BIOLOGICAL AGENTS

03

BIOLOGICAL AGENTS

GOAL OF THIS SECTION

To provide the best available scientific and medical information on selected biological agents that may be used by terrorists as weapons.

WHAT THIS SECTION INCLUDES AND WHY

- **Category A agents, as classified by the U.S. Department of Health and Human Services' (HHS) Centers for Disease Control and Prevention (CDC), are included because they are of the highest concern as potential threats. They have the potential for major public health impact and social disruption and are also known to have been studied by some countries for use in biological warfare.**
- **Category B agents, which are defined as a "second highest priority" by CDC, are also included. Although these agents are fairly easy to disseminate, they generally cause moderate illness and low death rates.**

WHAT THIS SECTION DOES NOT INCLUDE AND WHY

- **Category C agents, which are considered to be "third highest priority" by CDC, are not included because they are currently not major bioterrorism threats. However, these agents are emerging as infectious disease threats that CDC believes could, in the future, be engineered to produce biological weapons. Examples of Category C agents include yellow fever, drug-resistant tuberculosis, and hantaviruses.**

Please note: Information on the use of personal protective equipment (e.g., biohazard suits and masks) can be found in the "Self-Care for Media" section (see p. 157).

BIOLOGICAL AGENT OVERVIEW

- The threat from **biological agents** arises when naturally occurring microbes are *weaponized*—harnessed and modified to cause disease or even kill many people.
- Organisms can be used in their naturally occurring state or they may be able to be modified to increase virulence and/or render the disease they cause resistant to treatment.
- To determine if an outbreak may be bioterrorism, scientists will look for the following characteristics:
  - A large number of cases appearing at the same time, particularly in a discrete population (e.g., people from the same town, people who attended the same event)
  - A large number of cases of a rare disease or one considered a bioterrorism threat (e.g., plague, tularemia)
  - More severe disease manifestation than typical for a given disease and/or an unusual route of exposure
  - A disease that is unusual in a given place or is out of season (e.g., a flu outbreak in the summer in the United States)
  - Multiple simultaneous outbreaks of the same disease or different diseases
  - A disease that affects animals as well as humans
  - Unusual disease strains or uncommon antibiotic resistance to an organism

Although some of these characteristics may be true of a naturally occurring outbreak, they will generally signal that the outbreak needs to be closely scrutinized.

UNDERSTANDING BIOLOGICAL AGENTS

The first step in understanding biological agents and how they affect the human body is a review of associated terminology.

Infectious Diseases

- *Infectious diseases* are caused by the invasion of the body by harmful microorganisms.
- Microorganisms multiply and make the person sick by attacking organs or cells in the body.

> **"JOURNALISTS FROM LARGE CITIES TO SMALL TOWNS** could wake up and be on the front lines of a new kind of warfare involving radiological, chemical, or biological agents with all the associated hazards or responsibilities. There's a whole new dimension here that's never existed before."
>
> *Peter Van D. Emerson, Senior Associate*
> *Harvard University's John F. Kennedy School of Government*
> *"Girding for Terror," American Journalism Review, April 2003*

- These harmful microorganisms include viruses and bacteria, as well as certain other microscopic organisms, and are sometimes called *pathogens*.
- There is usually a lag time, called an *incubation period*, between when a person is infected and when the symptoms appear.
- People can become infected with these diseases in any number of ways, including consuming contaminated water or food, being bitten by insects or animals, or inhaling or touching the microorganisms or their spores.
  - Spores are produced by certain bacteria and plants. Like seeds, spores do not grow until the environment is conducive for them to do so. They are highly resistant to heat and other environmental factors.
- All of the diseases discussed in this section are considered infectious diseases. Illnesses caused by chemical agents (see "Chemical Agents" section [p. 95]), by contrast, are not infectious diseases.

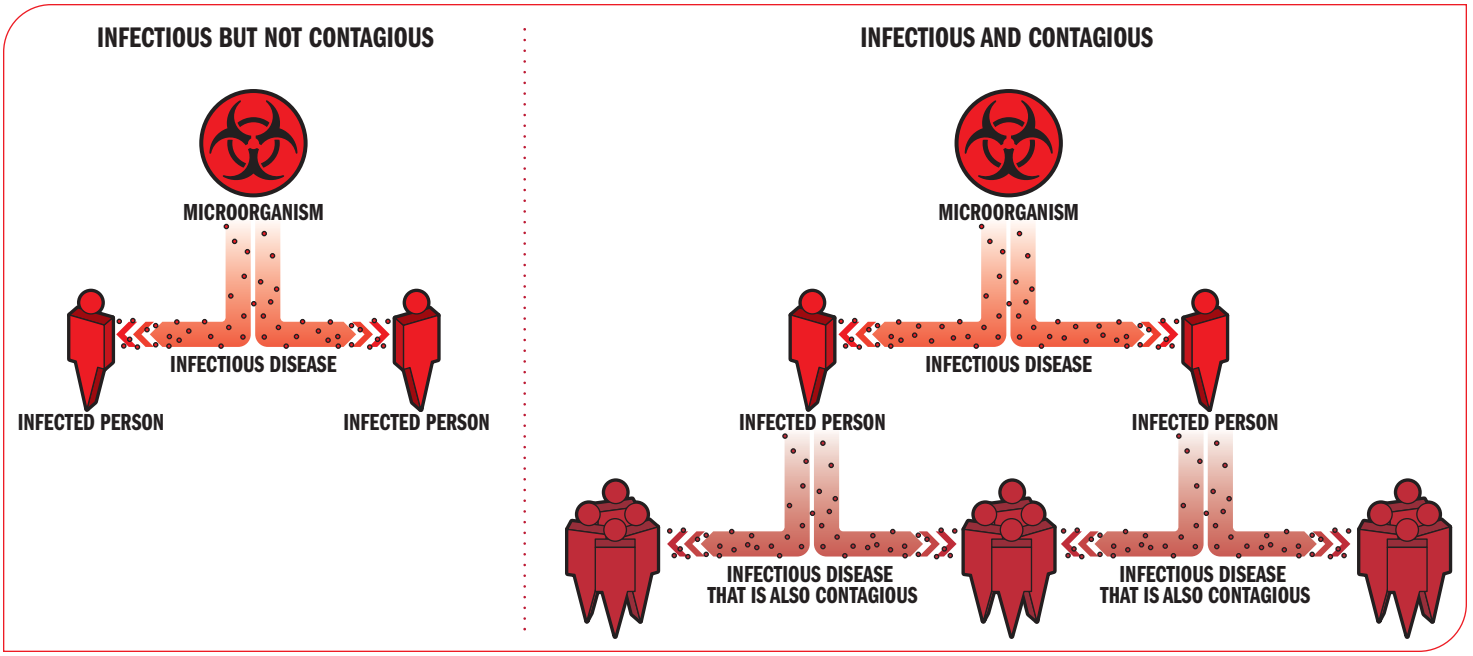
Contagious Diseases

- A *contagious disease* is an infectious disease that can be "caught" by a person who comes into contact with someone who is infected. Not all infectious diseases are contagious.
- Exposure to a contagious disease usually happens through contact with the infected person's bodily fluids or secretions, such as a sneeze.
- Depending on the disease, the level of contact required to pass on the illness could be as casual as water droplets in the air from a cough (e.g., smallpox).
- The level of contagiousness has nothing to do with how serious the resulting disease may be. For example, pneumonic plague and the common cold are both highly contagious, but pneumonic plague is obviously a much more serious disease.
- There are some infectious diseases that are not contagious at all, no matter how close the contact with an infected person (e.g., botulism, tularemia).

Toxins

- *Toxins* are the poisonous, usually protein-based, substances produced by microorganisms (bacteria, mold, virus) in certain infectious diseases.
- Microorganisms use these toxins as the specific weapons for attacking organs or cells in the body.
- *Antitoxins* are medications that attempt to neutralize a toxin without necessarily killing the bacteria, mold, or virus that is producing the toxin.
- Many different types of antitoxins exist because a specific antitoxin will usually only fight a particular kind of toxin.
- Although toxins are usually classified as being biologically produced, common language often refers to the poisons created by nonliving chemical agents as *chemical toxins*.

FIGURE 3–1: INFECTIOUS DISEASE: SOMETIMES CONTAGIOUS, SOMETIMES NOT



Bacteria and Viruses

› Both *bacteria* and *viruses* can cause infectious diseases.

Bacteria

› *Bacteria* are one-celled microorganisms that are capable of multiplying.

› Not all bacteria are harmful (e.g., bacteria turn milk into cheese).

› *Antibiotics* are medications that can be used to kill harmful bacteria.

› Some bacteria can develop resistance to antibiotics, making the medications less effective.

› Hospitals will typically have supplies of antibiotics known to be effective against most Category A and B bacterial agents.

Viruses

› *Viruses* are simpler than bacteria, often made up merely of a bit of deoxyribonucleic acid (DNA) or ribonucleic acid (RNA) that is surrounded by a protective coat of protein.

› Viruses are parasitic in nature and unable to multiply without *host cells*—cells within a person's body that the viruses invade and use to multiply.

› Antibiotics are not effective against viruses.

› Some antiviral medications do exist, but many that might help against Category A agents are still in clinical trials. Consult HHS' National Institute of Health's National Institute for Allergy and Infectious Diseases' (NIAID) Web site (http://www2.niaid.nih.gov/biodefense) for ongoing research in this area.

DELIVERY OF BIOLOGICAL AGENTS

The ability to successfully deliver a biological attack depends on:

› The type of agent or organism

› The method of dissemination

› The weather (e.g., wind speed, humidity, time of day, precipitation, temperature):

- Wind speed affects how widely an agent can be spread
- Humidity can cause decomposition of an agent
- Precipitation can cause clumping, making fine particles more difficult to inhale

Routes of Entry

Biological agents can enter the body through:

BACTERIA	VIRUSES
• One-celled microorganisms that contain several components within the single cell.	• Bits of DNA or RNA.
• Some bacteria can also exist as spores that help them survive harsh conditions. Spores can germinate to become full-fledged bacteria; this is the case with anthrax.	• Viruses need to infect living cells to survive and multiply.
• Antibiotics can be used to kill bacteria.	• Antibiotics do not affect viruses; some antiviral medications exist.

- Absorption
- Inhalation
- Ingestion
- Injection

Delivery Methods

Biological weapons can be prepared for delivery as a weapon in wet or dry form:

- In dry form, agents are more stable and refinement is easier
- In liquid form, agents are less stable, require refrigeration, and are difficult to refine to small particle sizes

Biological weapons can be delivered by:

- Wet or dry aerosol sprayers
- Explosive devices
- Transmission through insects, animals, or humans
- Introduction into food, water, or even medications
- In or on objects, in some cases (e.g., anthrax in envelopes)

Effectiveness of Release

The effectiveness of a biological release depends on:

- The particle size and its potency (for example, in an aerosol release, the size must be between 1 and 5 microns to be inhaled and cause illness) (Note: 1 micron is one millionth of a meter. A strand of hair ranges between 20 and 200 microns in width.)
- How well the agent survives in the environment
- Weather conditions

TESTING FOR BIOLOGICAL AGENTS

Quick diagnosis and treatment of a patient exposed to a biological agent are key to saving that patient's life. A biological attack may go unnoticed until large groups of people begin exhibiting symptoms, which makes prompt diagnosis even more critical. But getting a quick medical answer is complicated by the fact that currently there is no single test that can diagnose whether a person has been exposed to biological agents. There are clinical trials under way, however, on better testing methods.

To look for evidence of biological agents, physicians will take blood or other samples to be tested at clinical laboratories. As the clock is ticking, the sample must be collected and sent to the appropriate lab for analysis. However, it takes time to isolate the bacteria, toxin, or virus from the sample. This timeframe can stretch from hours to days, depending on the agent, the amount of exposure, the proximity and capabilities of the lab, and the time the test(s) take. The following list provides descriptions of the types of tests that may be run:

- **Environmental testing** is examining a building or an area for the presence of a biological or chemical agent. Testing is usually a two-step process. Using anthrax as an example, if the sample contains a large amount of the bacteria (*Bacillus anthracis*), a positive reading may come back within minutes. However, this quick initial result from the scene may be what is called a false positive result, so a more reliable test must be done by a more sophisticated laboratory to confirm the results. The confirmation test can take up to 72 hours depending on how fast the bacteria grow and can be positively identified.

SHOULD I KEEP SUPPLIES OF CIPRO AND KI IN MY MEDICINE CABINET AT HOME?

After the anthrax attacks of 2001, many people wanted to obtain certain medical supplies, such as Cipro (ciprofloxacin hydrochloride) or KI (potassium iodide) tablets, to have on hand in case of an emergency. Although people may feel comforted by keeping these supplies at home, the truth is that personal stockpiling of such products can actually do more harm than good. Because we do not know how a future attack will unfold, it is impossible to know what type of medical response will be best. Here are a few specific concerns that public health officials have about the stockpiling of medical supplies:

- **False sense of security. Believing that one has what he or she needs at home can result in not getting necessary medications if they are really needed. For example, Cipro is a prescription antibiotic that was the drug of choice in the 2001 anthrax attacks. It may be useful for combating some kinds of biological agents but may not be the best drug to use for all bacteria. And, if the drug has been sitting in a medicine cabinet for several years, it may no longer be potent.**
- **Some supplies may be ineffective against a given threat. KI, for example, can protect the thyroid gland from exposure to radioactive iodine, which may be released in some radiological incidents, but this does not help protect against other forms of radioactivity that may come with an attack. In addition, not all attacks will involve the release of radioactive iodine. Some communities with nearby nuclear reactors have made KI available to residents, but that doesn't mean that maintaining a ready stock of KI is right for every community and every family. If an attack with a dirty bomb or other radiological device took place, KI may not be helpful, and people may mistakenly think that they are protected.**
- **Side effects and adverse reactions. Certain medications, including Cipro, can cause an allergic reaction or severe side effects in some people. Taking these drugs without proper guidance can increase the risk of possible side effects and adverse reactions.**

Public health officials do recommend that people have other supplies on hand, including food, water, medications taken routinely, and a battery-powered radio. A more detailed list of supplies can be found in appendix F (see p. 242). In an emergency, public health officials will let community members know through the media what is going on and where they should go to obtain necessary medical supplies.

- A **nasal swab** is an environmental test that may be used to assist in a public health investigation to determine the presence of a bioterrorism agent in an area or building. Nasal swabs are not used to determine if a person is infected by a given agent.
- A **culture** is a method for growing an organism in the lab (for example, in a Petri dish). A culture can help in identifying a bacteria or virus. Cultures are the most readily available technology for clinical diagnosis of a suspected case of bioterrorism but can be time consuming to complete.
- A **blood culture** is a test that looks for bacteria or viruses in the blood. Blood is drawn from a patient, and the sample is sent to a special laboratory for analysis. The sample is incubated, or kept in a warm place, at a certain temperature, and in this controlled environment, the bacteria grow and are isolated from the blood for easier identification.
- "Media" are the nutrient mixes used to grow organisms in a lab. **Selective media** are used to identify an organism by giving it or depriving it of certain nutrients. For example, selective agents can be added or removed, which "poison" some organisms while allowing others to grow.
- **Gram staining** uses dyes to make a bacterial cell stand out for identification. A specimen is put on a slide and a four-part staining procedure begins. This test may produce results in less than an hour, but it is not specific enough to definitely identify the organism, and a longer confirmation test is still needed.
- Obtaining **sputum** involves getting a sample of a patient's phlegm by having him or her cough it up. Sputum samples are usually ordered when a patient is exhibiting pneumonia-like symptoms that could be an indicator of an inhalational form of anthrax, plague, or tularemia. The sample is then stained and viewed under a microscope to look for the presence of certain bacteria. Part of the same sample is also used for a culture.

There are also more sophisticated tests that are used to identify agents, such as:

- **Immunoassays,** which look for specific antigens or antibodies and are useful in detecting the presence of toxins. However, antibody production for identification can take time.

- **Gene amplification assays,** such as a polymerase chain reaction, which look at the DNA or RNA to identify an agent. However, sample preparation can take a long time.

In general, detection and identification using any of these methods is dependent on the sample quantity and quality and the exactness of the processing. A combination of tests will yield the most accurate results. In the absence of immediate results, physicians who suspect bioterrorism may begin a preliminary course of treatment until the lab results are in.

HOW LONG TESTING SHOULD TAKE

Unfortunately, there is no single answer to the question of how long testing will take. The testing of biological agents is complicated by several factors, which can affect the time that passes before the presence of an agent can be confirmed or a diagnosis can be made. These factors include:

- **Identifying the agent:** Although bioterrorism is now a household term, actual incidents of bioterrorism have been rare, leaving today's physicians with limited experience in identifying these agents in the lab or treating affected patients. This means that the first patients who become sick may be mistaken for having other illnesses, thus causing a delay in the effort to test for biological agents.
- **Presumptive vs. confirmatory diagnoses:** Not all tests are conclusive. Some tests, such as Gram stains, can give a presumptive diagnosis that an agent is present, but followup tests are needed. In general, presumptive diagnosis of an agent can usually be made in about a day. Confirmatory diagnosis can take 2–3 days.
- **Viral, bacterial, or toxin load:** The "load" refers to how much of the agent is present in a patient. If relatively large amounts of an agent are present in a patient, cultures designed to grow the bacteria or virus could take as little as a few hours. If smaller amounts of the agent are present in a patient, these same culture tests could take up to 2 or 3 days.
- **Lab capabilities:** Can the needed tests be done in local labs, near a suspected attack, or do the samples need to be shipped out to more advanced labs, thus affecting the overall timeline? Shipping samples to more advanced labs can tack on an extra day or two to the wait time. CDC's Laboratory Response Network helps facilitate this process.
- **The kind of test that is used:** Numerous tests are employed to detect the presence of bioterror agents. Blood cultures can take up to 3 days, in some cases for example, but Gram stains can be ready within an hour. However, some of these quicker tests will only give preliminary information, which must be confirmed with more comprehensive tests.

More information on the laboratory system in the United States can be found in the "Planning for the Unthinkable: Preparation and Response in Public Health" section (see p. 5).

WHAT WE DON'T KNOW ABOUT BIOLOGICAL WEAPONS OF MASS DESTRUCTION

- It is not known who is in possession of biological Weapons of Mass Destruction.
- Medical experts do not know if bacteria have been engineered to be resistant to antibiotics.
- Experts do not know how potent the strains will be in a biological attack.
- Experts do not know if the illnesses caused by some of these agents will be immediately recognizable.
- There is disagreement on how long some of these agents can survive in the environment.
- Experts do not know if the diseases these agents cause will be the same as past epidemics (e.g., is today's smallpox the same as the disease that was eradicated?).

THERE IS NO SINGLE ANSWER to the question of how long testing will take.

CATEGORY A AGENTS

Category A agents are defined by CDC as the "highest priority" of concern for potential bioterrorist threats. Category A agents are given the most consideration in this section because there are many different kinds—each with a different effect on the body—and because the natural origin of these so-called bioweapons makes the building blocks relatively easy for terrorists to acquire. In general, dissemination of any of the Category A agents could strain the public health care system and cause widespread concern.

Basic facts and scientific information for Category A agents are provided; agents are treated alphabetically.

A

ANTHRAX

BASIC FACTS

- **Scientific name: *Bacillus anthracis;* rod-shaped bacteria (not a virus).**
- **Anthrax is the disease that develops after exposure to spores produced by this bacteria.**
- **The spores can remain dormant for long periods but are still capable of causing infection when someone comes in contact with them by touching or breathing them in.**
- **Anthrax spores can cause three types of illness, depending on how a person is exposed:**
  - **Inhalational (respiratory)—most lethal**
  - **Cutaneous (skin)**
  - **Gastrointestinal (digestive)**
- **The anthrax illness is not contagious.**
- **Anthrax can be treated with antibiotics if diagnosed early.**
- **An anthrax vaccine exists but is not in widespread use.**

ANTHRAX SPORES AS A WEAPON

Historically, many nations have weaponized anthrax by turning it into a concentrated powder or aerosol form. Generally, anthrax spores tend to clump together and the body can defend itself against them in that form. In a refined state, however, the spores are very dangerous when inhaled.

- Anthrax bacteria are easy to grow in a lab but not easy to refine as a weapon.
- Anthrax spores can be manipulated so they can float through the air and disperse as widely as possible.
- Anthrax spores can be released into the air directly or through a building's heating and ventilation system.
- The 2001 anthrax attacks demonstrated that spores can even be distributed through envelopes in the mail.
- Once aerosolized, anthrax spores cannot be seen by the naked eye or smelled.
- Weaponized anthrax spores can remain in the environment for long periods of time.

WHAT WE DON'T KNOW ABOUT ANTHRAX AS A WEAPON

- Exactly how long the spores remain dangerous is unclear.
- Experts cannot say whether spores can become airborne again after settling. This was one of the issues that made it difficult to assess how the attacks on the U.S. mail system would play out.
- Experts disagree on how many spores are necessary to infect someone. Originally it was believed that it would take up to 10,000; but after the 2001 attacks, experts have revised that number; some believe it takes only a few thousand. For immune compromised people, there is no safe lower limit.

IDENTIFYING AN ATTACK

- An anthrax attack will most likely go undetected until people start becoming sick.
- Tests to confirm the presence of anthrax spores can be conducted on suspicious powder or residue.
- Environmental testing confirms the presence of spores in a building.
  - Testing determines the extent of exposure in a building or site (whether anthrax spores are there and how many).
  - Initial tests onsite are not as accurate as subsequent lab tests and can sometimes generate false positive results.
  - Initial tests may miss smaller quantities of spores.
  - Samples must be sent to specialized laboratories for more definitive tests.
  - Receipt of conclusive results can take up to 72 hours due to the complexity of taking the sample (workers must wear protective suits), transporting it to a specialized lab, isolating the bacteria or spores, and producing a test result.
- Blood tests are more reliable in confirming individual cases of anthrax disease.
- Nasal swabs can be a quick tool to confirm the presence of anthrax spores in a given environment (but not to diagnose illness). See the following "Diagnosis" section for more information.

ANTHRAX ILLNESSES

Anthrax spores can induce three types of illness, depending on how they make contact with the human body.

INHALATIONAL ANTHRAX

Exposure

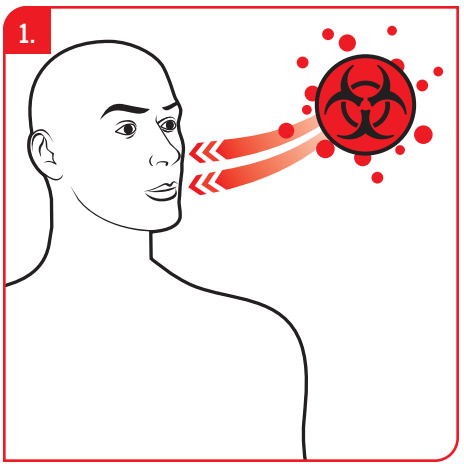
- Victims breathe in spores floating through the air; the spores then lodge in their lungs.
- Certain cells take the spores to the lymph nodes surrounding the lung. Once they enter the lymph nodes, the spores germinate into bacteria and cause inflammation and enlargement of these lymph nodes.
- Anthrax bacteria then spread from the lymph nodes to sites throughout the body and produce a toxin that can be destructive to organs and is difficult to treat.

Symptoms

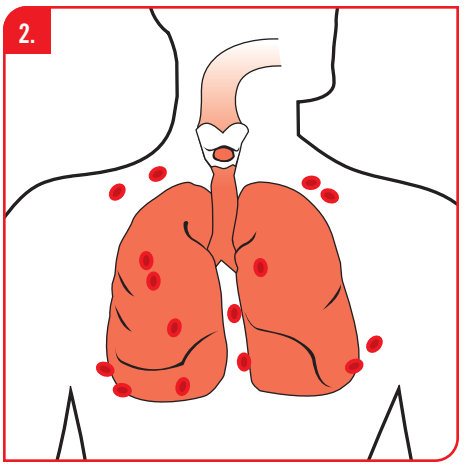
Symptoms can occur within 7 days of infection or can take up to 42 days to appear. These symptoms include:

- Fever (temperature greater than 100 degrees Fahrenheit); may be accompanied by chills or night sweats
- Flu-like symptoms
- Cough, usually a non-productive cough; chest discomfort; shortness of breath; fatigue; or muscle aches
- Sore throat, followed by difficulty swallowing; enlarged lymph nodes; headache; nausea; loss of appetite; abdominal distress; vomiting; or diarrhea

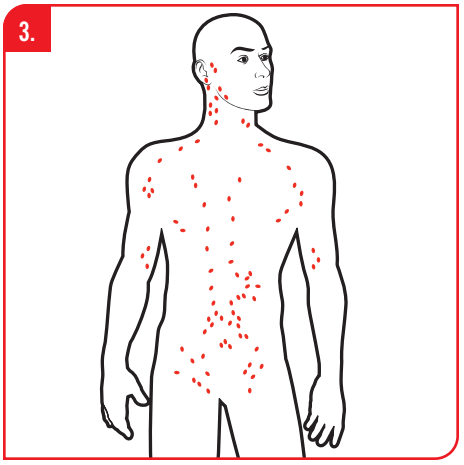
FIGURE 3–2: INHALATIONAL ANTHRAX



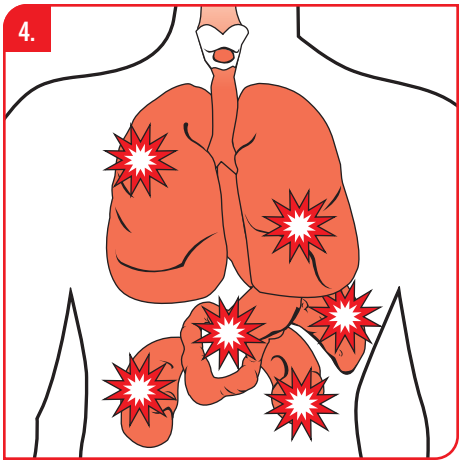
Anthrax spores inhaled.



Anthrax spores lodge in lungs where certain cells take them to lymph nodes surrounding the lungs. Once they enter the lymph nodes, the spores germinate into bacteria and cause inflammation and enlargement of these lymph nodes.



Anthrax bacteria spread from the lymph nodes around the lungs and throughout the body.



Anthrax bacteria produce toxin that can destroy organs.

Note: Antibiotics must be prescribed quickly to kill the anthrax bacteria.

Recovery/Mortality Rate

- Inhalational anthrax is the most lethal form of an anthrax illness.
- Inhalational anthrax was the cause of all five deaths in the 2001 U.S. postal system attacks.
- Some patients treated with antibiotics can have an initial recovery followed by a relapse once antibiotic therapy has been terminated.
- Inhalational anthrax, like most diseases, is more deadly for people with compromised immune systems.
- Untreated inhalational anthrax has a 90 percent mortality rate.
- The survival rate for inhalational anthrax victims depends on quick diagnosis and treatment with antibiotics.
- The mortality rate is still approximately 75 percent, even with antibiotics.

CUTANEOUS ANTHRAX

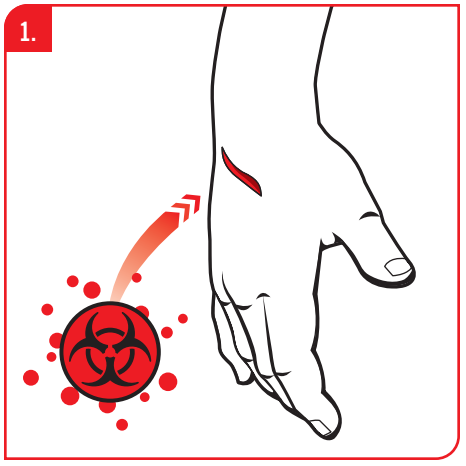
Exposure

Anthrax spores enter the body through an open wound or cut, or even through microscopic breakdowns of the skin.

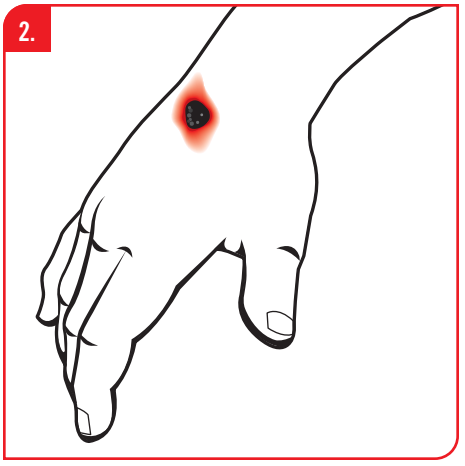
Symptoms

- Symptoms appear within 1–7 days after exposure.
- A small sore quickly develops into a blister.
- The blister becomes a skin ulcer, or eschar, and ultimately develops a black scab in the center.
- The sore, blister, and ulcer do not hurt and initially look like a spider bite.

FIGURE 3–3: CUTANEOUS ANTHRAX



Anthrax spores enter the body through an open wound or cut, or even through microscopic breakdowns of the skin.



Within 1–7 days, a small sore develops into a blister that becomes a skin ulcer and ultimately develops a black scab in the center.

Recovery/Mortality Rate

- Cutaneous anthrax is the least deadly form of anthrax.
- The survival rate is 80 percent without treatment and more than 99 percent with treatment.

GASTROINTESTINAL ANTHRAX

Exposure

Gastrointestinal anthrax occurs when anthrax is ingested, usually through meat from anthrax-infected animals.

Symptoms

- First signs of the infection appear within 2–5 days of exposure.
- Initial symptoms include nausea and loss of appetite.
- Later symptoms include bloody diarrhea, fever, and severe stomach pain.
- Symptoms mirror those for stomach flu, food poisoning, and appendicitis.

Recovery/Mortality Rate

If untreated, at least 25 percent of gastrointestinal anthrax cases lead to death.

DIAGNOSIS

To treat someone with an anthrax illness successfully, it must be diagnosed early. Early diagnosis is complicated because there is no single screening test to confirm anthrax illness.

- Exposure is confirmed by isolating the anthrax bacteria from the blood, skin lesions, or respiratory secretions or by measuring specific antibodies in the blood.
- Blood tests to confirm an anthrax infection can take up to 72 hours, since it takes time to isolate a particular bacterium in a blood sample. Some circumstances may produce test results much more quickly. For example, in a severe inhalational case, there may be

a large concentration of bacteria in a sample, which may allow technicians to obtain a result in a few hours.

- If inhalational anthrax is suspected, physicians typically obtain a chest X-ray and a CAT scan to confirm their suspicions.
- Nasal swabs can detect the presence of spores but are not a diagnostic tool. A positive swab does not mean a person will develop an anthrax illness and a negative swab does not mean a person will not develop an anthrax illness. A nasal swab is only an indicator of whether anthrax spores are present in an area.

WHAT WE DON'T KNOW ABOUT ANTHRAX AS AN ILLNESS

- No one knows for sure when treatment must begin to be successful. Some believe antibiotics must start within hours, others say days.
- Physicians do not know if children or specific ethnic groups are more vulnerable to anthrax than the general population.
- There is still debate about how many spores are needed to infect a person.

TREATMENT

All three types of anthrax can be treated with antibiotics. Though ciprofloxacin was first used as a treatment for anthrax during 2001, doxycycline is now the preferred antibiotic for anthrax infection. The reason for this is to prevent other bacteria from developing resistance to ciprofloxacin.

- Antibiotics are prescribed for 60 days.
- Treatment must begin as soon as possible after exposure to be successful because the bacteria produce a toxin in the body that poisons the system quickly and sometimes irreversibly. Antibiotics kill the bacteria but cannot remove the toxin or lessen the effects of any toxin already in the body. There is no antitoxin for the anthrax toxin.
- Those with inhalational anthrax normally have to be hospitalized and on a ventilator to help with breathing.
- Anthrax patients do not have to be isolated since the illness cannot be passed from person to person.
- Which antibiotic is prescribed depends on a patient's age and health, the number of cases in the area being treated, and what is available at the hospital and/or through the Strategic National Stockpile. More information on the Strategic National Stockpile can be found in the "Planning for the Unthinkable: Preparation and Response in Public Health" section (see p 5).
- Additional antibiotics for treatment of anthrax are being studied in animal efficacy trials.

VACCINE

- The vaccine is used as a preventive measure for those in high-risk populations, including:
  - Lab workers
  - Members of the armed forces deployed to countries suspected of having biological weapons programs
- The current anthrax vaccine is not available to the general public but might be used if an anthrax attack occurs.
- The vaccine is given as a series—three shots administered 2 weeks apart.
- Subsequent injections are given at 6, 12, and 18 months; annual boosters follow.
- The current vaccine can have side effects:
  - *Mild side effects* may include soreness, itching, or a lump where the shot was administered; muscle or joint aches; fatigue; or headache
  - *Severe side effects* may include a severe allergic reaction (very rare)
  - There is no evidence that the vaccine has long-term adverse side effects
- In October 2004, HHS awarded a contract to VaxGen, Inc., for the manufacture of 75 million doses of a new anthrax vaccine for the Strategic National Stockpile. Evidence from laboratory and animal research has shown that the new vaccine, which uses purified recombinant protective antigen, is effective in providing protection against aerosol exposure to anthrax spores (HHS 2004).
- For more information on the clinical trials for new anthrax vaccines, anthrax diagnostic tests, and new antibiotics for anthrax treatment, see NIAID's Web site (http://www2.niaid.nih.gov/biodefense).

PREVENTION

Although anthrax cannot be spread from person to person, the spores can travel widely. Following are steps that can be taken to minimize the risk to people who have come into contact with anthrax spores:

- Wash skin with soap and water
- Start antibiotic treatment if exposure is suspected but not yet confirmed
- Treat mail with low doses of radiation; irradiating mail kills anthrax spores
- Use special mail handling procedures, such as wearing gloves and masks, to prevent cutaneous anthrax

ANTHRAX HISTORICAL TIMELINE

Naturally occurring, anthrax has affected humans for centuries. It was typically contracted by people, as well as animals, who ate, handled, or inhaled spores from infected animals or animal products. Early cases of reported anthrax exposure, however, were isolated and were among workers who handled wool or leather products.

1876: Robert Koch isolates the bacteria that cause anthrax.

1880: First successful immunization against anthrax is performed on livestock.

1937: Japan starts biological warfare program in Manchuria, including tests involving anthrax.

1942: The United Kingdom experiments with anthrax at Gruinard Island off the coast of Scotland (which was only recently decontaminated).

1943: The United States begins developing anthrax weapons.

1970: Anthrax vaccine is approved by the U.S. Food and Drug Administration.

1972: At the Biological Weapons Convention, more than 100 nations agree not to produce or stockpile Weapons of Mass Destruction (including the United States).

1979: Aerosolized anthrax spores are released accidentally at a Soviet Union military facility, killing about 68 people.

1991: U.S. troops are vaccinated for anthrax in preparation for the Gulf War.

1995: Iraq admits it produced 8,500 liters of concentrated anthrax as part of its biological weapons program.

1998: U.S. Secretary of Defense William Cohen approves an anthrax vaccination plan for all military service members.

2001: Letters containing anthrax powder are sent through the U.S. Postal Service; 22 people become ill and 5 people die.

ASSESSING THE RISK

- Because it is a naturally occurring bacteria and is studied in thousands of labs, anthrax is **readily available.**
- Anthrax spores are **highly stable** and can survive in the environment for decades.
- Terrorists would have to be **highly skilled** to mill weapons-grade anthrax spores or distribute them effectively to inflict mass casualties.
- Anthrax is **highly lethal** and may potentially be made more so by engineering it to be resistant to antibiotics.

THE CHALLENGE OF ACCEPTING AND COMMUNICATING UNCERTAINTY: IMPLICATIONS OF THE ANTHRAX ATTACKS

As with many of the naturally-occurring diseases that could be caused by acts of terrorism, anthrax is a disease that is rare in America today. Between 1989 and the anthrax attacks of 2001, only one case of anthrax was reported in the United States. Earlier in the 20th century, there were only 100 cases per year, and it is thought that the anthrax illness had been largely prevented through an animal vaccination program.

Much of what was known about anthrax before the 2001 attacks was based on these historical case records. CDC conducted 41 field investigations from 1950 to 2001, which supplied information about how anthrax can be contracted, how it affects the body, and the kinds of decontamination procedures used. Most of these cases involved agricultural workers who handled infected animals. The public health community approached the 2001 attacks with this real-world, working knowledge of anthrax. Unfortunately, the weaponized anthrax used in 2001 showed that what was true of naturally occurring anthrax did not prove true for this new, weaponized form of the pathogen.

For example, the miniscule size of the weaponized anthrax spores released in 2001 showed that the spore powder could actually escape through the tiny pores in paper envelopes and infect people who handle the envelopes—something naturally occurring spores could never do.

Officials are learning that what we "think we know" about these pathogens may not hold true during a bioterror attack. And these differences can change the way an illness is contracted, prevented, treated, and decontaminated. Communication with the public will try to explain that the ongoing investigation during the actual incident may reveal characteristics of the pathogens that are new and unexpected. Public health treatment and containment strategies will be based on the best available knowledge at the time and may need to be adapted during the crisis as new facts are brought to light. Former CDC Director Jeffrey Koplan said it well in 2001: "No doubt there will be things we learn 2 weeks from now that we wish we would have known today."

Sources:

Centers for Disease Control and Prevention. (2002). Epidemiologic response to anthrax outbreaks: Field investigations, 1950–2001. Emerging Infectious Diseases, 8(10). http://www.cdc.gov/ncidod/eid/vol8no10/02-0223.htm.

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BOTULINUM TOXIN

BASIC FACTS

- **Scientific name: Botulinum toxin. The toxin, or poison, is produced by the bacterium *Clostridium botulinum* (not a virus).**
- **Botulinum toxin is the most poisonous substance known to science.**
- **Botulism is a muscle-paralyzing disease that develops after a person is poisoned with botulinum toxin.**
- **The toxin is colorless, odorless, and tasteless.**
- ***Clostridium botulinum* exists naturally in the environment, and the botulinum toxin it produces can cause two types of illness:**
  - **Foodborne botulism**
    - **Infant botulism**
  - **Wound botulism**
- **Inhalation botulism, caused by breathing botulinum toxin, does not occur naturally but could happen as a result of deliberate dissemination of the toxin in the air by a technologically sophisticated terrorist or as a laboratory accident.**
- **Botulism is not contagious.**

BOTULINUM TOXIN AS A WEAPON

Clostridium botulinum bacteria produce a toxin. Terrorists have tried to weaponize botulinum toxin by refining the toxin and putting it into an aerosol form. Refined or crude preparations of toxin could be used to poison food or beverages, and refined toxin, with a sophisticated delivery system, could be used to disseminate the toxin by air.

- Botulism toxin can be disseminated via the air, water, or food.
- Such contamination would be hard to detect because botulinum toxin is colorless, odorless, and tasteless.
- Poisoning the water supply would be difficult for terrorists because:
  - Large quantities of toxin would be needed to affect the water system
  - Chlorine in most water treatment facilities would destroy the toxin

WHAT WE DON'T KNOW ABOUT BOTULINUM TOXIN AS A WEAPON

Experts believe that only a small amount of the toxin would need to be inhaled to be deadly on a large-scale basis. However, because there has never been a successful attack, the exact amount needed is still a question.

IDENTIFYING AN ATTACK

- Because botulinum toxin is colorless, odorless, and tasteless, a foodborne, waterborne, or aerosol attack would probably go unnoticed until people exhibit symptoms.
- Existing public health surveillance is likely to rapidly identify a large-scale attack once victims began seeking medical care.

BOTULINUM TOXIN ILLNESSES

FOODBORNE BOTULISM

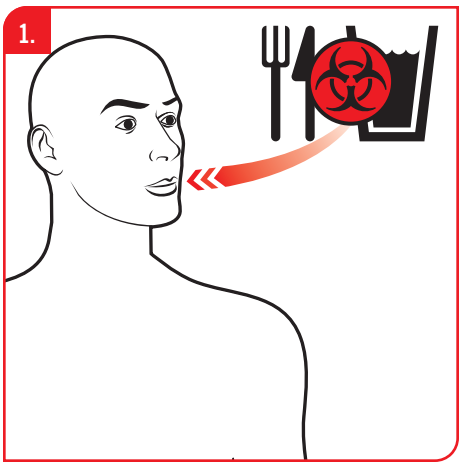
Exposure

- This form of botulism is caused by eating improperly preserved or cooked food; contamination can be caused by improper canning or cooking of foods.
- Contaminated food may be discolored or have a bad odor or taste.
- In infants, botulism can occur when a large amount of the spore is ingested through food products, such as honey and corn syrup, normally tolerated by adults.

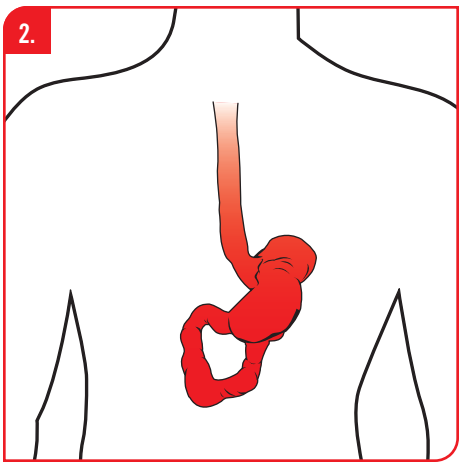
Symptoms

- Foodborne symptoms generally begin 18–36 hours after eating contaminated food but can occur as early as 6 hours or as late as 10 days after food consumption.
- Initial symptoms include blurred or double vision, slurred speech, drooping eyelids, difficulty swallowing, dry mouth, and muscle weakness.
- Botulism toxin spreads throughout the body and predominantly affects the nervous system.
- Within hours, a facial paralysis begins and spreads to the rest of the body.
- Botulism can result in respiratory failure.

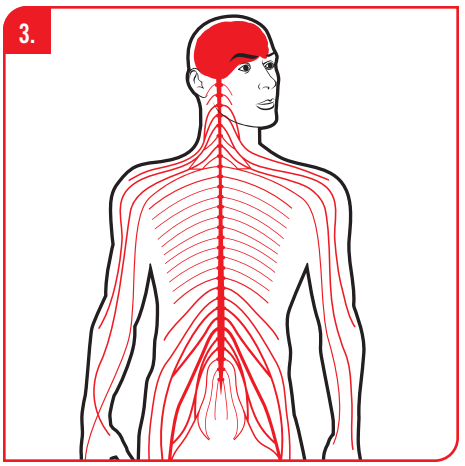
FIGURE 3–4: FOODBORNE BOTULISM



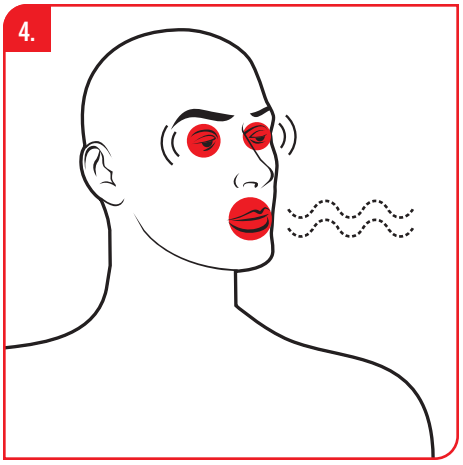
Botulinum toxin ingested through food or water.



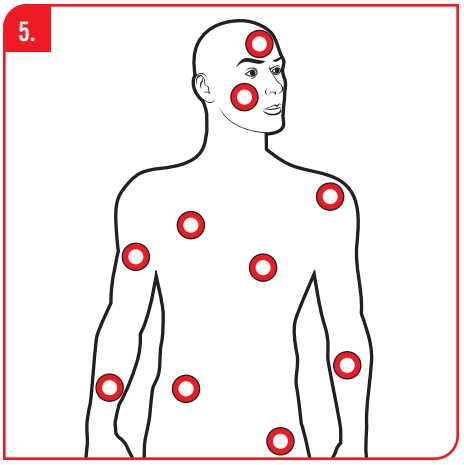
Botulinum toxin absorbed.



Botulinum toxin spreads throughout the body and predominantly affects the nervous system.



Initial symptoms include blurred or double vision, drooping eyelids, and slurred speech.



Within hours, a facial paralysis begins and spreads through the body.

Note: Symptoms of inhalational botulism would be similar.

Recovery/Mortality Rate

If treated, ingested botulism has a survival rate of more than 90 percent.

WOUND BOTULISM

Exposure

- This form of botulism is extremely rare.
- It occurs when someone gets the bacteria into an open cut.
- This illness is most often found in injection drug users.

Symptoms

Symptoms are similar to those for foodborne or inhaled botulism.

Recovery/Mortality Rate

The fatality rate for wound botulism is less than 3 percent.

INHALATIONAL BOTULISM

Exposure

- This form does not occur naturally and only three cases (from a laboratory accident) have ever been reported.
- It would be caused if people inhaled refined botulinum toxin disseminated through the air.

Symptoms

- Symptoms of inhaled botulinum toxin are similar to those of foodborne botulism.
- Symptoms may begin several hours to several days after an airborne attack (e.g., studies with monkeys show that symptoms begin 12–80 hours after exposure).

Recovery/Mortality Rate

Because there are so few recorded cases, it is unclear what the fatality rate of inhalation botulism would be in an attack.

DIAGNOSIS

Botulism is a rare disease. Whether it is naturally occurring or the result of terrorism, a single case of the illness may be difficult for physicians to diagnose. However, if several or many cases appear together, it is likely that the diagnosis would be made quickly.

- There is no single test to detect botulinum poisoning.
- A blood test can detect traces of botulinum.
- A stool sample test may be useful in detecting foodborne or infant botulism.
- Suspected foods should also be tested for presence of the botulinum toxin.
- Special tests (e.g., brain scan) may be needed to exclude similar conditions from botulism.

TREATMENT

Prompt medical attention is the key to successful treatment for a botulism illness.

- Treatment should begin as soon as botulism is suspected.
- Botulism antitoxin derived from horse serum is prescribed.
- This antitoxin reduces the spread of paralysis but will not reverse paralysis that has already set in, so early treatment is critical.
- With treatment, most paralysis will eventually go away.
- In severe cases, patients may need long-term care, including a ventilator to help assist breathing.

VACCINE

A vaccine to protect against botulism is not available to the general public.

- An experimental vaccine produced in the 1960s is given to lab workers and military troops sent to high-risk areas.
- This experimental vaccine is not considered useful for the general population because many months pass before a vaccinated person builds full immunity and because repeated vaccination is required to maintain this immunity.
- People who receive the experimental vaccine may not benefit from the medical uses of botulinum toxin, including cosmetic surgery and treatment of vocal chord spasms.

PREVENTION

Proper food handling and cooking is the best way to prevent naturally occurring botulism poisoning.

- Do not eat food that has been left out for long periods of time.
- Practice proper home canning of food to reduce the risk of botulism.
- Boiling food for 10 minutes can destroy botulinum toxin if there is concern that food has been contaminated.

BOTULINUM TOXIN HISTORICAL TIMELINE

World War II: Japan uses botulinum toxin to poison food of Chinese prisoners.

Cold War Era: Various nations, including the Soviet Union and the United States, experiment with botulinum toxin as a bioweapon.

1972: At the Biological Weapons Convention, more than 100 nations agree not to produce or stockpile Weapons of Mass Destruction (including the United States).

1990: Japanese cult Aum Shinrikyo tries unsuccessfully to produce an aerosol version of botulinum toxin.

Post-Cold War: Some nations in the Middle East are suspected of having stockpiles of botulinum toxin; some former Soviet Union stockpiles of botulinum toxin are unaccounted for.

ASSESSING THE RISK

- *Clostridium botulinum* is a common, naturally occurring bacteria, but the toxin is not **easily available** because one has to have the laboratory knowledge to produce the toxin from the bacteria.
- Botulinum toxin is only **moderately stable** because the aerosol form can deteriorate in sunlight.
- Terrorists would have to be **highly skilled** to stabilize the botulinum toxin for airborne release. A foodborne release would be somewhat easier.
- An airborne attack could produce **highly lethal** results; a foodborne attack could also be lethal.

PLAGUE

BASIC FACTS

- **Scientific name: *Yersinia pestis*; a bacterium (not a virus).**
- **Plague is the disease that develops after infection with this bacterium.**
- **Humans contract plague by inhaling it or from the bite of an infected flea.**
- **Plague infection takes three primary forms:**
  - **Bubonic**
  - **Pneumonic**
  - **Septicemic**
- **Only pneumonic plague is contagious through respiratory droplets with direct close contact (within 6 feet).**
- **Plague is highly lethal if untreated.**
- **Plague can be treated with antibiotics if caught early.**
- **Some plague infections occur naturally each year (usually bubonic).**

PLAGUE AS A WEAPON

Because pneumonic plague is highly lethal and contagious and would quickly overwhelm communities and their health care systems, countries with biological weapons programs have explored using plague in aerosol form to infect large groups of people.

- A pneumonic plague outbreak would be difficult to contain.
- Treatment must be immediate (within 24 hours of first symptoms) to be successful.
- Once refined, plague bacteria can be released into the air undetected.
- Once released into the air, plague bacteria remain infectious for up to an hour.
- Aerosolized plague bacteria can infect large groups of people quickly.
- Plague bacteria degrade quickly in sunlight or heat.

WHAT WE DON'T KNOW ABOUT PLAGUE AS A WEAPON

Experts are uncertain as to how wide an area would be affected by an aerosol release of plague bacteria or whether it can be disseminated successfully through the mail, as was the case with anthrax.

IDENTIFYING AN ATTACK

- A plague attack will likely go unnoticed until people exhibit symptoms.
- Tests of powder or residue can identify the presence of plague bacteria.

PLAGUE ILLNESSES

There are three common forms of illness caused by the plague bacteria:

BUBONIC

Exposure

- Bubonic plague is caused when infected fleas bite humans.
- A person can also be infected through a break in the skin.
- This form of plague illness is not contagious.

Symptoms

- Bubonic plague infects the lymphatic system and causes severe swelling.
- The first symptoms appear 2–6 days after infection and include weakness, high fever, and chills.
- If bubonic plague is not treated, bacteria can spread through the bloodstream, causing septicemic plague or a secondary case of pneumonic plague.
- Later symptoms appear, such as muscular pain, swelling of lymph glands, and seizures.

Recovery/Mortality Rate

If untreated, bubonic plague is fatal in more than 50 percent of cases because of progression of the bacteria into the bloodstream.

PNEUMONIC

Exposure

- This form of the disease infects the lungs.
- It is caused by breathing in aerosolized plague.
- This illness can be transmitted from person to person through respiratory droplets with direct close contact (within 6 feet).

Symptoms

- Symptoms usually surface 2–4 days (range of 1–6 days) after exposure.
- Initial symptoms include high fever, cough, and chills, similar to the flu.
- Later symptoms include pneumonia and bloody sputum (coughing up blood).

Recovery/Mortality Rate

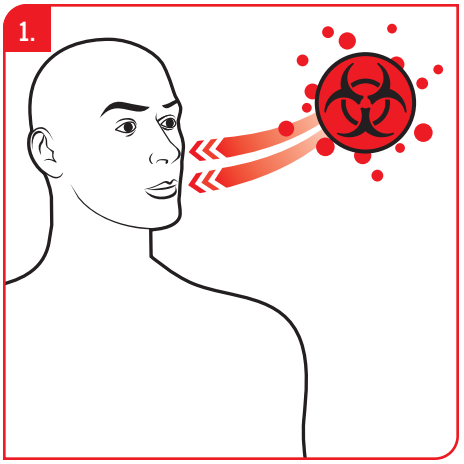
- Without early detection and treatment, the mortality rate from pneumonic plague is nearly 100 percent.
- If treated, the mortality rate from pneumonic plague is still 50 percent.

SEPTICEMIC

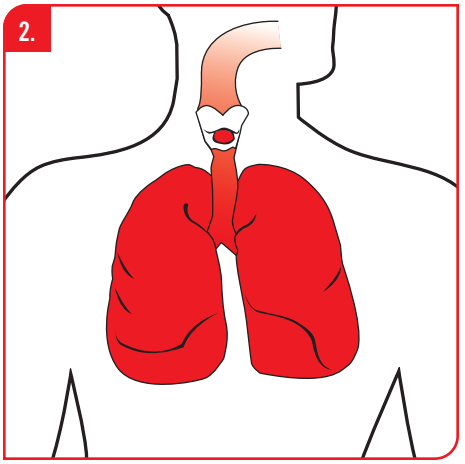
Exposure

- Septicemic plague may be a secondary illness caused by complications from bubonic or pneumonic plague, or it can occur by itself.
- Plague bacteria enter the bloodstream.
- This form of the disease is not contagious.

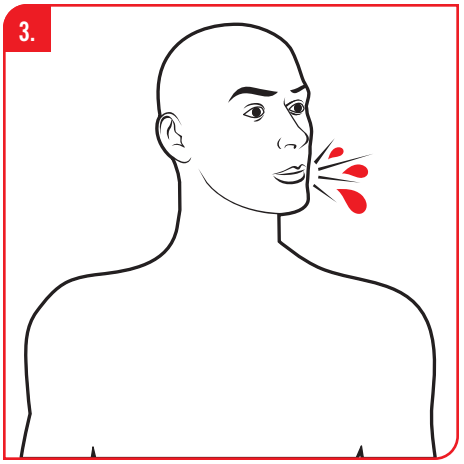
FIGURE 3–5: PNEUMONIC PLAGUE



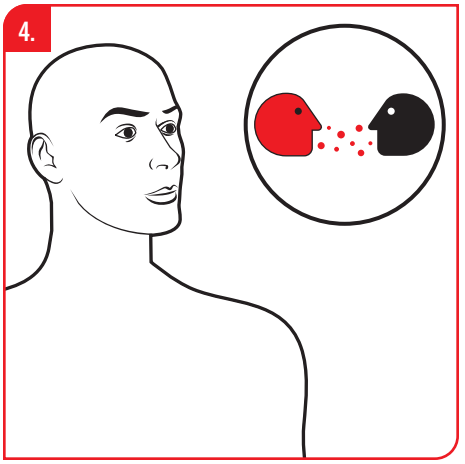
Plague bacteria inhaled.



Pneumonia starts to develop within 1–6 days.



Symptoms include coughing up blood.



Plague may be transmitted to others through respiratory droplets (contagious).

Symptoms

- Symptoms appear 2–6 days after infection.
- Initial symptoms include nausea, vomiting, fever, and chills.
- Later symptoms include low blood pressure, abdominal pain, shock, and, finally, internal bleeding.

Recovery/Mortality Rate

- Death occurs rapidly if this form of plague is untreated.
- Even with treatment, the recovery rate is only 50 percent.

DIAGNOSIS

Plague can be difficult to diagnose because its initial symptoms are flu-like and the disease progresses so rapidly. Because it is contagious in the inhaled form, a bioterror attack involving plague could go undetected until large groups of people begin exhibiting symptoms.

- If bubonic plague is suspected, physicians check for the presence of a painful, swollen lymph node called a bubo, which occurs no more than 24 hours after initial symptoms.
- Blood cultures, a sputum sample, or examination of a lymph node sample can confirm plague.
- Physicians will ask for a travel history from the patient to see if he or she has traveled to a known outbreak area.

TREATMENT

Treatment of plague with antibiotics must begin immediately to be effective. Containing a plague outbreak involves isolation and other precautions so that plague does not quickly spread in communities and overwhelm the health care systems.

- Antibiotics, such as streptomycin, gentamicin, the tetracyclines, and chloramphenicol, are all effective against plague.
- Determining which antibiotic to prescribe depends on patient age, health, and availability of the drug, in addition to the number of cases in an area.
- Antibiotic treatment for pneumonic plague must begin within 24 hours after the first symptoms to be successful.
- Patients with pneumonic plague should be isolated.
- Antibiotics are recommended for people exposed to someone who has pneumonic plague.
- As a precaution, antibiotics may be administered to a person before plague is diagnosed.

VACCINE

- There is currently no licensed plague vaccine available in the United States.
- Clinical trials on a vaccine for pneumonic plague are underway. For more information, see NIAID's Web site (http://www2.niaid.nih.gov/biodefense).

PREVENTION

- Preventing plague starts with controlling flea and rat populations, the two known carriers of plague.
- Insect repellants should be used to prevent flea bites.
- People traveling to an outbreak area may be given a 3-week course of preventive antibiotics.

PLAGUE HISTORICAL TIMELINE

Middle Ages: Plague, sometimes called the "Black Death," kills millions in Europe; invading armies use plague corpses as weapons.

World War II: Japanese army drops plague-infected fleas over China; it is unclear how many people were infected.

Cold War: The United States and the Soviet Union study plague as a biological weapon; the Soviet Union learns ways to aerosolize plague.

1970: The United States suspends its program.

1972: At the Biological Weapons Convention, more than 100 nations agree not to produce or stockpile Weapons of Mass Destruction (including the United States).

Post-Cold War: Stockpiles of plague are unaccounted for in the former Soviet Union; laboratories around the world receive plague samples for study.

ASSESSING THE RISK

- Although plague bacteria are under study in many countries, safeguards in these labs would make a potent strain **minimally available** to terrorists.
- Plague is **moderately stable** in the environment. It can remain infectious for up to an hour after being released into the air, but the organism will break down more quickly if exposed to sunlight or heat.
- Terrorists would have to be **highly skilled** to refine plague into an aerosol attack.
- Plague is **highly lethal** even with treatment.

SMALLPOX

BASIC FACTS

- **Scientific name: Variola Major; a virus from the Orthopoxvirus family.**
  - **A closely related virus, Variola Minor, causes a less severe form of illness with less than 1 percent fatality rate.**
- **Smallpox was a naturally occurring disease that killed an estimated 300 million people in the 20th century.**
- **Officially eradicated in nature in 1980, smallpox has more recently been of concern as a potential bioterrorism threat.**
- **The smallpox virus is moderately contagious; direct, face-to-face contact is usually required to spread the disease. Smallpox can also be spread through direct contact with infected body fluids or contaminated objects (e.g., bedding).**
- **Characterized by skin lesions and high fever, smallpox historically has killed approximately 30 percent of those infected.**
- **Routine vaccinations in the United States ended in 1972. At present, a large portion of the population is considered vulnerable to infection should a bioterrorism incident occur.**

SMALLPOX AS A WEAPON

Because it is contagious from person to person and could potentially infect large groups of people, taxing the health care systems of a community, smallpox would be an attractive weapon for terrorists. It would most likely be delivered in an aerosol form.

- The smallpox virus could be disseminated into the air as a fine spray or powder and could infect large numbers of people.
- In aerosol form, the smallpox virus may be infectious for 24 hours before degrading. Heat and sunlight (UV exposure) may destroy the virus within hours.
- Terrorists could possibly use smallpox virus samples to intentionally infect a few people, possibly themselves, with the intention of infecting others. However, it is doubtful that any one individual would succeed in infecting more than a few others. By the time that these individuals were contagious, they would be very obviously seriously ill.

WHAT WE DON'T KNOW ABOUT SMALLPOX AS A WEAPON

Experts do not know if the smallpox virus in a weaponized form would be as contagious as the disease was before it was eradicated.

IDENTIFYING AN ATTACK

Because smallpox has been eradicated worldwide, even one case of smallpox would be considered a probable terrorist attack.

- The first sign of an attack would likely be victims becoming ill, usually between 7 to 17 days after exposure.
- A properly disseminated aerosol cloud of the smallpox virus would be invisible, odorless, and extremely hard to detect.

SMALLPOX ILLNESS

EXPOSURE

- The incubation period is typically 7–17 days following exposure.
- Infection usually occurs only when a susceptible person is in face-to-face contact with someone who has the virus and is ill with fever and a rash of round lesions.
- The virus is usually spread by droplets; however, having it spread by aerosol or contaminated objects (e.g., bedding) is also possible.
- Smallpox is not known to be transmitted by insects or animals.

SYMPTOMS

- Initial symptoms of smallpox may include high fever, fatigue, headache, and backache.
- Typically, people with smallpox are not contagious until lesions start appearing and they are obviously ill.
- **Two to 3 days after the onset of symptoms:** A rash of round lesions develops on the face, arms, and legs. At the same time, lesions in the mouth are also present and release large amounts of the virus into the saliva.

- **Seven days after the onset of symptoms:** The lesions become small blisters and by the seventh day are filled with pus.
- **Twelve days after the onset of symptoms:** Lesions begin to crust over. Severe abdominal pain and delirium can occur in the later stages of the disease.
- **Three to 4 weeks after the onset of symptoms:** Scabs develop and fall off. A patient who survives is no longer contagious after the final scab falls off.

RECOVERY/MORTALITY RATE

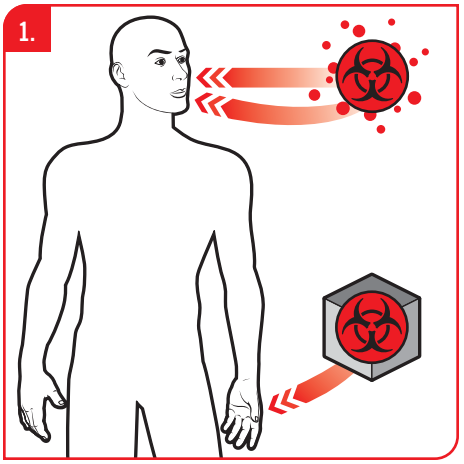
- Death is likely in one-third of all smallpox cases, usually during the first or second week of illness.
- Of those who recover, 65–85 percent are marked with deep-pitted scars.
- Some who recover may be permanently blind.

DIAGNOSIS

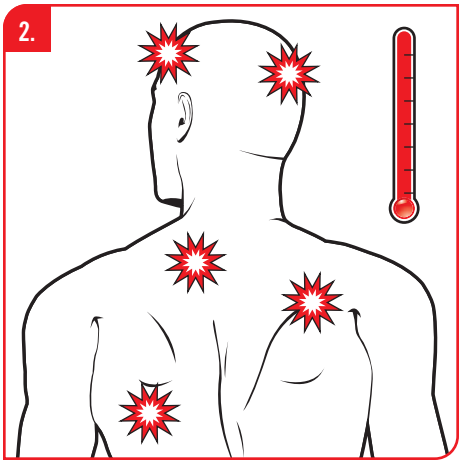
Physicians have not seen cases of smallpox for more than 2 decades, and making a diagnosis would require familiarity with the disease and its history. However, CDC has worked on educating first responders and emergency room personnel about the signs and symptoms of smallpox.

- Smallpox is most commonly identified by the distinctive rash it causes.
- The rash can sometimes be confused initially with chicken pox.
- The smallpox lesions are painful (as opposed to chicken pox lesions).
- The distribution of smallpox lesions on the body is different than chicken pox.

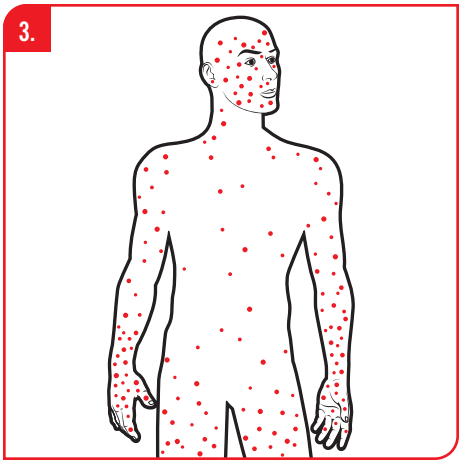
FIGURE 3–6: SMALLPOX



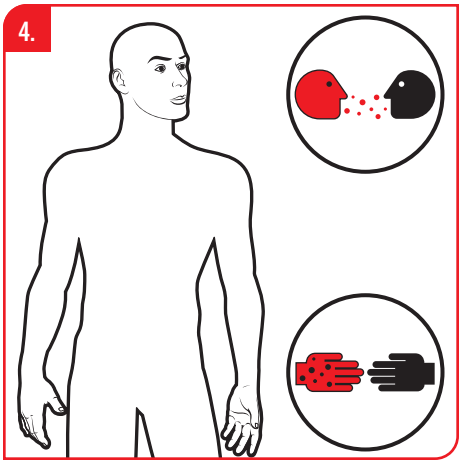
Smallpox virus inhaled or transmitted through contaminated objects.



Initial symptoms include headache, backache, and fever.



Severe rash starts on face, arms and legs, and spreads across the body.



Smallpox may be transmitted to others through bodily fluids (contagious).

- Patients with smallpox are typically much sicker.
- Testing of the fluid from the lesions can confirm smallpox.

TREATMENT

There is little that physicians can do, other than supportive care, to treat the illness itself; containing a smallpox outbreak becomes the priority once a case is suspected or confirmed. The public health community becomes involved to track down and vaccinate those who may have been exposed to an infected patient and their close contacts (e.g., family). Strict home or hospital isolation of cases is very important; close contacts must be kept under close daily surveillance and isolated if they develop fever.

- Antibiotics are not effective.
- There is no way to fight the virus once patients become sick.
- Patients with smallpox are isolated.
- Patients with smallpox may require intravenous (IV) fluids and medication to control fever or pain.
- Secondary bacterial infections of the skin sometimes occur. These can be treated with antibiotics.
- Research is currently underway on the use of the antiviral drug cidofovir as a treatment for smallpox.

VACCINE

After the September 11 attacks, fears that terrorists would use the smallpox virus as a biological weapon led to renewed vaccine production. There is now enough vaccine available in the Strategic National Stockpile for every American in case of an attack.

- The vaccine contains a live virus (vaccinia) which is related to the smallpox virus but entirely different from it; the vaccinia virus is weaker so that people produce antibodies but usually develop only the single pustule at the site of vaccination and, sometimes, a low grade fever.
- The vaccine provides a high level of immunity from infection for 3–5 years after vaccination and decreasing immunity thereafter. It is unclear how long the vaccine provides some protection against the disease. If a person is vaccinated again later, immunity lasts even longer.
- However, if a person actually has had smallpox and survives, he or she then has lifelong immunity.
- The vaccine prevents disease in 95 percent of those vaccinated.
- Given within 3 days after exposure to the smallpox virus, the vaccine will prevent or significantly modify smallpox in the majority of persons. Vaccination 4–7 days after exposure likely offers some protection from disease or may modify the severity of the disease.
- The smallpox vaccine is currently not administered to the general public because:
  - The likelihood of an attack is not known
  - Vaccination can result in complications for several well-defined, but specific, groups of people with skin conditions, such as eczema, as well as for people with HIV/AIDS and others with compromised immune systems
  - Pregnant women, infants under 1 year old, and those taking steroids could also suffer complications
  - Recent research indicates that people with certain heart conditions should not receive the vaccine (at least until further research is conducted)
- The vaccine is effective after one dose, so it could easily be given to many people if a smallpox event or outbreak takes place.
- Vaccination of only those people who might have been exposed to the smallpox virus and their contacts (ring vaccination) was used successfully in the past to eradicate smallpox. However, mass vaccination might be necessary in the aftermath of a terrorist attack. More information on vaccination strategies can be found in the "Planning for the Unthinkable: Preparation and Response in Public Health" section (see p. 5).

WHAT WE DON'T KNOW ABOUT THE SMALLPOX VACCINE

Experts do not know how many of those vaccinated or revaccinated for smallpox before 1972 can still get sick if exposed today.

PREVENTION

- Place smallpox patients in medical isolation so that they will not spread the virus.
- Take special precautions to ensure that all bedding and clothing of patients are cleaned using bleach and hot water.
- Clean contaminated surfaces with disinfectants, such as bleach or ammonia.
- Within 3 days, vaccinate people who have come into direct and prolonged face-to-face contact with smallpox patients. Closely watch them for symptoms of smallpox.
- In an aerosol release, widespread decontamination is not necessary, since the airborne virus rapidly blows away from the area and particles die on their own within 1–2 days.
- Physicians typically use a "ring vaccination" approach, vaccinating the circle of people who may have come in contact with a smallpox patient and the family contacts of this group of people in order to provide a ring of protection from further spread. This approach was successfully used in the past to control outbreaks until smallpox was finally eradicated.

SMALLPOX HISTORICAL TIMELINE

1700s: Smallpox is likely used as a biological weapon during the French and Indian War when British soldiers distributed blankets that had been used by smallpox patients to initiate outbreaks among American Indians.

1796: Edward Jenner uses the milder cowpox virus to develop a vaccine for smallpox.

1949: The last confirmed case of smallpox in the United States occurs.

1972:

- Routine smallpox vaccination ends in the United States.
- At the Biological Weapons Convention, more than 100 nations agree not to produce or stockpile Weapons of Mass Destruction (including the United States).

October 1977: An unvaccinated person in Somalia becomes the last documented naturally occurring case of smallpox in the world.

1980: The World Health Organization officially declares smallpox eradicated.

1989: Vaccination of U.S. military personnel is discontinued.

2002: Amid new fears of smallpox being used as a weapon, the Bush Administration announces a priority program to produce enough smallpox vaccine to assure its availability for every American. A voluntary program to vaccinate high risk health care workers is announced. More than 600,000 military personnel are vaccinated.

2003: Clinical trials are under way for a new vaccine; for more information, see NIAID's Web site (http://www2.niaid.nih.gov/biodefense).

ASSESSING THE RISK

- The smallpox virus has a **low availability,** as the only two confirmed repositories for the virus are in high containment laboratories in the United States and Russia. Still, there is concern that some countries may have secretly retained their smallpox samples for bioweapons research and production.
- The smallpox virus is **highly stable** (can survive for 1–2 days) in aerosol form.
- Terrorists would have to be **moderately skilled** to produce the smallpox virus in aerosol form if they could acquire the virus.
- Smallpox is **highly lethal** because it kills approximately 30 percent of those infected; it is quite contagious and spreads from person to person.

TULAREMIA

BASIC FACTS

- **Scientific name: *Francisella tularensis*; a bacterium (not a virus).**
- **Tularemia is the disease caused by this bacterium; it is also known as Rabbit Fever or Deer Fly Fever.**
- **Tularemia spreads to humans from infected animal tissue.**
- **The disease can be spread through contaminated food and water.**
- **Tularemia is not contagious.**
- **A small amount of the bacteria can cause the disease.**
- **There are three types of tularemia:**
  - **Ulceroglandular**
  - **Inhalational**
  - **Typhoidal**

TULAREMIA AS A WEAPON

Weaponized tularemia bacteria would most likely be disseminated through the air. But terrorists could also use the bacteria to contaminate food or water.

- If released into the air, *F. tularensis* can remain potent for up to 2 hours.
- The bacteria can survive at low temperatures in water, soil, hay, or frozen animal carcasses.
- The bacteria quickly degrade in heat once released in the air.

WHAT WE DON'T KNOW ABOUT TULAREMIA AS A WEAPON

Experts are not sure exactly how small an amount of bacteria is needed to cause infection. According to CDC, as few as 10–50 bacteria could cause disease.

IDENTIFYING AN ATTACK

- An attack may go undetected until people start getting sick.
- Testing of powder or residue can confirm the presence of tularemia bacteria.
- Environmental monitoring of air and water samples can detect the presence of tularemia bacteria.

TULAREMIA ILLNESSES

The tularemia infection takes several forms, depending on the strength of the bacteria and how they enter the body.

ULCEROGLANDULAR

Exposure

- People can contract this disease from the bite of an infected tick or fly.
- People can also contract this disease when an open wound comes in contact with infected meat.

Symptoms

- Symptoms typically appear between 3 to 5 days, but sometimes as late as 14 days after exposure.
- Skin ulcers appear at the infection site.
- Lymph nodes in the area become swollen.

Recovery/Mortality Rate

- The disease is treatable with antibiotics.
- With treatment, fewer than 2 percent of victims die from this form of tularemia.

INHALATIONAL

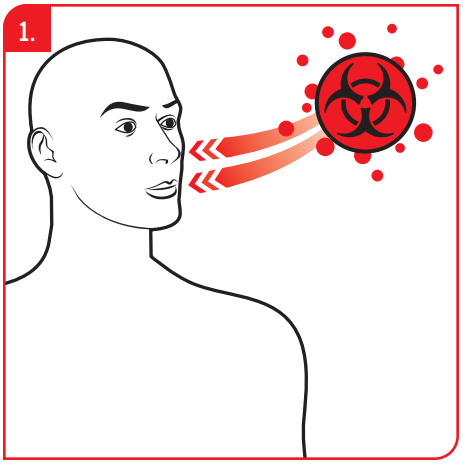
Exposure

The disease is contracted by inhaling the bacteria.

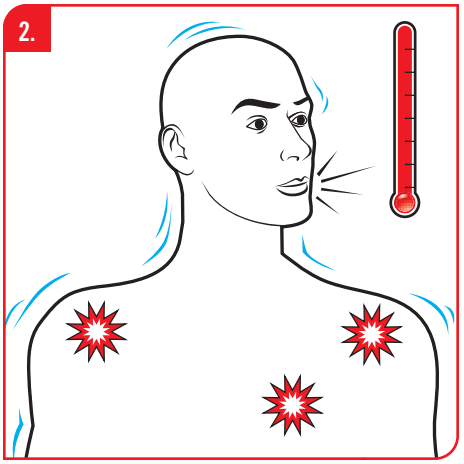
Symptoms

- Symptoms typically appear within 3–5 days but sometimes as late as 14 days after exposure.
- Early symptoms include sudden fever, chills, coughing, joint pain, weakness, and headaches, similar to the flu.
- Later symptoms include inflamed eyes, oral ulcers, severe pneumonia, chest pain, and respiratory failure.

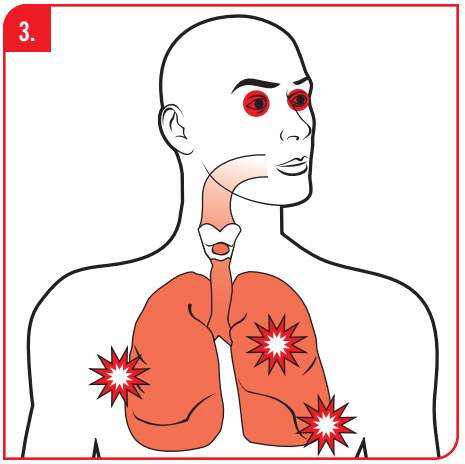
FIGURE 3–7: INHALATIONAL TULAREMIA



Tularemia bacteria inhaled.



Initial symptoms include sudden fever, chills, coughing, and aches.



Later symptoms include inflammation of the eyes, pneumonia, and chest pain.

Recovery/Mortality Rate

- This form of the disease is treatable by antibiotics.
- Inhalational tularemia has a 60 percent fatality rate if untreated.

TYPHOIDAL

Exposure

This is a secondary form of tularemia that develops after a victim has contracted inhalational tularemia.

Symptoms

- This form of tularemia attacks the circulatory system as well as the respiratory system.
- Symptoms include fever, extreme exhaustion, and weight loss.

Recovery/Mortality Rate

- This form of tularemia is treatable with antibiotics.
- The recovery rate is similar to that for inhalational tularemia.

DIAGNOSIS

All forms of tularemia are difficult to diagnose because early symptoms resemble those of the cold and flu.

- A rapid diagnostic test for tularemia does not exist.
- A chest X-ray may confirm inhalational tularemia.
- Blood tests can confirm the presence of tularemia bacteria.

TREATMENT

- All forms of tularemia can be successfully treated with antibiotics, including streptomycin, gentamicin, or doxycycline.
- The choice of antibiotics is determined by the patient's age and health and the availability of the drug when weighed against the number of cases in an area.
- Physicians prefer the injection of antibiotics for more effective results.

VACCINE

- An investigational vaccine for tularemia was developed but is currently unavailable. When it was in use, it was in limited distribution, mainly to lab workers.
- The vaccine is not useful for people who have already been exposed to tularemia.
- The current vaccine does not fully protect against inhalational tularemia.
- Research continues on a next-generation vaccine for inhalational tularemia; for more information, see NIAID's Web site (http://www2.niaid.nih.gov/biodefense).

PREVENTION

- Avoid contact with dead animals that may be infected.
- Decontaminate yourself with soap and water if you have come into contact with the bacteria.
- Decontaminate surfaces using solutions that are a combination of bleach and alcohol.

TULAREMIA HISTORICAL TIMELINE

1940s: The United States, the Soviet Union, and Japan study tularemia as a biological weapon.

1970s: Reports indicate that Soviets develop strain of tularemia resistant to antibiotics.

1972: At the Biological Weapons Convention, more than 100 nations agree not to produce or stockpile Weapons of Mass Destruction (including the United States).

1990s: Mass quantities produced by the Soviet Union in biowarfare program remain unaccounted for.

Summer 2000: An outbreak of pneumonic tularemia occurs on Martha's Vineyard, linked to brush and lawn cutting; 15 patients are successfully treated.

ASSESSING THE RISK

- Although the disease can occur naturally, it is rare, so the bacteria are only **moderately available.**
- Tularemia bacteria are **minimally stable,** since even moderate heat and disinfectants can kill the organism.
- Terrorists would have to be **highly skilled** to use tularemia in an attack because the bacteria are difficult to process and stabilize into a form that can do great harm. A waterborne attack would require too great of an amount of the bacteria to poison the water, since chlorine added to most drinking water would kill the bacteria.
- When treated with antibiotics, tularemia has a **low lethality.**

EXAMINING TULAREMIA—IS IT TERRORISM OR A NATURALLY OCCURRING DISEASE?

Whenever a case of an illness caused by a potential bioterrorism agent occurs, the media will ask, "Is this terrorism?" CDC's disease detectives, or epidemiologists, will also ask that question and will use what we know about these illnesses, and what we know about the new cases, to help answer the question. Since many of the Category A and B agents exist naturally in the United States, it is important to look closely at individual cases and outbreaks before jumping to any conclusions. Tularemia—a disease which has been reported in every state except Hawaii—is an example.

During 1990–2000, a total of 1,368 cases of tularemia were reported to CDC from 44 states, averaging 124 cases per year. Although cases have appeared nationwide, four states accounted for 56 percent of all reported tularemia cases: Arkansas, Missouri, South Dakota, and Oklahoma.

In the United States, most persons with tularemia acquire the infection from arthropod bites, particularly tick and deerfly bites, or from contact with infected mammals, particularly rabbits. Fifty years ago, most cases occurred during winter and were often related to rabbit hunting. Now, most cases occur in the late spring and summer months, when tick bites are most common. Outbreaks of tularemia in the United States have also been associated with muskrat handling, deerfly bites, and lawnmowing or cutting brush.

Although tularemia does occur in the United States, it is a rare disease, so every case will be carefully observed. To answer the question "Terrorism or nature?," epidemiologists will ask whether the case and patients follow the familiar patterns of the past. For example:

- Is the case in an area of the country where we usually see tularemia?
- Has the patient had contact with animals or been bitten by a tick or other arthropod?
- Is this a time of year when we usually see tularemia in that geographic area?

The CDC's National Notifiable Diseases Surveillance System is used to track data on cases of various diseases, including tularemia. From these types of data, baseline patterns emerge for comparison purposes. Outbreaks that do not fit the usual pattern may raise red flags. For example, if cases occur in a person with no known risk factors, there is an unusual pattern of symptoms, or a cluster of cases is seen in an unusual area of the country, such as a major metropolitan area, then concern about possible terrorism would be higher. A case of pneumonic tularemia, particularly in low-incidence areas, would also be of concern.

Sources:

Centers for Disease Control and Prevention. (2002). Tularemia—United States, 1990–2000. Morbidity and Mortality Weekly Report, 51(9), 182–184. http://www.cdc.gov/mmwr/preview/mmwrhtml/mm5109a1.htm.

Centers for Disease Control and Prevention. (2003). Endemic, notifiable bioterrorism-related diseases, United States, 1992–1999. Emerging Infectious Diseases, 9(5). http://www.cdc.gov/ncidod/eid/vol9no5/02-0477.htm.

VIRAL HEMORRHAGIC FEVERS (VHFs)

BASIC FACTS

Viral hemorrhagic fevers (VHFs) are a class of diseases, contracted from viruses, that include:

- **Ebola**
- **Marburg virus**
- **Other illnesses (e.g., Lassa, Machupo)**

The following are general characteristics of VHFs:

- **They are naturally occurring in mosquitoes, ticks, rodents, and other animals**
- **They cause massive internal and external bleeding**
- **The fatality rate can be as high as 90 percent**
- **With the exception of yellow fever and Argentine hemorrhagic fever, for which vaccines have been developed, no vaccines exists that can protect against these diseases**
- **No drugs are available to combat the viruses that cause VHFs**

VHFs AS A WEAPON

- In aerosol form, any of these viruses could be highly lethal.
- Soviet scientists are known to have weaponized the Marburg virus, a close cousin of Ebola.
- Many other VHFs have potential for aerosol dissemination or weaponization.

IDENTIFYING AN ATTACK

- Evidence of an attack would most likely come when patients fall ill.
- Because natural outbreaks of VHFs have been known to occur, investigators would have to rule out nonterrorist causes.

VHF ILLNESSES

EBOLA

Of all the VHFs, Ebola is probably the best known due to outbreaks in Africa.

Exposure

- Ebola can be passed to humans through infected animals.
- Once a person becomes ill, the virus can be transmitted to others through exposure to blood or bodily fluids, including airborne droplets from coughing.
- Outbreaks most often occur in areas where isolation of patients is difficult.

Symptoms

- Patients usually become sick 4–6 days after exposure.
- The disease attacks blood vessels and organs, particularly the liver, spleen, and kidneys, causing heavy bleeding.
- Symptoms include fever, vomiting, diarrhea, and heavy bleeding from multiple sites.

Recovery/Mortality Rate

- The fatality rates range from 50–90 percent.
- Death usually occurs within 1–2 weeks of falling ill, most often from shock and blood loss.

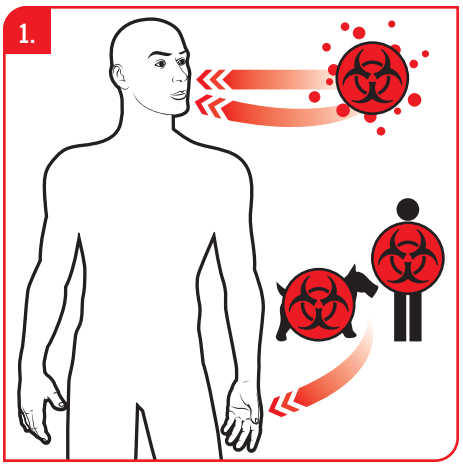
DIAGNOSIS

- Specific laboratory tests do exist to detect the virus in a blood sample.
- The handling of the virus is a biohazard, so tests need to be performed in a biosafety level 4 laboratory.
- Diagnosis is usually made by monitoring symptoms and by tracking a patient's exposure to the virus.

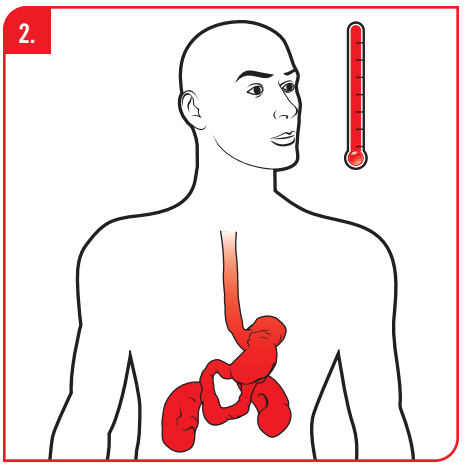
TREATMENT

Physicians treat the patient with fluids to prevent dehydration and try to control bleeding.

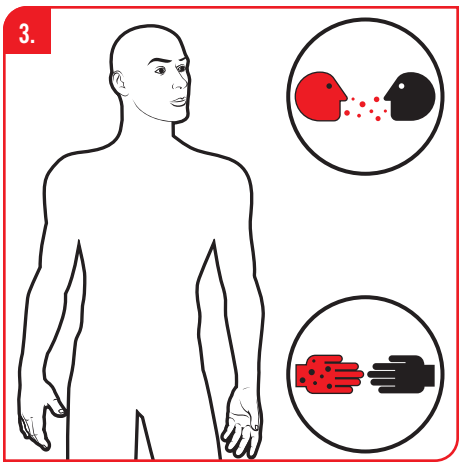
FIGURE 3–8: EBOLA



Ebola virus inhaled or transmitted through bodily fluids from an infected person or animal.



Symptoms include fever, vomiting, diarrhea, and heavy bleeding.



Ebola may be transmitted to others through bodily fluids (contagious).

VACCINE

- No vaccine currently exists for most VHFs.
- Research continues on a possible vaccine and antiviral drug treatments; for more information on clinical trials, see NIAID's Web site (http://www2.niaid.nih.gov/biodefense).
- Even under lab conditions, the virus is contagious, complicating vaccine research.

PREVENTION

Due to the contagious nature of Ebola, quick identification and isolation of victims is essential to containing the spread of it and other VHF diseases. While considered highly contagious, Ebola is spread only by direct contact with patients and their bodily fluids.

- Avoid infected animals or people.
- Isolate and monitor patients and people who have had close physical contact with patients.
- Hospital workers and caregivers must wear gowns, gloves, and masks and practice extreme caution while treating patients.
- Promptly bury or cremate patients who die from the disease because a corpse can be infectious for a period of time after death.

WHAT WE DON'T KNOW ABOUT EBOLA PREVENTION

- It is not known how long a person can remain contagious after recovering.
- Some research suggests that those patients who survive can continue to pass the disease to others through sexual contact for up to 7 weeks.

VHF HISTORICAL TIMELINE

1967: The Marburg virus is first recognized in laboratory workers in Marburg, Germany, and Belgrade, Yugoslavia; the workers had been exposed to tissues and blood from African green monkeys imported from Uganda.

1972: At the Biological Weapons Convention, more than 100 nations agree not to produce or stockpile Weapons of Mass Destruction (including the United States).

1976: The Ebola virus first emerges in two major disease outbreaks occurring almost simultaneously in Zaire and Sudan; more than 500 cases are reported, with a mortality rate of 80 percent.

1980s: Soviets weaponize the Marburg virus as an airborne powder and experiment on blending Ebola with smallpox.

1989: Monkeys imported from Africa to Reston, Virginia, test positive for Ebola, prompting an outbreak scare chronicled in the book "The Hot Zone."

1992: Japanese cult Aum Shinrikyo makes an unsuccessful attempt to obtain Ebola in Zaire.

1995: Ebola breaks out in Zaire, killing 244 of the 315 people infected.

1996: Ebola first surfaces in Gabon in the form of two outbreaks in February and July.

2000: Ebola outbreak in northern Uganda kills 173 people.

2001: Ebola kills 53 people in Gabon.

2004: A Russian scientist at a former Soviet biological weapons laboratory in Siberia dies after accidentally pricking herself with a needle laced with Ebola (showing how dangerous VHFs can be, even under lab conditions).

2005: Marburg outbreak confirmed in Angola, Africa.

ASSESSING THE RISK

- The ingredients to weaponize VHFs are **moderately available,** since naturally occurring outbreaks of Ebola could become a source for a terrorist organization. Some less virulent VHF viruses can be obtained from animals.
- VHFs are generally **minimally stable,** and few can be produced in aerosol form for widespread release.
- Terrorists would have to be **highly skilled** to weaponize VHFs since they are extremely dangerous to work with, even in the lab.
- VHFs are **highly lethal,** especially because there are no known vaccines or treatments to protect against most of them.

CATEGORY B AGENTS

Category B agents are defined by CDC as "second highest priority." Although these agents are fairly easy to disseminate, they generally cause moderate illness and low death rates. In most cases, scientists have experience with Category B agents as naturally occurring infectious diseases but do not know much about how they could be used as weapons by terrorists. Examples of Category B agents include *Salmonella*, *E. coli* O157:H7, Staphylococcus enterotoxin B, and ricin. Ricin is perhaps best known because it was sent through the mail to U.S. Senate office buildings in early 2004.

Basic facts and scientific information for Category B agents are provided; agents are treated alphabetically. Some categories of detail that appear in the Category A agents section do not appear here because the information available on some of these agents is limited.

B

BRUCELLOSIS

BASIC FACTS

- **Brucellosis is an infectious disease caused by the bacteria *Brucella* species (not a virus).**
- **These bacteria are mainly transmitted among animals (sheep, goats, cattle, deer, elk, pigs, dogs, and several others).**
- **Humans can contract brucellosis by coming into contact with infected animals (and unpasteurized milk from infected animals).**
- **Brucellosis is not very common in the United States.**
- **It is more common in countries where animal disease is high.**

BRUCELLOSIS AS A WEAPON

Scientists expect that terrorists would refine brucellosis into aerosol form for an open-air release.

WHAT WE DON'T KNOW ABOUT BRUCELLOSIS AS A WEAPON

Scientists are not sure if the bacteria that cause brucellosis can be aerosolized into a form that can cause mass casualties in an open-air or closed environment release.

BRUCELLOSIS ILLNESS

EXPOSURE

Humans can be infected three ways:

- Eating or drinking something contaminated with brucellosis (most common)
- Inhaling the organism (most common in laboratories or in a biological attack)
- Having the bacteria enter the body through open wounds

SYMPTOMS

- Human brucellosis symptoms include flu-like symptoms, including fever, sweats, headaches, back pains, and physical weakness.
- Severe infections to the central nervous system or lining of the heart can occur.
- Chronic or long-lasting symptoms may include recurrent fevers, joint pain, and fatigue.

RECOVERY/MORTALITY RATE

Recovery can vary from a few weeks to several months, depending on the timing of treatment and severity of the illness.

DIAGNOSIS

- Laboratory blood or bone marrow testing can detect *Brucella* organisms.
- A blood test can also be used to detect antibodies against the bacteria. This method requires that two blood samples be taken 2 weeks apart.

TREATMENT

The antibiotics doxycycline and rifampin are usually used in combination for 6 weeks to prevent reoccurring infection.

VACCINE

- Vaccines are available for the animal forms of brucellosis.
- There is no vaccine available for humans.

PREVENTION

- If food products have not been pasteurized, they should not be eaten.
- When handling animal carcasses, rubber gloves should be worn.

EPSILON TOXIN

BASIC FACTS

- **Epsilon toxin is produced by the bacteria *Clostridium perfringens* (not a virus).**
- **This toxin is a common cause of foodborne illness attributed to improper cooking, cooling, or holding of beef or chicken.**

EPSILON TOXIN AS A WEAPON

Could be used to contaminate the food supply, but this is not a toxin that could cause mass casualties.

WHAT WE DON'T KNOW ABOUT EPSILON TOXIN AS A WEAPON

Scientists do not know what concentrations would be needed to cause severe illness if this toxin were put into the food supply.

EPSILON TOXIN ILLNESS

EXPOSURE

People would most likely be exposed by eating tainted foods.

SYMPTOMS

Symptoms of the illness caused by epsilon toxin include severe stomach pain, diarrhea, nausea, and vomiting.

RECOVERY/MORTALITY RATE

- Most people recover within days with or without treatment.
- The illness from epsilon toxin can be fatal in some cases—for the elderly and those with compromised immune systems.

DIAGNOSIS

- Blood tests are used to determine the presence of the toxin.
- A stool sample test may help physicians make a diagnosis.

TREATMENT

The patient is given fluids to prevent dehydration.

FOOD SAFETY THREATS

OVERVIEW

There are a variety of bacteria that can affect food safety. Harnessed by terrorists, these could be used to poison the food supply and cause illness and death. Three examples are:

- ***E. coli* O157:H7**
- ***Salmonella***
- ***Shigella***

ESCHERICHIA COLI O157:H7 BASIC FACTS

- ***E. coli* O157:H7 is one of hundreds of strains of the bacteria *Escherichia coli* (not a virus).**
- **Most strains of *E. coli* are harmless and are found in healthy humans.**
- ***E. coli* O157:H7 is the most toxic of the strains and can cause severe illness and, in some cases, death.**

E. COLI ILLNESSES

EXPOSURE

- Eating raw or undercooked meat contaminated with *E. coli* O157:H7, especially ground beef, can expose a person to the bacteria.
- The bacteria can be passed by cows to milk and then to humans if the milk is not pasteurized.
- Eating contaminated raw vegetables, unpasteurized milk and juice, and swimming in or drinking sewage-contaminated water can also infect a person.
- *E. coli* O157:H7 can spread if an infected person does not wash his or her hands properly.

SYMPTOMS

- Symptoms appear from hours to days after exposure.
- The infection causes severely bloody diarrhea and abdominal cramps.
- A slight fever may be present.
- In young children under age 5 and the elderly, severe cases of O157:H7 may result in kidney failure. About 2–7 percent of infections lead to this complication.

RECOVERY/MORTALITY RATE

Most cases recover without antibiotics or other treatment in 5–10 days.

DIAGNOSIS

- *E. coli* O157:H7 can be diagnosed by testing a stool sample.
- Any person who suddenly has bloody diarrhea should seek medical attention.

TREATMENT

- Most cases of *E. coli* food poisoning are not O157:H7 and require no medical treatment.
- There is no evidence that antibiotics improve the course of this disease.
- Patients should not use over-the-counter medicines to combat diarrhea because diarrhea expels the bacteria from the body. However, replacing fluids to prevent dehydration is very important.
- Blood transfusions and kidney dialysis are required in the most severe cases of O157:H7.

VACCINE

There is no vaccine at this time.

PREVENTION

- Cook all ground beef and hamburger to an internal temperature of 160 degrees Fahrenheit.
- Keep raw meat away from ready-to-eat foods.
- Always wash hands, counters, and utensils that have touched raw meat.
- Wash raw produce under running water.
- Drink water that has been treated with chlorine or other disinfectants.
- Avoid swallowing lake or pool water while swimming.
- Wash hands to prevent the spread of the disease.
- People with diarrhea should avoid swimming in public pools or lakes, sharing baths, and preparing food for others.

SALMONELLOSIS BASIC FACTS

- **Salmonellosis is an infection from the bacteria called *Salmonella* (not a virus).**
- **There are many different types of *Salmonella* bacteria.**

SALMONELLOSIS AS A WEAPON

- An attack would be carried out by using the bacteria to contaminate the food supply.
- An attack would be identifiable if large numbers of people began getting sick.

SALMONELLOSIS ILLNESS

EXPOSURE

- Salmonellosis is usually spread to humans by eating foods contaminated with animal feces that contain the bacteria.
- Contaminated food usually looks and smells normal.
- Contaminated food is often meat, such as beef and poultry, or milk or eggs, but any food can be contaminated.

SYMPTOMS

- Symptoms usually develop 12–72 hours after infection.
- Symptoms include diarrhea, fever, and abdominal cramps.

RECOVERY/MORTALITY RATE

- Most people recover.
- This illness can be dangerous for the elderly and young children and those with compromised immune systems.

DIAGNOSIS

- A stool sample test can be used to detect salmonellosis (as with other bacterial infections).
- Once the test confirms salmonellosis, another test should be conducted to identify the type of salmonellosis.

TREATMENT

- Patients are given intravenous (IV) fluids in extreme cases to prevent dehydration.
- If the infection has spread from the intestines to other parts of the body, the patient may be prescribed antibiotics, such as ampicillin; gentamicin; trimethoprim/sulfamethoxazole (TMP–SMX), an antibiotic commonly known by the brand names of Bactrim™ and Septra™; or ciprofloxacin.
- Once the type of salmonellosis has been identified, the doctor can prescribe the appropriate antibiotic.

VACCINE

There is no vaccine at this time.

PREVENTION

- Avoid eating raw or undercooked eggs, poultry, or beef.
- Cook poultry and beef to an internal temperature of 160 degrees Fahrenheit.
- Avoid eating or drinking unpasteurized dairy products.
- Thoroughly wash produce.
- Always wash hands, counters, and utensils that have touched raw meat.

SHIGELLOSIS BASIC FACTS

- **Shigellosis is an infection caused by the bacteria Shigella (not a virus).**
- ***Shigella* is present in the diarrheal stools of infected persons.**

SHIGELLA AS A WEAPON

The bacteria would be used to infect food or water.

SHIGELLOSIS ILLNESS

EXPOSURE

- *Shigella* is ingested or enters the body through an open wound.
- Most *Shigella* infections are the result of the bacterium passing from stools or soiled fingers of one person to the mouth of another person (i.e., if someone does not wash his or her hands properly after a bowel movement and handles food).
- Flies can breed in infected feces and thus spread contamination to food.
- People swimming in water contaminated by sewage runoff or by a sick person can be exposed to the bacteria.

SYMPTOMS

- Symptoms usually occur 1–2 days after a person is exposed to the bacteria.
- Symptoms include diarrhea (often bloody), fever, and stomach cramps.
- A severe infection may include high fever and children younger than 2 years old may experience seizures.
- In some cases, an infected person may experience no symptoms but he or she can still spread the bacteria to others (see "Exposure" section above).

RECOVERY/MORTALITY RATE

Shigellosis usually resolves in 5–7 days.

DIAGNOSIS

- A stool sample test can detect the presence of the bacteria.
- Another stool test can identify the type of strain so appropriate medication can be prescribed.

TREATMENT

- A patient is given plenty of fluids to prevent dehydration. In severe cases, treatment is administered in the hospital.
- The following antibiotics are commonly used to treat shigellosis: ampicillin; trimethoprim/sulfamethoxazole (TMP–SMX), an antibiotic commonly known by the brand names of Bactrim™ and Septra™; nalidixic acid; or ciprofloxacin.
- Medicine to control diarrhea can make the illness worse.

VACCINE

There is no vaccine at this time.

PREVENTION

- Wash hands with warm water and soap for at least 15 seconds to stop the spread of shigellosis.
- Regularly disinfect diaper changing areas used for an infected child.
- Put diapers of an infected child in a closed-lid garbage can.

GLANDERS

BASIC FACTS

- **Glanders is the disease caused by the bacterium *Burkholderia mallei* (not a virus).**
- **Glanders primarily affects horses, mules, and donkeys but can infect humans.**
- **Glanders is stable in the environment.**
- **Glanders is an extremely rare disease.**

GLANDERS AS A WEAPON

- The bacteria are highly lethal in aerosol form.
- Only a few particles of the bacteria can make someone sick.
- The Germans used glanders in World War I against attacking cavalry.
- Soviet bioscientists experimented with the bacteria.

WHAT WE DON'T KNOW ABOUT GLANDERS AS A WEAPON

- Scientists know the bacteria that cause glanders can be put in aerosol form but are not sure how long they would survive in an outdoor release.
- Scientists do not know how long the bacteria would be infectious in an indoor release.

GLANDERS ILLNESS

EXPOSURE

- People are exposed by breathing in an aerosolized form of the bacteria.
- The bacteria can also enter the body through an open cut.
- Glanders can be passed from person to person but is not considered highly contagious.
- Because the disease is so rare, scientists are not sure how close the person-to-person contact needs to be to spread the disease.

SYMPTOMS

- Symptoms begin 1–4 days after exposure.
- Symptoms include fever, headaches, muscle tightness, and chest pain.
- Symptoms progress to swollen lymph nodes, watery eyes, and sensitivity to light.
- If the bacteria enter the body through a cut, a pustular lesion appears in 1–5 days.
- In severe cases, pneumonia develops.

RECOVERY/MORTALITY RATE

Glanders is highly lethal, killing 50 percent of those exposed.

DIAGNOSIS

- Symptoms of glanders resemble those for a cold or the flu.
- There is no single test to confirm glanders.

TREATMENT

- Glanders is treated with amoxicillin; tetracycline; and trimethoprim/sulfamethoxazole (TMP–SMX), an antibiotic commonly known by the brand names of Bactrim™ and Septra.™
- Even with treatment, the mortality rate is high (roughly 50 percent).
- No vaccine is available at this time.

MELIOIDOSIS

BASIC FACTS

- **Melioidosis is an uncommon disease caused by the bacterium *Burkholderia* (not a virus).**
- **Melioidosis is also called Whitmore disease.**
- **There is no evidence that melioidosis is contagious.**

MELIOIDOSIS AS A WEAPON

- These bacteria would be most effective in aerosol form.
- The bacteria could also be used to poison the food or water supply.
- The bacteria are found naturally in soil and water.

WHAT WE DON'T KNOW ABOUT MELIOIDOSIS AS A WEAPON

- Scientists are not sure if any countries have experimented with melioidosis as a biological weapon.
- Scientists are not sure how an aerosol version of the bacteria might affect the population.
- Scientists are not sure if a waterborne attack can be prevented by chlorination in the water or what amounts would have an impact.

MELIOIDOSIS ILLNESS

EXPOSURE

Victims breathe in or ingest the bacteria.

SYMPTOMS

- Symptoms of melioidosis include dry cough, fever, and pneumonia.
- Later symptoms can include a fatal blood infection (septicemia).

RECOVERY/MORTALITY RATE

With treatment, patients can recover but some can suffer from the after effects of the illness for up to 25 years after exposure.

DIAGNOSIS

- Blood tests can eventually confirm melioidosis.
- Physicians may suspect melioidosis if the patient has traveled to or lived in southeast Asia.

TREATMENT

- The most effective treatment for melioidosis is trimethoprim/sulfamethoxazole (TMP–SMX), an antibiotic commonly known by the brand names of Bactrim™ and Septra.™
- The antibiotics gentamicin and amoxicillin are also prescribed to treat melioidosis.
- There is no vaccine for melioidosis.

PSITTACOSIS

BASIC FACTS

- **Psittacosis is a disease caused by the microorganism *Chlamydia psittaci* (not a virus)—different from the Chlamydia species causing sexually transmitted disease.**
- **It is transmitted to humans from birds.**
- **It is most commonly referred to as parrot fever.**
- **Human-to-human transmission is rare.**

PSITTACOSIS AS A WEAPON

- There is no evidence that countries with biological weapons programs have experimented with psittacosis in an aerosol form.
- In most cases, this disease is not fatal.

WHAT WE DON'T KNOW ABOUT PSITTACOSIS AS A WEAPON

- Scientists do not know if an outbreak of this illness could be engineered by terrorists.
- Scientists do not know if a more potent strain has been harnessed to be effective as a bioweapon.

PSITTACOSIS ILLNESS

EXPOSURE

- People are exposed by inhaling respiratory secretions or dust from dried droppings of infected birds.
- This disease is most common in pet shops, on farms, or at slaughterhouses.
- People can be exposed by having an infected bird as a pet.

SYMPTOMS

- Symptoms can appear from 5 to 28 days after exposure.
- Most symptoms appear 10 days after exposure.
- Symptoms include fever, headache, chills, and muscle aches.
- In severe cases, a patient develops pneumonia.

RECOVERY/MORTALITY RATE

- The disease is usually mild in humans.
- The disease can be more severe in those with diabetes.
- The disease can be fatal in elderly people who do not receive treatment.

DIAGNOSIS

- The disease is difficult to diagnose because it resembles the flu.
- The diagnosis is most often confirmed by testing for antibodies.

TREATMENT

- Physicians should ask for a travel history and about exposure to pet birds.
- Tetracycline or doxycycline are the preferred antibiotics.

PREVENTION

- Identifying and isolating an exposed bird is the key to containment.
- Treatment of infected birds should be supervised by a veterinarian.
- Strict import and quarantine laws keep rare birds in isolation so they cannot infect humans.

Q FEVER

BASIC FACTS

- **Q fever is a disease caused by the bacteria *Coxiella burnetti* (not a virus).**
- **The bacteria are resistant to heat and many common disinfectants.**
- **The bacteria can survive for long periods of time in the environment.**
- **Farm mammals, such as sheep, goats, and cattle, are carriers of the bacteria that cause the Q fever illness. The bacteria are present in urine, feces, and milk and are shed in high numbers from amniotic fluid and placental tissue during birthing.**

Q FEVER AS A WEAPON

- This is a highly infectious disease.
- Inhaled, the bacteria can be very dangerous to humans.
- One single organism can cause illness.
- It is possible to produce this in aerosol form for an airborne release.
- These bacteria are less likely to be used to infect the food or water systems.

WHAT WE DON'T KNOW ABOUT Q FEVER AS A WEAPON

Scientists are not sure how effective a foodborne release would be or what quantities would be required for such a release to be effective.

Q FEVER ILLNESS

EXPOSURE

- Humans are exposed by inhaling infected barnyard dust.
- People can be exposed during the birth of an animal.
- People can also be exposed by drinking contaminated milk.
- Sometimes infected ticks carry the bacteria and can transmit the bacteria to humans, but ticks are not the principle means of infection.

SYMPTOMS

- Symptoms occur 2–3 weeks after exposure.
- Symptoms include high fever (104–105 degrees Fahrenheit).
- Symptoms also include sore throat, headache, chills, general aches, and sweats (similar to flu symptoms).
- Later symptoms may include diarrhea, vomiting, and chest pain.

RECOVERY/MORTALITY RATE

- The fever normally lasts up to 2 weeks.
- During this time, there is weight loss.
- Without treatment, only 1–2 percent of those infected die.
- Most people recover in several months.
- Complications include hepatitis and an inflammation around the heart.
- A chronic form of the disease can last as long as 20 years after the initial infection. Chronic Q fever affects the heart and is often fatal; it most often strikes those with preexisting heart valve disease or a history of bypass surgery.
- Once a person has Q fever, he or she may maintain lifelong immunity.

DIAGNOSIS

- There is no single test to diagnose Q fever.
- Doctors analyze blood tests to isolate the bacteria, their DNA, or antibodies indicating an infection.

TREATMENT

- Doxycycline is the antibiotic of choice to treat acute Q fever.
- Chronic Q fever typically requires multiple antibiotics given over a prolonged period of time.
- The antibiotic is most effective when given within 3 days of the first symptoms and for 21 days thereafter.

VACCINE

A vaccine is in limited use for researchers working with animals but it is not currently available in the United States.

PREVENTION

- Pasteurization of milk minimizes the risk of Q fever.
- Animal testing and quarantine can prevent transmission to humans.

RICIN TOXIN

BASIC FACTS

- **Scientific name: *Ricinus communis;* a biological toxin.**
- **Ricin can be made from the waste left over from processing castor beans.**
- **Ricin can take powder, mist, or pellet form, or it can be dissolved in water.**
- **Ricin has some potential medical uses, such as in bone marrow transplants and cancer treatment.**
- **The illness resulting from ricin poisoning is not contagious.**

Note: Ricin is classified by CDC as both a chemical and a biological agent because it is a chemical toxin but has a biological source (unlike other chemical agents, such as sarin).

RICIN TOXIN AS A WEAPON

- Ricin can be processed into a powder that could then be aerosolized.
- People would become sick after breathing in the substance.
- Pellets of ricin or ricin dissolved in a liquid can be injected into people's bodies.
- Ricin can also contaminate water or food and then be swallowed.

WHAT WE DON'T KNOW ABOUT RICIN TOXIN AS A WEAPON

Scientists are not sure how much ricin is needed in an aerosol release to cause mass casualties or how long it remains viable in the environment.

IDENTIFYING AN ATTACK

- Almost any ricin illness would be considered an attack, since accidental ricin poisoning is extremely unlikely.
- Evidence of an attack would be numerous cases of illness by people who have been in the same location or attended the same event.

RICIN TOXIN ILLNESS

Ricin works by getting inside the cells of a person's body and preventing the cells from making the proteins they need. Without the proteins, cells die. Eventually this is harmful to the whole body, and death may occur.

EXPOSURE

Ricin can be inhaled, ingested, or injected.

SYMPTOMS

Inhalation

- Initial symptoms occur within 8 hours of exposure and include difficulty breathing, fever, cough, nausea, and tightness in the chest.
- Later symptoms include heavy sweating and fluid buildup in the lungs (making breathing even more difficult), and the skin might turn blue. Low blood pressure and respiratory failure may result, leading to death.

Ingestion

- Initial symptoms occur within 6 hours and include vomiting and bloody diarrhea. Severe dehydration may result, followed by low blood pressure.
- Later symptoms may include hallucinations, seizures, and blood in the urine. Within several days, the person's liver, spleen, and kidneys might stop working, and the person could die.

Injection

- A tiny amount of ricin (the size of a pinhead) is enough to cause death, such as in the 1978 case in London in which ricin was used on the tip of an umbrella to assassinate a Bulgarian exile.
- Ricin immediately kills the muscles and lymph nodes near the site of the injection.
- Failure of the major organs and death usually follow within 4 days.

RECOVERY/MORTALITY RATE

- Chances of death depend on the method of exposure and dose of toxin received.
- If the dose is sufficient, death from ricin poisoning could occur within 36–72 hours of exposure.
- If death has not occurred in 3–5 days, the victim usually recovers.

DIAGNOSIS

- No reliable test exists to confirm ricin exposure.
- Tracking symptoms of those suspected of being exposed could lead to a diagnosis.
- An X-ray could confirm fluid in the lungs.

TREATMENT

- No antidote exists to counteract the effects of ricin poisoning.
- Victims are given intravenous (IV) fluids and assisted with breathing, possibly with a ventilator.
- Medications to control low blood pressure and seizures may also be administered.
- Those who have recently ingested ricin may have their stomachs flushed with activated charcoal to keep the toxin from being absorbed into the body.
- Eyes that come in contact with ricin should be flushed with water.

VACCINE

No vaccine exists to protect against ricin poisoning.

PREVENTION

- Leave the area of a known ricin release to prevent exposure.
- If exposed, remove clothing and shower thoroughly with soap and water.

STAPHYLOCOCCAL ENTEROTOXIN B (SEB)

BASIC FACTS

- **Staphyloccal enterotoxin B (SEB) is one of the toxins linked to foodborne illness.**
- **SEB is produced naturally by the *Staphylococcus aureus* bacteria (not a virus).**
- **SEB is not contagious.**

SEB AS A WEAPON

- SEB is produced in aerosol form for easy dissemination in the air or in a building's ventilation system.
- SEB can also be released in food or water.

WHAT WE DON'T KNOW ABOUT SEB AS A WEAPON

Scientists do not know how much of the toxin is needed in an aerosol release to inflict mass casualties.

SEB ILLNESS

EXPOSURE

SEB illness develops after the toxin is inhaled or ingested.

SYMPTOMS

- Symptoms appear 3–12 hours after exposure.
- Symptoms of inhaled exposure include fever, chills, and headache, similar to flu symptoms.
- Symptoms of ingested exposure include nausea, vomiting, and diarrhea, similar to stomach virus symptoms.

RECOVERY/MORTALITY RATE

- Higher mortality rates of 50–80 percent occur after inhalation of the toxin.
- Most patients recover from ingested forms of the toxin.
- The progression of the disease depends on the route of exposure and the dose of the toxin.

DIAGNOSIS

- Respiratory symptoms will signal when a patient may have inhaled the toxin.
- Tests of respiratory secretions can detect the toxin.
- Evidence of the toxin can be found in blood and urine.
- SEB is quickly identified in food.

TREATMENT

- Patients with severe cases resulting from aerosol exposure may require a ventilator.
- A vaccine is currently not available but is under development. For more information, see NIAID's Web site (http://www2.niaid.nih.gov/biodefense).

TYPHUS FEVER (EPIDEMIC OR LOUSE-BORNE TYPHUS)

BASIC FACTS

- **Caused by the bacterium *Rickettsia prowazekii* (not a virus).**
- **The disease is spread from person to person by body lice. (Not to be confused with typhoid fever, which is spread by unrelated bacteria.)**

WHAT WE DON'T KNOW ABOUT TYPHUS FEVER AS A WEAPON

It is not known to what extent scientists have explored the use of typhus in other forms that would be more deadly for use in a mass casualty event.

TYPHUS FEVER ILLNESS

EXPOSURE

- People are infected when exposed to body lice from other infected individuals.
- A less severe disease, murine typhus, is spread via fleas from infected mice, rats, and some other animals. Murine typhus is caused by different but related bacterium, *Rickettsia typhi*.
- This Louse-borne typhus is not contagious except as spread by lice.

SYMPTOMS

- Symptoms appear 1–2 weeks after exposure.
- Symptoms include fever, headache, chills, and general pains.
- Initial symptoms are followed by a body rash, typically beginning around the armpits or upper trunk and spreading outward.
- The rash typically does not appear on the face, the palms of the hands, or the soles of the feet.

RECOVERY/MORTALITY RATE

- The recovery rate is good (except in high outbreak areas) if antibiotic treatment begins quickly.
- Left untreated, the disease kills up to 40 percent of infected individuals; those who recover typically undergo a 2–3 month convalescence.
- In some individuals, typhus may arise spontaneously many years after recovery from an infection. This illness, called Brill-Zinsser disease, appears to be caused by reactivation of a dormant infection and is typically milder than the initial disease.

DIAGNOSIS

Typhus is diagnosed by a variety of blood tests.

TREATMENT

Doxycycline is the most prescribed antibiotic of choice for typhus illness. Some other antibiotics are also effective.

PREVENTION

- Typhus can be prevented by delousing and improved hygiene.
- There is no U.S. Food and Drug Administration-approved vaccine for epidemic typhus.

VIRAL ENCEPHALITIS

BASIC FACTS

- **The majority of cases of "encephalitis" are caused by viruses (not bacteria).**
- **Several different types or families of viruses can cause encephalitis.**
- **The term "encephalitis" only refers to inflammation of the brain. "Encephalomyelitis," which refers to inflammation of the brain and spinal cord, is a term that may also be used since most cases of viral encephalitis also involve the spinal cord. These illnesses are different than "meningitis," which refers to inflammation of the covering (meninges) of the brain.**
- **Many "encephalitis viruses" are arthropod-borne viruses (arboviruses), typically transmitted to humans and animals via the bits of mosquitoes, ticks, and sandflies. However, many other infectious agents, such as mumps, measles, adenoviruses, enteroviruses, herpesvirus, and rabies, can also cause encephalitis. These agents will not be discussed here.**
- **Many outbreaks of viral encephalitis, particularly those associated with mosquito transmission, occur naturally and have a seasonal pattern (often more cases in late summer when more vectors [e.g., insects] are present).**
- **The most common mosquito-borne viral encephalitis infections are:**
  - **Alphaviruses—Eastern equine encephalitis (EEE), Venezuelan equine encephalitis (VEE), and Western equine encephalitis**
  - **Flaviviruses—St. Louis encephalitis, West Nile virus encephalitis, Japanese encephalitis, tick-borne encephalitis, and dengue encephalitis**
  - **Bunyavirus—Rift Valley encephalitis**

VIRAL ENCEPHALITIS AS A WEAPON

- Viral agents causing encephalitis could be weaponized relatively easily. Many encephalitic viruses, such as VEE, can be aerosolized.
- VEE and EEE are two examples of viruses that are thought to have been weaponized.
- Viral agents causing encephalitis may be attractive as weapons because they are available in nature and could cause disease outbreaks initially indistinguishable from naturally occurring outbreaks. If aerosolized viral agents were introduced into areas where there are insects capable of transmitting disease, there could be a secondary transmission of the disease (i.e., an insect first bites an infected person and then bites another person, thereby spreading the disease).
- These viruses are zoonotic—capable of causing infection in humans and animals, such as horses.

WHAT WE DON'T KNOW ABOUT VIRAL ENCEPHALITIS AS A WEAPON

We have limited intelligence information on the current weaponization of specific agents causing viral encephalitis.

VIRAL ENCEPHALITIS ILLNESSES (CAUSED BY AN ARBOVIRUS)

EXPOSURE

- Under natural conditions, an individual would be bitten by an insect, which could introduce the virus into the body. If there are a large number of vectors (e.g., insects) that carry the virus and are capable of transmitting it to people, there is a greater likelihood of an outbreak of the disease.
- For laboratory workers working with such viruses, the aerosolization of infectious virus particles is a concern and lab safety and personal protective safeguards are necessary.
- In a bioterrorist scenario where the viral agents are aerosolized, the impact of the attack will probably be dependent on the number of people exposed, the amount of virus they are exposed to, and any preexisting immunity of the population.

SYMPTOMS

- Depending on the specific virus, the amount of virus introduced into the body, and the individual's state of immunity, symptoms may vary from none to drowsiness, headaches, stiff neck, confusion, seizures, coma, and death. Depending on the specific agent, the incubation period may vary from 2 to 3 weeks.
- In many cases of naturally occurring infection, the body's immune system fights off the infection. In many cases, there may be only mild symptoms, such as fever or headache or malaise, and the diagnosis is often missed. Individuals with compromised immune systems, such as infants and the elderly, may be at greater risk of developing complications.

RECOVERY/MORTALITY RATE

- Severity of disease and mortality rate are dependent on the particular virus infection. For example, EEE has been associated with a high mortality rate (50–80 percent) in older populations.
- Recovery is usually gradual, but residual effects of the infection may occur. These include disturbances in cognitive function, restlessness, recurring seizures, and personality changes.

DIAGNOSIS

- Viral encephalitis can be diagnosed through blood tests, viral cultures, and a spinal tap.
- An MRI or CAT scan may also be used for diagnosis.

TREATMENT

- Unlike bacteria, viral infections cannot be specifically treated with antibiotics.
- There are no licensed therapies for arboviral infections at this time, although certain drugs and therapies under Food and Drug Administration investigational use may be available, if needed.
- Treatment for arboviral encephalitis is supportive care (hospitalization, intravenous fluids, respiratory support, prevention of secondary infections, etc.).
- Various chemical compounds are being evaluated for possible antiviral activity against arboviruses.

VACCINE

- A licensed vaccine for Japanese Encephalitis is currently available in the United States.
- Vaccines against EEE, Western equine encephalitis, VEE, and Rift Valley encephalitis were developed by the U.S. Department of Defense and are available under specific investigational drug protocols through the U.S. Army Medical Research Institute of Infectious Diseases at Fort Detrick, Maryland.
- No licensed vaccines are available in the United States for viruses causing encephalitis, with the exception of rabies, mumps, and measles vaccines. Vaccines are under development against several arboviruses (EEE, Western equine encephalitis, VEE, tick-borne encephalitis, and West Nile virus).

PREVENTION

- In a bioterrorist attack, it is unlikely that the virus could survive very long (more than a few hours) outside of the body.
- Vector control measures (e.g., elimination of insect breeding sites) will reduce the risk of mosquito-borne disease.
- Personal protective measures, such as the use of insect repellents and appropriate clothing (e.g., shirts with long sleeves), will reduce the risk of bites.

WATER SAFETY THREATS

OVERVIEW

While not all are discussed in this guide, some examples of water-borne contaminants that pose threats include:

- **Cholera**
- **Giardiasis**
- **Cryptosporidiosis**

WATER SAFETY THREATS BASIC FACTS

- **There are several bacteria or parasitic organisms that can contaminate the water and make people sick.**
- **Diagnosis would most likely occur after large numbers of people begin getting sick with intestinal symptoms, including nausea and diarrhea.**
- **Symptoms usually occur within hours or days of exposure. Community water systems that do not filter their water or that inadequately disinfect drinking water are more likely to transmit disease-causing organisms.**
- **The most well-known of these diseases is cholera.**

CHOLERA BASIC FACTS

- **Cholera is an acute, diarrheal illness caused by infection of the intestine with the bacterium *Vibrio cholerae* (not a virus).**
- **Cholera can be highly lethal if untreated, but the mortality rate is low with treatment.**
- **The disease can spread rapidly in areas with inadequate treatment of sewage and drinking water.**
- **Cholera bacteria can also live in brackish rivers and coastal waters.**
- **Cholera is unstable in fresh water but remains vibrant in salt water.**

WHAT WE DON'T KNOW ABOUT CHOLERA AS A WEAPON

In most areas, chlorination and aeration of water kills the bacteria that can make people sick. Scientists do not know if terrorists have experimented with ways to infect the water systems that can withstand the chlorine treatment to inflict mass illnesses.

CHOLERA ILLNESS

EXPOSURE

- A person can become infected by drinking water or eating food contaminated with the cholera bacteria.
- In an epidemic, the source of contamination is usually the feces of an infected person contaminating the water supply.

SYMPTOMS

- Infection is often mild and no symptoms may occur.
- Approximately 1 in 20 infected people has a severe case, which is characterized by profuse watery diarrhea, vomiting, and leg cramps.
- In severe cases, the rapid loss of bodily fluids leads to dehydration and shock.

RECOVERY/MORTALITY RATE

- Without treatment, death can occur within hours.
- With prompt rehydration, fewer than 1 percent of cholera patients die.

DIAGNOSIS

- Physicians ask for a travel history from the patient to see if he or she has traveled to a known outbreak area.
- A stool sample test can confirm cholera.

TREATMENT

- Patients are treated with fluids to replace those lost due to diarrhea.
- Most patients are given large amounts of a water, sugar, and salt mixture to drink.
- More severe cases also require administration of intravenous (IV) fluids.
- Antibiotics shorten the course and diminish the severity of the illness, but they are not as important as rehydration.

VACCINE

There is no cholera vaccine currently available in the United States. However, there are vaccines widely available in countries where cholera is a major public health problem.

PREVENTION

Travelers to areas where cholera has occurred should observe the following recommendations:

- Drink only water that you have boiled or treated with chlorine or iodine; other safe beverages include tea and coffee made with boiled water and carbonated, bottled beverages with no ice
- Eat only foods that have been thoroughly cooked and are still hot or fruit that you have peeled yourself
- Avoid undercooked or raw fish or shellfish, including ceviche (raw fish salad)
- Make sure all vegetables are cooked; avoid salads
- Avoid foods and beverages from street vendors
- Do not bring perishable seafood back to the United States

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