

# NEWS & TERRORISM

## COMMUNICATING IN A CRISIS

A fact sheet from the National Academies and the U.S. Department of Homeland Security

## BIOLOGICAL ATTACK HUMAN PATHOGENS, BIOTOXINS, AND AGRICULTURAL THREATS

### WHAT IS IT?

A **biological attack** is the intentional release of a pathogen (disease-causing agent) or biotoxin (poisonous substance produced by a living organism) against humans, plants, or animals. An attack against people could be used to cause illness, death, fear, societal disruption, and economic damage. An attack on agricultural plants and animals would primarily cause economic damage, loss of confidence in the food supply, and possible loss of life. It is useful to distinguish between two kinds of biological agents:

- Transmissible agents that spread from person to person (e.g., smallpox, Ebola) or animal to animal (e.g., foot and mouth disease).
- Agents that may cause adverse effects in exposed individuals but that do not make those individuals contagious to others (e.g., anthrax, botulinum toxin).

### Availability of Agents

The Centers for Disease Control and Prevention (CDC) lists the bioterror agents considered to pose the highest threat (see Table 1). Once obtained, agents must be cultured or grown in quantity and then processed for use in an attack (“weaponized”). Agents can be:

- **Isolated from sources in nature.** The threat agents in Table 1 are either biotoxins or agents that cause zoonotic diseases (that occur in wildlife and are transmissible to humans)—except for smallpox, which is solely a human disease and has been eradicated from nature.
- **Acquired from laboratories or bioweapons stockpile.** Smallpox virus is officially studied in only two laboratories in the world. Anthrax is widely studied in labs. Hemorrhagic fever viruses are studied only in limited high-security locations. Most high threat agents had been studied and stockpiled in bioweapons programs outside the United States until as recently as the 1990s.
- **Synthesized or genetically manipulated in a laboratory.** This would require expertise and access to advanced technology.

### How Biological Agents Could Be Disseminated

For an attack on people, biological agents could be disseminated in one or more of the following ways:

- **Aerosol dissemination** is the dispersal of an agent in air from sprayers or other devices. The agent must be cultured and processed to the proper size to maximize human infections, while maintaining the agent’s stability and pathogenicity (ability to produce illness). An aerosol attack might take place outdoors in a populated area or

“Communication before, during and after a biological attack will be a critical element in effectively responding to the crisis and helping people to protect themselves and recover.”

A *Journalist’s Guide to Covering Bioterrorism* (Radio and Television News Director’s Foundation, 2004)

**Table 1. Diseases/Agents Listed by the CDC as Potential Bioterror Threats** (as of March 2005). The U.S. Department of Agriculture maintains lists of animal and plant agents of concern.

**CATEGORY A:** Easily disseminated and/or contagious; high mortality rates; might disrupt society; requires special action for public health preparedness.

#### Bacteria (single-celled organisms):

Anthrax (*Bacillus anthracis*)  
Plague (*Yersinia pestis*)  
Tularemia (*Francisella tularensis*)

#### Viruses (DNA or RNA requiring other host cells to replicate):

Smallpox (*Variola major virus*)  
Viral Hemorrhagic Fevers: Ebola, Marburg, Lassa, Machupo (*various families of viruses*)

#### Biotoxins (poisonous substances produced by living organisms):

Botulism (*Clostridium botulinum toxin*)

**CATEGORY B:** Moderately easy to disseminate; moderate illness rates, low mortality; requires enhanced diagnostic capacity, surveillance.

#### Bacteria:

Brucellosis (*Brucella species*)  
Glanders (*Burkholderia mallei*)  
Meliodosis (*Burkholderia pseudomallei*)  
Psittacosis (*Chlamydia psittaci*)

Food safety threats (e.g., *Salmonella species*, *Escherichia coli* O157:H7, *Shigella*)

Water safety threats (e.g., *Vibrio cholerae*, *Cryptosporidium parvum*)

#### Viruses:

Viral encephalitis (Alphaviruses)

#### Rickettsia (micro-organisms that live in cells):

Q fever (*Coxiella burnetii*)  
Typhus fever (*Rickettsia prowazekii*)

#### Biotoxins:

Epsilon toxin of *Clostridium perfringens*  
Ricin toxin from castor beans  
Staphylococcal enterotoxin B

**CATEGORY C:** Emerging infectious diseases that could be a future threat. (not all-inclusive)

#### Viruses:

Examples are Nipah virus and Hantavirus

### Historical Perspective on Biological Attack

- In 2001, the anthrax attacks through the U.S. mail infected 11 people with inhalational anthrax, of which five died. An additional 11 people were infected with cutaneous (skin) anthrax, of which there were no fatalities.
- In the 1990s, the cult Aum Shinrikyo failed in attempts to release anthrax and botulinum toxin in Tokyo but did succeed in a chemical attack with Sarin nerve agent.
- In 1984, the cult followers of Baghwan Shree Rajneesh sickened 751 people in Oregon by placing salmonella bacteria in salad bars in 10 restaurants to keep people from voting in an election.
- In World War II, Unit 731 in Japanese-occupied Manchuria dropped plague-infected fleas in China, allegedly resulting in more than 50,000 deaths.
- In World War I, German agents successfully infected Allied livestock with anthrax and glanders.
- In the 1340s, Europeans threw plague-infected cadavers over city walls to infect those within.

### Laws and Treaties Governing Biological Weapons

- The Geneva Convention of 1925 was the first international agreement to address chemical and biological weapons. It prohibits “bacteriological methods of warfare,” but did not outlaw the development of such weapons.
- The Biological and Toxins Weapons Convention (BWC) of 1972 is the first arms control treaty to outlaw an entire class of weapons and forbids States from developing, producing, stockpiling, or retaining biological weapons or assisting other States in developing these weapons systems.
- The Australia Group is a loose association of nations that agrees not to export tools and technologies, including pathogens, that have “dual uses”—that is, they can be used for both legitimate and nefarious purposes.

indoors, e.g., in the ventilation system of a building, in the subway, on planes. It takes expertise to process biological agents to *maximize* the effect of aerosol dissemination, but even relatively crude devices could have an impact.

- **Food or water**, especially ready-to-eat food (vegetables, salad bars) could be intentionally contaminated with pathogens or toxins. The water supply is less vulnerable because dilution, filtration, and the addition of chlorine can kill most disease-causing organisms.
- **Human carriers** could spread transmissible agents by coughing, through body fluids, or by contaminating surfaces. Most agents would make people ill or incapacitated before they become highly contagious, thereby reducing transmission of the disease.
- **Infected animals** can cause people to become ill through contact with the animals or contaminated animal products.
- **Insects** naturally spread some agents such as plague bacteria (vector borne illnesses) and potentially could be used in an attack.
- **Physically distributed** through the U.S. mail or other means.

#### For an agricultural attack:

- **A point introduction** of an infected plant or animal or its fluids could spread disease through the rest of the crop or livestock. Agricultural biothreat agents (e.g., foot and mouth disease, avian influenza, soy bean rust, and karnal bunt of wheat) do not have to be aerosolized to be effectively disseminated.

**Table 2. Onset, Health Impacts, and Treatments for Some Agents of Concern**

Disease (agent)	Incubation period*	Symptoms
<b>HIGH THREAT AGENTS (CATEGORY A)</b>		
<b>Anthrax</b> ( <i>Bacillus anthracis</i> ) (inhalational)	typically 1–6 days, but up to 42	Fever, cough, profound sweats, malaise, fatigue, myalgias
<b>Plague</b> ( <i>Yersinia pestis</i> )	1–7 days (usually 2–3 days)	Fever, cough, shortness of breath, sore lymph nodes
<b>Tularemia</b> ( <i>Francisella tularensis</i> )	1–21 days (avg 3–6)	Fever, cough, pneumonia, headache
<b>Marburg</b> (Viral hemorrhagic fever)	4–21 days	Sudden onset, fever, headache, followed by vomiting and diarrhea, rash, generalized bleeding in severe cases
<b>Ebola</b> (Viral hemorrhagic fever)	4–21 days	Sudden onset, fever, headache, followed by vomiting and diarrhea, rash, generalized bleeding in severe cases
<b>Smallpox</b> (Variola major virus)	7–17 days (avg 12)	Fever, aches, after 2–4 days rash appears
<b>Botulism</b> ( <i>Clostridium botulinum</i> toxin)	12 hours–5 days	Muscle paralyzing illness
<b>LOWER THREAT AGENTS (SELECTED CATEGORY B AGENTS)</b>		
<b>Cholera</b> ( <i>Vibrio cholerae</i> )	4 hours–5 days (usually 2–3 days)	Sudden onset of voluminous watery diarrhea, vomiting, cramps, dehydration
<b>Glanders</b> ( <i>Burkholderia mallei</i> )	1–14 days via aerosol	Pneumonia with or without blood poisoning, ulcers in nose, mouth, throat and lungs
<b>Q fever</b> ( <i>Coxiella burnetii</i> )	7–41 days	Flu-like illness that can lead to pneumonia and hepatitis
<b>Encephalitis</b> (Alphaviruses)	2–6 days	Fever, aches, pain behind the eye, nausea, vomiting
<b>Ricin</b> ( <i>Ricinus communis</i> )	18–24 hours	Can shut down organ function

\* Incubation periods listed are for naturally occurring outbreaks, which could differ for agents used as weapons. Data for incubation p

## IMPACT FOLLOWING THE RELEASE OF A PATHOGEN

### Detection of a Biological Attack

Unlike a chemical or nuclear attack, a biological attack may go undetected for hours, days, or potentially weeks (depending on the agent) until people, animals, or plants show symptoms of disease. If there are no immediate signs of the attack as with the anthrax letters, a biological attack will probably first be detected by local health care workers observing a pattern of unusual illness or by early warning monitoring systems that detect airborne pathogens. Evidence of an attack may appear in animals before humans.

### The Area Affected

For an aerosol release, the area affected would depend on the quantity of agent released, whether the release is indoors or outdoors, and weather conditions. Agents released outdoors would disperse roughly in the direction of the prevailing wind and could degrade with sunlight and by drying out from environmental exposure. Agents released indoors could initially have a higher concentration. Sometimes agents can be re-aerosolized by machinery, foot traffic, or other means.

### Finding the Cause and Source of Illness

There may be uncertainties about crucial facts such as the exact location or extent of the initial release, the type of biological agent used, and likelihood of additional releases. Laboratory scientists will work quickly to identify the specific agent. Epidemiologists will attempt to trace the path of infections back toward a single person, vector (insect or animal), vehicle (food or water), or other point of origin. Attribution of a biological attack is typically much more difficult than attribution of a conventional terrorist attack.

Spread (person to person)	Lethality if untreated	Persistence of Organism	Vaccine Status (as of March 2005)	Medical Treatment
No (only skin form spreads)	High (if inhaled) viable in soil > 40 yrs	Very stable spores	Licensed	Antibiotics
Moderate	High unless treated within 12–24 hours (pneumonic)	For up to 1 year in soil; 270 days in live tissue	Not current	Antibiotics
No	Moderate	For months in moist soil or other media	Not current	Antibiotics
Via fluids	>25% lethal	Relatively unstable	None	Supportive treatment only
Via fluids	50–80% lethal	Relatively unstable	Investigational	Supportive treatment only
Moderate	High to moderate ≥30% lethal	Very stable	Licensed	Supportive
No	High without respiratory support	Stable for weeks in nonmoving food/water	Licensed (availability uncertain)	Antitoxin if administered quickly
Rare, although spreads rapidly via untreated water	Low with treatment, high without	Unstable in aerosols & fresh water, stable in salt water	Investigational	Antibiotics
No	Death in 7–10 days in blood poisoning form	Very stable	None	Antibiotics
No	Very low	For months on wood and sand	Not licensed in U.S.	Antibiotics
Low	Low	Relatively unstable	None	Supportive treatment
No	High (injected)	Stable supportive treatment	Investigational	No antidote;

period, lethality, and persistency from U.S. Army Medical Research Institute of Infectious Diseases Blue Book, August 2004.

## WHAT IS THE DANGER?

### Impact on Human Health

Biothreat agents have the potential to produce a life-threatening illness. Biotoxins are essentially poisons that can be fatal at high enough doses. Table 2 lists health impacts and medical treatments for the Category A and some Category B agents. Even a small amount of some biothreat agents released in air could result in significant loss of life, depending on a number of factors that include the:

- Infectivity of the agent (how many particles are needed to cause illness).
- Lethality of the agent.
- Length of time it takes to detect and treat those who are exposed or have become ill.

### Dose Response in Humans

The exact infectious dose (the number of organisms needed to make one sick) of most biological agents is unknown; approximate doses are extrapolated from animal studies. Whether a person becomes ill after exposure to a biological agent depends on a number of factors including:

- Type and amount of agent taken into the body.
- Duration of exposure.
- Route of exposure (inhalation, ingestion, insect bite).
- “Host” factors (e.g., age, immune status, other illnesses of the person exposed).

### Differences in Intentional vs. Natural Outbreaks of Disease

Naturally occurring outbreaks of category A agents have become rare because of improved living standards, hygiene, and health services in developed nations. For example, human bubonic plague, which was transmitted by rats and fleas to humans in past centuries resulting in large losses of life, has virtually been wiped out. However, agents used in an aerosol attack may act differently than naturally occurring outbreaks and could produce a form of the disease with a shorter time of onset of illness, making timely diagnosis, treatment, and containment more difficult.

### Spread of Diseases

Some transmissible (contagious) diseases can spread through respiratory droplets from coughing and sneezing or when a person comes in contact with a surface harboring a virus or bacteria and then touches their mouth or nose. The viral hemorrhagic fevers and cholera are spread by direct contact with body fluids or feces. People infected with contagious diseases may widely disseminate the disease by travel.

### Psychological Impact

Psychological responses following a bioterrorism event may include anger, fear, and social isolation. Following the 2001 anthrax attacks, thousands of people who thought they were infected sought treatment. Trying to distinguish those who haven't been infected could complicate medical centers' ability to treat those who have been exposed and infected, especially when diagnoses are unclear.

## WHAT SHOULD PEOPLE DO TO PROTECT THEMSELVES?

### Practical Steps

During a declared biological emergency:

1. People in the group or area that authorities have linked to exposure who have symptoms that match those described should seek emergency medical attention.

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### Infectious Is Different From Contagious

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The terms “infectious” and “contagious” are often confused. Infectious refers to the number of particles (spores or organisms) needed to infect an individual. The fewer number of particles needed, the more infectious the agent. Agents are contagious if they spread from person to person. Some agents that are highly infectious, such as Tularemia and Q fever, are not contagious.

2. Use common sense, practice good hygiene and cleanliness to avoid spreading germs.

**People who are potentially exposed should:**

1. Follow instructions of health care providers and other public health officials.
2. Expect to receive medical evaluation and treatment. Be prepared for long lines. If the disease is contagious, persons exposed may be quarantined.

**If people become aware of a suspicious substance nearby, they should:**

1. Quickly get away.
2. Cover their mouths and noses with layers of fabric that can filter the air but still allow breathing.
3. Wash with soap and water.
4. Contact authorities.
5. Watch TV, listen to the radio, or check the Internet for official news and information including the signs and symptoms of the disease, if medications or vaccinations are being distributed, and where to seek medical attention if they become sick.
6. Seek emergency medical attention if they become sick.

### **Medical Treatment**

Table 2 lists general medical treatments for several bioterror agents. In general, bacterial illnesses are treated with antibiotics, and viral illnesses are treated with supportive care, although there are a few specific medications to treat viral infections. Bioterror agents are treated with antidotes or antitoxins, if available. Vaccines can prevent or mitigate the effects of a disease. The smallpox vaccine may provide protection even if given 1–4 days after exposure, and the anthrax vaccine can be given after inhalation exposure if accompanied by treatment with antibiotics for a number of weeks.

### **Controlling the Spread of Contagious Diseases**

Methods to control contagious disease include isolation, quarantine, barrier methods (gloves, filter masks, eye protection), and hand washing. Rapid identification of potentially infected persons increases the effectiveness of these methods.

## **WHAT ARE THE LONG-TERM CONSEQUENCES?**

### **Monitoring and Clean-up**

After a biological agent has been identified, officials will take steps to characterize how long the agent will persist. Clean-up within buildings may entail the use of gas or liquid decontaminants to kill the agent. For example, chlorine dioxide gas was released through ventilation systems of buildings contaminated with anthrax. In some cases, multiple rounds of decontamination may be necessary. Decisions regarding how much clean-up is necessary will depend on:

- The amount of agent released.
- How far the agent has spread.
- How the space will be used following clean-up.

### **Long-term Health Consequences Following Exposure**

The long-term health consequences for those who survive exposure to biological attack agents are unknown. A long-term medical surveillance program would likely be established to monitor potential health effects of those exposed.

### **Economic Impact of an Agricultural Attack**

Once detected, an act of agricultural bioterrorism may quickly halt the movement and export of livestock or the affected crop, resulting in potentially severe economic consequences for producers, shippers, and consumers. It may also disrupt normal travel and commerce.

## ADDITIONAL INFORMATION

Centers for Disease Control and Prevention—<http://www.bt.cdc.gov>

Infectious Disease Society of America—<http://www.idsociety.org>

National Institute of Allergy and Infectious Disease—<http://www.niaid.nih.gov/biodefense/>

U.S. Army Medical Research Institute of Infectious Diseases—<http://www.usamriid.army.mil>

U.S. Department of Health and Human Services —<http://www.hhs.gov/emergency>

U.S. Department of Homeland Security—<http://dhs.gov/dhspublic> • <http://www.ready.gov>

This report brief was prepared by the National Academy of Engineering and National Research Council of the National Academies in cooperation with the Department of Homeland Security. For more information or referrals to subject-matter experts, contact Randy Atkins at 202-334 1508, [atkins@nae.edu](mailto:atkins@nae.edu), or visit [www.nae.edu/factsheets](http://www.nae.edu/factsheets). *Making the Nation Safer, Tracking the Atmospheric Dispersion of Hazardous Materials Releases* and other National Research Council reports related to this topic are available from the National Academies Press, 500 Fifth Street, NW, Washington, DC 20001; 800-624-6242; [www.nap.edu](http://www.nap.edu).

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