The ability to use certain biological and chemical agents as weapons is predicated on certain principles: The agent needs to be economically viable, it must be able to reach the target with limited collateral damage, and it must achieve the desired result. One additional element to make an element appealing as a weapon is the lack of treatment options or limited availability for antidotes, antibiotics, vaccines, active antibodies in immune globulin, or medications. Using these agents intentionally to cause harm and their release into the air, food, or water supply is bioterrorism, leaving first responders to identify whether an attack has occurred.

During the Cold War, both the United States and the Soviet Union researched the possibility of using biological and chemical weapons. Terrorist attacks occurring within the last 30 years include the release of salmonella by the Rajneeshee Cult in Oregon into several salad bars and the water system in 1984, and anthrax spores mailed to Senator Tom Daschle’s office in Washington, D.C., in 2001.

Similar attacks using a chemical weapon were the release of sarin gas into the Tokyo subway in Japan in the 1990s, which killed 12 people and injured 5,000, and in 1988 in Halbja, Iraq, Saddam Hussein released a chemical cocktail made up of mustard gas, sarin, tabun, and VX. This combination of a blister agent and nerve agents could not be treated. In response to the threat of terrorism, numerous world health and political organizations have listed the most likely biological and chemical weapons to be used for an attack.

**BIOLOGICAL WEAPONS**

Biological weapons are biological agents such as bacteria, viruses, or toxins with the potential to cause deadly illness leading to mass casualties and civil disruption. According to a 1993 North Atlantic Treaty Organization (NATO) handbook, 31 pathogens are considered to be possible weapons of mass destruction based on the criteria of virulence, effectiveness, and ease of dispersal or use. Other factors that determine whether an agent might be a viable weapon for terrorists are whether it can be easily procured or produced in a laboratory, is dispersible in aerosol form for maximum toxicity, and is able to survive conditions to reach the intended target.

While a weapon could be as benign as a flu-type virus, the widespread results might be mitigated by the lack of severity of illness and perhaps lack of awareness the attack even occurred. Biological weapons are small and can be passed from person to person to cause a continuing outbreak. The result could be prolonged, and with new cases, new events, and the possibility for changing epidemiology, an outbreak would receive ongoing media attention.

Smallpox was considered eradicated by the World Health Organization (WHO) in 1980, and WHO recommended that the vaccination no longer be given as standard procedure, meaning that the disease is unlikely to be contracted from a natural source. After the attacks with anthrax, the probability of smallpox being used as a weapon is high. It is highly contagious and hardy enough to remain stable and infectious in a variety of environments. The best treatment relies on early detection, isolation of infected persons, and focused selective vaccination. In 2002, the Centers for Disease Control and Prevention (CDC) recommended a three-phase vaccination plan to immunize first responders with...
Anthrax is the common name of the bacterium *Bacillus anthracis*. When a person is exposed naturally by eating tainted meat or absorbing it through the skin from infected wool or hides, antibiotics are effective. As a potential biological weapon, anthrax can be easily grown on nutrients in the laboratory. When dried, the bacterium forms spores that can last in a variety of environments (hot, dry, or cold) and when reintroduced to the warm moist environment in the lungs after inhalation, the spores can germinate and cause illness and possible death within two to 10 days of exposure. Ciprofloxacin is considered the drug of choice for the strains of *B. anthracis* engineered for bioterrorism and is effective prophylaxis when given to persons with potential exposure.

Plague is caused by the bacterium *Yersinia pestis*, a gram-negative rod with an incubation period of two to 10 days. The most toxic form and the one more likely to be used as a biological weapon results in pneumonic plague, which is contracted from inhaled droplets and causes kidney and respiratory failure. Antibiotic therapy of streptomycin, gentamicin, or doxycycline should begin immediately and infected persons must be placed in strict respiratory isolation.

Botulism is a paralytic disease caused by food-borne *Clostridium botulinum*. Release of the toxin throughout the body causes blurred vision and difficulty swallowing and speaking usually within 24 to 36 hours and can lead to general weakness, respiratory failure, and death. Diagnostic assistance and procurement of treatment in the form of botulinus antitoxin can be obtained from state health departments or the CDC.

Tularemia is caused by *Francisella tularensis*. The bacterium is resistant to freezing, remains viable in water for weeks, and has a two- to 10-day incubation period. It can be contracted naturally through contact with animal tissues or ticks, with probable aerosol transmission. Due to virulence and ease of dissemination, it was added to lists of possible biological weapons. The symptoms produced are fever, headache, nausea, and prostration. It will likely develop a lesion at the inoculation site, either on the skin or the eyes. Treatment with the antibiotics streptomycin and tetracycline or chloramphenicol is effective.

Hemorrhagic fever viruses from the arenavirus, filovirus, unyavirus, or flavivirus families target the vascular bed. Microvascular damage and changes in vascular permeability cause body fluids to leak out of tissues and orifices. The most feared in this category are the Ebola and Marburg viruses, as the vector remains unknown. Hemorrhagic fevers are most commonly disseminated by arthropod vectors (the bites of fleas and mosquitoes) and can be controlled with insecticide. Isolation is important and the use of universal precautions (gowns, masks, gloves, and eye protection) will help contain the virus. No specific treatment for hemorrhagic fevers exists except intravenous ribavirin for Lassa fever.

Q-fever is transmitted to humans through inhalation or ingestion. The cause of infection is the rickettsiae *Coxiella burnetii*, which is resistant to heat and drying and survives in dust. Following an incubation period of one to three weeks, fever, headache, and muscle pain develop. Pneumonia, endocarditis, and central nervous system effects may occur. Treatment for acute infection with tetracycline or doxycycline can suppress symptoms and shorten the duration of clinical illness.

Other such diseases include Brucellosis, which is transmitted from animals to humans with an incubation period of a few days to several weeks. The onset of illness includes fever, chill, and sweats. An infected person may not seek medical attention until they experience weakness, weight loss, and
exhaustion. Combination antibiotic therapy is the most effective. Glanders caused by *Burkholderia mallei* is best treated with streptomycin and tetracycline or chloramphenicol and streptomycin. No vaccine exists. Typhus is an epidemic louse-borne infection caused by *Rickettsia prowazekii*. After an incubation period of 10 to 14 days the mild symptoms of the prodromal phase are followed by chills, high fever, delirium, and stupor. Treatment includes tetracycline or chloramphenicol. Prognosis is age related; in children the disease is mild; the mortality rate increases from 10 percent in persons aged 20–30 and rises to 60 percent by age 60. Vaccination provides some protection to decrease severity of illness.

Ricin is an immunotoxin and the chief active compound found in castor beans. Ingesting the seeds can result in death in six to eight days. The symptoms of poisoning include nausea, vomiting, and diarrhea leading to dehydration and icterus. When inhaled, the response is more immediate and severe.

**CHEMICAL WEAPONS**

Chemical weapons are chemical agents and fall into four categories: blister agents, nerve agents, choking agents, and blood agents. Most of these agents are delivered in the form of gases or vapors in chemical warfare. The toxic response is the rapid absorption into the body after inhalation. Technically, any chemical compound used as a weapon with intent to harm could be considered a chemical weapon. One such example is rubbing an arrow across the back of a poison frog from the Amazon. This chemical has now been classified as curare and the effect on the nervous system has been determined.

Chemical agents have been used in warfare as early as World War I, when white phosphorous was used in grenades and mortar shells to cause thermal burns, and to mark targets. After surgery to remove particles and bathing in bicarbonate solution, a person poisoned by white phosphorus should be treated like any other burn victim.

Nerve agents are potent compounds that cause cholinesterase inhibition; they are mostly organophosphate compounds similar to insecticides such as malathion but more potent. Many countries and terrorist groups have the capability to manufacture sarin, soman, tabun, GF, and VX. These agents can be inhaled or absorbed through the skin. Paramedics entering the contamination area must wear level A protective gear. Poisoning results are systemic with miosis, salivation, abdominal cramps, diarrhea, muscle paralysis, and respiratory arrest. Through the inhaled route, they also cause severe bronchoconstriction.

Nerve agent victims must be decontaminated with water and then evaluated for the need to administer antidotes. Treatment includes atropine for muscarinic effects, pralidoxime for nicotinic effects, and benzodiazepines for central nervous system effects. While the only specific treatment is atropine given intravenously and repeated until the acetylcholine excess is reversed, additional treatment includes treatment with cholinesterase reactivating agent pralidoxime. During the Persian Gulf War, military personnel were issued self-injectables, including an initial dose of atropine/pralidoxime combination.

Choking agents interfere with oxygen delivery. Chlorine gas is intermediately water soluble and reacts with water in the upper airways. At high concentrations, it may produce bronchospasm, pulmonary injury, and pulmonary edema. Treatment includes administration of oxygen and monitoring of pulmonary status. Phosgene gas is only slightly water soluble. It can be fatal after only brief exposure because it turns to hydrochloric acid in the lungs to cause pulmonary edema. Treatment is supportive only, with
pulmonary monitoring, intubation, and ventilation as needed.

Cyanide is a blood agent. It has a bitter almond odor and prevents cells from using oxygen. Death results from respiratory failure in eight to 10 minutes by inhalation. Treatment options include moving the poisoned person to fresh air or administering pure oxygen. Cyanide can also be used to contaminate a water supply. An antidote kit for cyanide should include amyl nitrite, sodium nitrite, and sodium thiosulfate.

SEE ALSO:
Anthrax; Bioterrorism; Botulism; Hemorrhagic Fever; Smallpox.

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