How to Use This Manual

This manual provides the instructor with additional useful information related to the accompanying MS PowerPoint® slides. The manual and slides are divided into six topic areas: Introduction to Bioterrorism, Emergency Response Planning, Diseases of Bioterrorist Potential, Health Surveillance and Epidemiologic Investigation, Consequence Management, and Communications. Links to Web sites of interest are included in the lower right-hand corner of some slides and can be accessed by clicking the link while in the “Slide Show” view. Blocks of material in the manual are periodically summarized in the “Key Point” sections, to assist the instructor in deciding what material to include in a particular presentation. A Summary of Key Points is indicated in bold, at the beginning of each module.

The level of detailed knowledge required may vary for some topics by job duties. Therefore, less detailed custom shows are included in the Emergency Response Planning and Diseases of Bioterrorist Potential: Overview modules for those workers without planning oversight or health care responsibilities, respectively. In addition, there are three Consequence Management modules: for public health leaders, for public health professionals, and for other public health staff (see Appendix A).
Diseases of Bioterrorist Potential

Slide 1: Curriculum Title
Slide 2: Acknowledgements
Slide 3: Module Title
Learning Objectives (Slide 4)

The learning objectives for this module are:

1. Describe the epidemiology, mode of transmission, and presenting symptoms of disease caused by the CDC-defined Category A agents
2. Identify the infection control and prophylactic measures to implement in the event of a suspected or confirmed Category A case or outbreak
Plague (Slides 5-19)

Summary of Key Points
(Listed in slide 18)
1. The most likely presentation in a BT attack is pneumonic plague.
2. Unlike other forms of plague, pneumonic plague is transmitted person to person, and thus respiratory droplet precautions are indicated in suspected cases until 48 hours after the initiation of antibiotic therapy.

History, Epidemiology, and Microbiology (Slides 5-7)

Naturally occurring plague is transmitted to rats and other rodents following the bite of an infected flea. When the natural rat reservoir is unavailable, fleas will bite humans, as was the case historically during plague epidemics. The resulting form of plague – bubonic plague – is the most common naturally occurring form, and is different from that expected in the event of a bioterrorist attack. Although the Japanese used plague-infected fleas as a biowarfare weapon during WW II to create a bubonic plague epidemic, this is not as efficient a weapon as a plague aerosol.

Currently, a bioterrorist attack is more likely to employ aerosolization of *Y. pestis*, and victims of the attack will present with pneumonic plague. Plague bacilli are killed by sunlight and estimated to remain viable in an aerosol for no longer than one hour following release (Inglesby, et al., JAMA 2000;283:2281-90).
Yersinia pestis, a gram negative bacillus, is the causative agent of plague. Slide 7 shows a peripheral blood smear from a patient with septicemic plague.

**Case Definition and Classification** (Slides 8-10)

The case definition for plague is listed in slides 8 and 9, and the criteria for case classification, in slide 10.
**Clinical Presentation** (Slides 11-15)

**Key Points**

1. Bubonic, pneumonic, and septicemic plague each begin with the acute onset of a non-specific febrile illness.
2. Pneumonia (without buboes) is the most likely presentation of plague in a BT attack.
3. Pneumonic plague progresses rapidly to respiratory failure and death if not treated early.

Slides 11-15 describe the three clinical forms of plague, and their presentations. All three forms begin with the acute onset of fever, chills, myalgia, and malaise.
Pneumonic plague is the most likely form expected after a BT attack. Approximately 12 percent of cases of septicemic plague also result in pneumonic involvement. Since a BT attack is most likely to occur via an aerosol release, it is unlikely that the patient with pneumonic plague in this scenario will have a bubo. Pneumonic plague may present as a severe community-acquired pneumonia with chest pain, dyspnea (difficulty breathing), and cough. Gastrointestinal symptoms may be prominent, and the disease progresses rapidly; both features are also consistent with inhalational anthrax. Unlike inhalational anthrax, patients with pneumonic plague usually have bloody sputum and are infectious.

Bubonic plague involves infection, inflammation, and marked tenderness of the regional lymph nodes draining the inoculation (bite) site. Bacteria gain access to the bloodstream and cause septicemia and endotoxemia with associated complications. Most cases of naturally occurring plague are bubonic plague.
Preventing for and Responding to Bioterrorism

Slide 15: The photo on the right is from the CDC National Center for Infectious Disease, Division of Vector-borne Diseases. The photo on the right shows an inguinal bubo on a person with bubonic plague. The photo on the left illustrates gangrene secondary to thrombosis of acral blood vessels in septicemic plague (giving the name “black death” to fatal cases in previous plague pandemics).

Treatment and Infection Control (Slides 16-17)

Person-to-person transmission of pneumonic plague is thought to occur via respiratory droplets. Patient isolation, standard respiratory droplet precautions, and disposable surgical masks are recommended to prevent transmission for at least the first 48 hours of antimicrobial therapy (Bolyard, et al, Am J Infect Control, 1998;26:289-354). Patients should wear surgical masks during transport. Exposed persons refusing antibiotic prophylaxis should be closely watched for development of fever or cough for seven days after last exposure and treated immediately if either occur. Microbiology lab personnel should be alerted when specimen testing from suspected or confirmed plague cases is requested. Bodies of patients who have died of plague should be handled with strict precautions.

Aerosol generation procedures should be avoided, and appropriate high efficiency particulate respirators and negative pressure rooms employed if such procedures are necessary.
Antibiotic prophylaxis is recommended for individuals exposed to a presumed plague aerosol and for close contacts of pneumonic plague patients. Antibiotics should be continued seven days from the time of exposure or last contact with an infected patient. Antibiotic prophylaxis is not necessary for contacts of bubonic plague patients in the absence of symptoms.

**Summary of Key Points (Slide 18)**

- The most likely presentation in a BT attack is pneumonic plague.
- Unlike other forms of plague, pneumonic plague is transmitted person to person, and thus respiratory droplet precautions are indicated in suspected cases until 48 hours after the initiation of antibiotic therapy.

**Case Reports (Slide 19)**

Slide 19 contains links to two Morbidity and Mortality Weekly case reports of pneumonic plague.
Botulism (Slides 20-30)

Summary of Key Points
(Listed in slides 28-29)

1. An outbreak of botulism occurring with a common geographic factor, but with no common food exposure, would suggest a deliberate aerosol exposure.

2. Inhalational botulism does not occur naturally, and any potential cases suggest a deliberate source of infection.

3. Gastrointestinal symptoms may not occur with inhalational botulism or with food-borne botulism (e.g., resulting from deliberate contamination of the food supply).

4. Botulinum antitoxin must be administered as soon as possible for optimum results.
Microbiology, Epidemiology, and Pathogenesis (Slides 20-22)

Key Points

1. Naturally occurring forms of botulism include infant, food-borne, and wound botulism.
2. A bioterrorist attack with botulinum toxin is most likely to be via aerosol (inhalational botulism), or possibly through contamination of the food supply.

Botulism is caused by botulism toxin, a zinc protease produced by *Clostridium botulinum*. *C. botulinum*, a ubiquitous soil bacteria, produces hardy spores that survive for extended periods in the environment. Vegetative cells germinated from spores produce toxin under anaerobic conditions. Several toxin types, A-G, have been classified based on reactivity with specific antitoxins, but all have similar effects. Types A, B, and E are most often associated with human disease. The toxin is easily inactivated by heat, sunlight, and chlorine. Contamination of the water supply is thus unlikely (this would also require a large, impractical amount to achieve a high enough concentration in the water). Contamination of untreated beverages and food is possible, and could result in disease if not heated sufficiently prior to consumption.
The incubation period for food-borne botulism is 12-72 hours and is dose-dependent. Inhalational botulism does not occur naturally and should always suggest a deliberate source. It is likely that the incubation period for botulism following an aerosol exposure would be less than that following a food-borne exposure. No person-to-person spread occurs, and no special infection control precautions are indicated for botulism cases.

Botulinum toxin has been studied extensively for use as a biological weapon. Although botulism is rarely fatal when treated early and appropriately, ventilatory support is often necessary. An outbreak could thus severely task the health care system’s resources. The need for significant supportive care and the relative availability of botulinum spores (spores can be found worldwide in soil) make botulinum toxin a likely biological weapon.
Clinical Forms and Case Definition (Slides 23-25)

The clinical forms of botulism are listed in slide 23. Inhalation botulism is considered the most likely presentation in a biological attack. Food-borne botulism is another possible bioterrorism-related presentation. Food-borne botulism results from production of toxin in foods contaminated with botulism spores that are canned or processed under conditions favorable for toxin production. Wound botulism results from toxin production by spores contaminating devitalized tissue. Infant botulism is the most common form reported in the U.S. and results from toxin production by organisms residing in the intestinal tract. The case definition for botulism is listed in slide 24.
Slide 25 lists the case classification categories for food-borne botulism and other cases of botulism not meeting the criteria for food-borne, wound, or infant botulism (i.e., inhalation botulism would be considered “botulism, other”). Infant and wound botulism are unlikely presentations in a biological attack, and thus case criteria are not listed here. Detection of botulinum toxin in clinical specimens is via mouse bioassay, performed at LRN laboratories, Level B or higher. The age parameter for a confirmed case of “botulism, other” (i.e., ≥ 1 year), differentiates this classification from infant botulism. An aerosolized biological attack, however, may result in victims with a wide range of ages, and thus the case classification may require revision.

Treatment and Prophylaxis (Slides 26-27)

Botulinum antitoxin is most effective when given early in the course of illness. It prevents the binding of additional toxin to nerve receptors, but does not reverse the effects of already-bound toxin. Damaged nerves must regenerate, and recovery may take weeks to months. The currently licensed antitoxin, available from CDC, is effective against the three most commonly occurring toxins – A, B & E. A botulism outbreak resulting from a biological attack could potentially occur with toxins C, D, F, or G.
Adverse effects of botulism antitoxin include a spectrum of hypersensitivity reactions to equine antiserum including urticaria, serum sickness, and anaphylaxis. Patients should be screened for hypersensitivity to horse serum before receiving the equine antitoxin, and desensitized if necessary. Patients should be closely monitored during treatment, and diphenhydramine and epinephrine should be on-hand during administration of antitoxin to treat hypersensitivity reactions.

Many cases require intensive care, prolonged mechanical ventilation, and extensive rehabilitation. In addition to antitoxin, ventilation, and supportive care including nutrition through tube or parenteral feeding, fluid balance, and treatment of complications (e.g., pneumonia and other infections, pressure ulcers) must be provided.

Prophylactic use of botulism antitoxin for potentially exposed but asymptomatic persons is not recommended. Asymptomatic persons who may have been exposed to botulism toxin should be under medical observation and treated at the first signs of illness. An investigational pentavalent botulism toxoid vaccine has been used by the military and for certain laboratory workers, but is not available for general use and is not effective in post-exposure prophylaxis.
Summary of Key Points (Slides 28-29)

Botulism
Summary of Key Points

- An outbreak of botulism occurring with a common geographic factor, but with no common food exposure, would suggest a deliberate aerosol exposure.

- Inhalational botulism does not occur naturally, and any potential cases suggest a deliberate source of infection.

Case Reports (Slide 30)

This slide contains links to case reports on botulism. Note that these are not BT-related cases.

Resources (Slides 31-33)
References

General Bioterrorism Information and Web Sites


Emergency Response Planning


Last Revised December 2002
Plague and Botulism


Health Surveillance and Epidemiologic Investigation

CDC. Case definitions under public health surveillance. MMWR; 1997:46(RR-10):1-55.


List of nationally notifiable infectious diseases.
http://www.cdc.gov/epo/dphsi/phs/infdis.htm


**Diseases of Bioterrorist Potential**

Advisory Committee on Immunization Practices (ACIP). Use of smallpox (vaccinia vaccine), June 2002: supplemental recommendation of the ACIP.


CDC. Considerations for distinguishing influenza-like illness from inhalational anthrax. MMWR 2001;50(44):984-986.


Last Revised December 2002


**Working Group on Civilian Biodefense Consensus Recommendations:**


Environmental Sampling and Decontamination


CDC. Use of onsite technologies for rapidly assessing environmental Bacillus anthracis contamination on surfaces in buildings. MMWR. 2001;50(48):1087.


Environmental Protection Agency. EPA’s role in responding to anthrax contamination. http://www.epa.gov/epahome/hia-anthrax.htm#FORRESPONDERS.

Consequence Management


CDC. Interim recommendations for the selection and use of protective clothing and respirators against biological agents http://www.bt.cdc.gov/DocumentsApp/Anthrax/Protective/10242001Protect.asp


Psychological Aftermath of Trauma


Communication and Informatics


Covello T, Peters RG, Wojtecki JG, Hyde RC. Risk communication, the West Nile Virus epidemic, and bioterrorism: responding to the communication challenges posed by the intentional or unintentional release of a pathogen in an urban setting. J Urban Health: Bulletin of the NY Academy of Medicine 2001;78(2):382-391.

Appendix A: Modules (MS® Powerpoint files)

**Introduction to Bioterrorism**
One module (33 slides)

**Emergency Response Planning**
One module, with one custom show for personnel without planning oversight responsibilities
- Public health leaders (36 slides)
- Other public health staff (24 slides)

**Diseases of Bioterrorist Potential**
Six modules
- Overview (25 slides, with 20-slide custom show for staff without health care responsibilities)
- Anthrax (29 slides)
- Smallpox (44 slides)
- Plague and Botulism (33 slides)
- Tularemia and VHF (38 slides)
- Environmental Sampling and Decontamination (43 slides)

**Health Surveillance & Epidemiologic Investigation**
One module (32 slides)

**Consequence Management**
Three modules
- Public health leaders (51 slides)
- Public health professional staff (51 slides)
- Other public health staff (30 slides)

**Communication & Informatics**
One module (42 slides)
Appendix B: Glossary

**Bulbar:** Referring to the cranial nerves

**Coagulopathy:** A disease affecting the coagulability (clotting) of the blood

**Confluent:** Joining, running together

**Conjunctivitis:** Inflammation of the conjunctiva; “red eye”

**Depigmentation:** Loss of pigmentation (color)

**Diplopia:** Double vision

**Dyspnea:** Shortness of breath

**Edema:** An accumulation of an excessive amount of watery fluid in cells or tissues

**Enanthem:** A mucous membrane eruption (rash)

**Epistaxis:** Nose bleed

**Erythema:** Redness

**Eschar:** A thick, coagulated crust or slough

**Exanthem:** A skin eruption (rash) occurring as a symptom of an acute viral or coccal disease

**HAZMAT:** Hazardous materials management; HAZMAT workers respond to discharges and/or releases of oil, chemical, biological, radiological, or other hazardous substances.

**Hematemesis:** Vomiting of blood

**Hemoptysis:** Coughing up blood

**Hemorrhagic mediastinitis:** Bloody inflammation in the chest cavity

**Hypotension:** Low blood pressure

**Indolent ulcer:** Chronic ulcer, showing no tendency to heal

**Leukocytosis:** Elevated white blood cell count

**Lymphadenitis:** Inflammation of a lymph node or lymph nodes
**Lymphadenopathy:** A disease process (e.g., swelling) affecting a lymph node or nodes

**Macule:** A small, discolored patch or spot on the skin, neither elevated above nor depressed below the skin's surface

**Malaise:** General ill feeling

**Myalgia:** Muscle aches

**Papule:** A small, circumscribed solid elevation on the skin

**Percutaneous:** Denoting the passage of substances through unbroken skin; passage through the skin by needle puncture

**Petechiae:** Pin-head sized hemorrhagic spots in the skin

**Pharyngitis:** Inflammation of the tissues of the pharynx; “Sore throat”

**Pleuropulmonary:** Relating to the pleura and the lungs

**Preauricular:** Anterior to the auricle of the ear

**Prodrome:** An early or premonitory symptom of a disease

**Prophylaxis:** Prevention of a disease, or of a process that can lead to disease

**Prostration:** A marked loss of strength, as in exhaustion

**Pustule:** A small circumscribed elevation of the skin, containing purulent material

**Sepsis:** The presence of various pus-forming and other pathogenic organisms, or their toxins, in the blood or tissues

**Stomatitis:** Inflammation of the mucous membrane of the mouth

**Vesicle:** A small, circumscribed elevation on the skin containing fluid (i.e., blister)

*Reference: Stedman’s Medical Dictionary, 26th Ed.*
In the wake of the 2001 anthrax attacks, thousands of people and organizations across the country have scrambled for information on how to protect themselves, their families, and their employees from anthrax and other potential agents of bioterrorism. Health officials have been flooded with requests to deliver presentations on bioterrorism preparedness and response at community forums, clinical conferences, business meetings, and other public venues. Potential instructors and trainers, however, have been handicapped by the lack of up-to-date, basic orientation resources on bioterrorism preparedness and response.

*Preparing for and Responding to Bioterrorism: Information for the Public Health Workforce* is a series of train-the-trainer resources that addresses the public health aspects of bioterrorism. It is scientifically accurate, up-to-date (as of the date of publication), and immediately relevant to the public health workforce. The series consists of thirteen PowerPoint™ slide sets, each accompanied by a detailed instructor’s manual. The slide sets cover emergency response planning, surveillance and epidemiologic response, diseases of bioterrorist potential, consequence management, and communication and informatics. They are flexible and can be customized for local community needs. Included in each slide set and instructor’s manual is a list of resources, references, and contacts for further information on bioterrorism preparedness and response—before, during, and after an incident.

We hope these resources will help the public health workforce to plan for and respond to public health emergencies, including a bioterrorist attack, and facilitate coordination between public health and other emergency responders.

Cover image: *Yersinia pestis* (Plague)

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