Course Learning Outcomes for Unit IV

Upon completion of this unit, students should be able to:

3. Explain the technology, types, effects, fabrication, development, and use of nuclear, biological, chemical, and agricultural weapons.
   3.1 Explain the technology, types, fabrication, development, and use of biological and agricultural weapons.

4. Assess how terrorism, genetic engineering, biological warfare, and cyberterrorism may affect future prospects.
   4.1 Discuss how bioterrorism and biological warfare may affect or prevent future attacks of terrorism.

6. Evaluate the moral and ethical implications of using WMD.
   6.1 Explain the moral and ethical implications that must be considered in the use of a biological WMD.

Reading Assignment

Chapter 4:
Biological Agents, pp. 121–157

Unit Lesson

What are Biological Weapons?

Biological weapons disseminate agents, infectious diseases, pathogens, or toxins to harm or kill others. Biological weapon key considerations include virulence, toxicity, incubation periods, transmissibility, lethality, stability, and infectivity. Biological agents are cost-effective and easily produced:

- bacteria—anthrax, brucellosis, plague, and tularemia;
- virus—smallpox, yellow fever, and Marburg;
- Rickettsia;
- Fungi;
- toxins—ricin, saxitoxin, or botulinum; and
- infectious pathogens—avian influenza, malaria, HIV, or tuberculosis (TB) (Pichtel, 2011).

What Makes an Effective Biological Weapon?

- ability to infect people with a small dose
- the capacity to cause illness, incapacitation, or death
- a shorter incubation period between infection and symptom onset
- minimal contagiousness
- no immunity
- not treatable with common antibiotics
- suitable for mass production
- easy to store, transport, or disseminate
- resilient against environmental conditions (Pichtel, 2011)

Ways to disseminate biological agents: Biological agents are more potent than chemical agents based on weight and quantity. There are many different means to disseminate biological agents; however, not all methods would be successful. A biological agent's delivery would differ based on the agent's characteristics, virulence, and resilience. Here are some common methods of biological agent dissemination:

- heating, ventilation, and air conditioning (HVAC) systems;
- water treatment facilities or water lines;
- pressurized sprayers (backpack sprayer, airplanes, unmanned aerial vehicles [UAVs]);
- food/water contamination;
- envelopes or packages;
- infected items such as blankets or clothing, or people (intentional human to human transmission); and
- possibly explosive munitions (Pichtel, 2011).

Brief history of biological agents: Biological agents are more potent than conventional and chemical weapons. Technology evolution has made it easier to produce stronger and more virulent biological agents. The history of biological warfare can date back as early as 600 BC. Here are a few examples of biological agents being used for biological warfare:

- 600 BC: Solon used the purgative herb hellebore during the siege of Krissa (Pichtel, 2011).
- 1155: In Tortona, Italy, well water was poisoned with human bodies (Pichtel, 2011).
- 1346: Plague-covered bodies were used at the siege of Kaffa by Tartars (Centers for Disease Control and Prevention [CDC], n.d.-e).
- 1710: Russian troops catapulted plague bodies into Swedish cities (Pichtel, 2011).
- 1763: The British introduced smallpox to Native American populations through blankets (Pichtel, 2011).
- 1863: Confederates sold yellow fever and smallpox covered clothing to the Union Army (Pichtel, 2011).
- WWI: Germany and France used glanders and anthrax (Pichtel, 2011).
- WWII: Japan used the plague and anthrax; the development of biological warfare programs began (Pichtel, 2011).

Different Priority Categories of WMD Agents

Category A (high-priority agents) agents are organisms or toxins that pose the highest risk to the public or to national security. High priority agents include the following characteristics:

- easily spread or transmitted from person to person,
- result in high death rates,
- potential for major public health impact,
- cause public panic, and
- require special public health preparedness and actions (CDC, n.d.-b).

The following are types of Category A, high priority agents:

- *Anthrax*: This is caused from bacterium. It is not spread from human to human.
  - There are three types of transmission:
    - cutaneous (skin)—20% fatal if untreated, less than 1% with treatment;
    - ingestion (gastrointestinal)—25%- 60% fatal; and
    - inhalation (lungs)—75% fatal even with treatment.
  - Symptoms appear within seven days. Fever is greater than 100°F. There is flu-like cough; chest discomfort; shortness of breath; fatigue; muscle aches; sore throat; enlarged lymph nodes; headache; nausea; abdominal distress; loss of appetite; vomiting; diarrhea; and sores around the face, arms, or hands that develop into a painless ulcer with a black center.
  - Weaponized anthrax has low-cost production and is easy to produce. It does not require advanced technology to create. Information on culturing and dispersion is easily available. Anthrax is extremely stable and can be stored indefinitely as a dry powder, and it is not contagious (CDC, n.d.-a).
- *Botulism*: This is a toxin created by the bacterium *Clostridium botulinum.*
  - There are five methods of transmission:

        - foodborne—eating foods with the toxin;
        - wound—caused by a toxin produced from a wound that is infected;
        - infant—caused by consuming the spores of the botulinum bacteria, which grows in the intestines and releases the toxin;
        - adult—same as infant, but occurs in adults; and
        - latrogenic—accidental overdose of toxin.
    - Symptoms appear between 18 and 36 hours but can occur as early as six hours or as late as 10 days, and include double or blurred vision, drooped eyelids, slurred speech, difficulty swallowing, dry mouth, and muscle weakness (CDC, n.d.-c).
    - Weaponized botulism was reportedly produced by Iraq prior to the Gulf War.
- *Plague*: This is caused by the bacterium, *Yersinia pestis*. It is transmitted to humans through flea bites, contact with contaminated fluids, or infectious droplets (coughing).
    - Common types and symptoms are listed below:
        - Bubonic plague: Without proper treatment, this has a fatality rate of 50% to 60%. The incubation period is one to eight days. Symptoms include fever, headache, chills, and swollen and tender lymph nodes.
        - Septicemic plaque: Without proper treatment, this has a fatality rate of nearly 100%. The incubation period is two to six days after initial symptoms. Symptoms include fever, chills, extreme weakness, abdominal pain, bleeding into the skin and organs, and skin and tissue may turn black, especially on fingers, toes, and nose. Septicemic develops from an untreated bubonic plaque.
        - Pneumonic plague: If not treated within the first 24 hours, this has a fatality rate of nearly 100%. The incubation period is two to four days after exposure. Symptoms include fever, headache, body weakness, rapidly developing pneumonia with shortness of breath, chest pain, coughing, bloody or watery mucous, and respiratory failure.
    - Plague as a biological weapon: There is widespread accessibility of Yersinia pestis in global microbe banks. There are techniques for developing mass production. The fatality rates for pneumonic plague are extremely high (CDC, n.d.-e).
- *Smallpox*: This is caused by the variola virus. Humans are the only natural hosts for the virus. It is not as contagious as the measles, whooping cough, or the flu. There is a seven to 17-day incubation period. It is more dangerous than anthrax.
    - Common types include
        - ordinary smallpox (30% fatal),
        - modified (occurs on previously vaccinated people),
        - flat (usually 100% fatal), and
        - hemorrhagic (usually 100% fatal).
    - Symptoms include high fever, malaise, head and body aches, vomiting, and rash that starts on the tongue and spreads to the face, arm, legs, hands, and feet. The person becomes very contagious once he or she has the rash (CDC, n.d.-f).
    - Weaponized smallpox has a high mortality rate. It is easy to disseminate from person to person. It causes mass panic. One case was a successful release of aerosol smallpox by the Soviet Union. To control requires advanced planning for outbreak control and isolation. The world population is immunologically naïve, unprotected, and highly susceptible to smallpox (Reidel, 2005).
- Other common category A agents are tularemia and viral hemorrhagic. A great acronym to remember for category A agents is BE PAST:
    - B—botulism
    - E—Ebola
    - P—plague
    - A—anthrax
    - S—small pox
    - T—tularemia (CDC, n.d.-b).

Category B agents are the second highest priority agents. This requires specific enhancements of the CDC's capacity and disease monitoring. Category B agents result in moderate illness and low death rates and are moderately easy to spread.

The following are common category B agents:

- *Ricin*: This is a natural poison found castor beans and is not contagious (toxin not bacteria or virus). Symptoms occur between six to eight hours of exposure and become potentially fatal within 48-72 hours. Exposure methods are as follows:
  - Inhalation symptoms include difficulty breathing, fever, cough, nausea, and tightness of the chest.
  - Ingestion/Injection symptoms including vomiting, diarrhea, dehydration, low blood pressure, and spleen and liver failure.
  - Cutaneous exposure has limited effects, but can cause redness and pain.
- *Weaponized ricin*: No antidote for ricin exists. It is easy to make and produce. The recipe is readily available online (including the patent information for ricin). It can be formed into a powder, mist, or pellet, and is dissolved in water. Ricin is stable under normal conditions. In 1978, Georgi Markov was assassinated with a ricin pellet (CDC, n.d.-c).
- Other common category B agents include
  - staphylococcal,
  - typhus fever (Rickettsia),
  - brucellosis,
  - epsilon toxin,
  - salmonella,
  - glanders,
  - melioidosis,
  - psittacosis, and
  - viral encephalitis.

Category C agents include potential bioterrorism agents and emerging diseases:

- hantaviruses,
- influenza,
- nipah,
- tick-borne encephalitis,
- yellow fever,
- emerging diseases,
- rabies,
- SARS coronavirus,
- tick-borne hemorrhagic fever viruses,
- other forms of rickettsiosis,
- congo-crimean hemorrhagic fever,
- orientia tsutsugamushi, and
- multi-drug resistant tuberculosis (CDC, n.d.-b).

Proliferation of Biological Agents

The following countries have suspected offensive biological weapons or agents, biological research programs, or capabilities:

- Albania,
- China,
- Cuba,
- Egypt,
- India,
- Iran,
- Iraq,
- Israel,
- Libya,
- North Korea,
- Pakistan,
- Russia,
- South Korea,
- Sudan,

- Syria,
- Taiwan, and
- United States (Arms Control Association, 2014).

Agroterrorism

Agroterrorism is a subset to bioterrorism. Agriculture and the food industry are pertinent to the U.S. economy and survival. The following are indicators of an Agroterrorism event:

- This may include an unusual clustering of illness or mortality in a particular region or within a short span of time for large numbers of animals or humans. This may include atypical, unexplained symptoms.
- Symptoms occur in an area where a particular disease is extremely rare.
- Normally healthy individuals suddenly become ill.
- It may present an unusual age distribution for common diseases.
- It may also present a disease occurring outside its typical season (Pichtel, 2011, p. 156).

Pichtel (2011) discusses the short- and long-term effects from an attack on crops, livestock, or food supplies and how these could impact or destroy the economy of a nation and people's livelihood and cause death and illness. It may not be detected until levels are out of control and place food supplies at risk for long periods.

Responses to an agroterrorism threat: The following steps in response can be applied to agroterrorism events as well as other CBRNE events:

- recognize—indicators (agricultural disease);
- avoid—prevent accidental exposure or spread;
- isolate—isolation or quarantine procedures (essential to control/eradicate disease); and
- notify—know who to identify to initiate response processes (Pichtel, 2011, p. 157).

Mitigating the threat:

- *Food biosecurity*: This includes deterrents to improve readiness conditions within agriculture and food sectors.
- *Auditing tools*: This includes more thorough checklists focusing on security aspects of processing plants, products, and personnel handling food.
- *Bioterrorism Act of 2002*: This requires all food plants to register with the Food and Drug Administration.

Click on the link to watch the Federal Bureau of Investigation (n.d.) video: *National Security Mitigating Bioterrorism.*
https://www.fbi.gov/news/videos/law-enforcement-and-the-national-security-branch

Click here to view the video transcript.

There are serious vulnerabilities with the United States agricultural system. An agroterrorist act would cause great impact to the United States economy. Agroterrorism could destroy businesses, kill crops, harm animals, and cause great sickness among humans.

Detection: Biological or agricultural terrorism is difficult to detect, and it may occur in many different forms. Understanding detection is the key to prevention and response from a biological attack.

Symptomatic detection: Most likely, a biological attack is a clandestine attack. The first evidence of dissemination of this type of weapon is usually presented by disease in humans and animals. The manifestation of symptoms in hospitals and the coordination of the public health authorities is one way to track the dispersion of a biological agent.

Terrorist attacks versus natural outbreaks: Terrorist attacks may be hard to distinguish from naturally occurring outbreaks. Several days could pass before medical authorities could put together the symptoms and recognize the illness to determine that it is a terrorist attack (Pichtel, 2011).

BioWatch systems: There are numerous environmental surveillance systems available, such as the BioWatch system. The BioWatch system detects the presence of a biological agent. If something is detected, the system then performs sampling to confirm the incident. If BioWatch detects and confirms an agent, it allows time for mobilization of medical authorities for response (Garza, 2012).

Response Agencies

The Department of Health and Human Services (HHS) serves as the federal government's primary agency for preparing and planning for public health and medical treatment for biological terrorism and naturally occurring outbreaks. The Department of Agriculture (USDA) is the primary agency for outbreaks and/or attacks on animals and food processing/production. The Secretary of Homeland Security is the principle federal official for domestic incident management, who is accountable for managing operations to prepare, respond, and recover from terrorist attacks, major disasters, and other emergencies. State, tribal/territorial, and local governments are responsible for detecting and responding to outbreaks, minimizing health and social consequences. The Centers for Disease Control and Prevention (CDC) provides guidance to agencies and coordinates with the Department of Homeland Security, Federal Bureau of Investigation, and other organizations as required. The CDC also provides the following services:

- assists health departments to integrate response operations and overall preparedness and response frameworks,
- assists states to develop response plans consistent with capabilities and resources, and
- assists departments to build communication within the healthcare communities.

Summary

Biological agents are more difficult to monitor than chemical agents. Detecting biological agent production is very difficult because less agent equals more effect. The facilities, operations, and development leave a much smaller footprint. This makes it much easier for an individual, state-sponsored government, or terrorist organization to create biological agents.

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Garza, A. (2012, July 12). The truth about BioWatch: The importance of early detection of a potential biological attack. Retrieved from https://www.dhs.gov/blog/2012/07/12/truth-about-biowatch

Pichtel, J. (2011). *Terrorism and WMDs: Awareness and response*. Boca Raton, FL: CRC Press.

Reidel, S. (2005). Smallpox and biological warfare: A disease revisited. *Baylor University Medical Center Proceedings*, *18*(1) 13-20. Retrieved from http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1200695/

Suggested Reading

The following Centers for Disease Control and Prevention (CDC) websites supplement the information contained in the lesson and textbook reading. You are encouraged to review this information.

Centers for Disease Control and Prevention. (n.d.). Basic information: What is anthrax? Retrieved from http://www.cdc.gov/anthrax/basics/index.html

Centers for Disease Control and Prevention. (n.d.). Botulism. Retrieved from http://www.cdc.gov/botulism/index.html

Centers for Disease Control and Prevention. (n.d.). Ricin. Retrieved from http://emergency.cdc.gov/agent/ricin/index.asp

Centers for Disease Control and Prevention. (n.d.). Plague. Retrieved from http://www.cdc.gov/Plague/

Centers for Disease Control and Prevention. (n.d.). Smallpox. Retrieved from http://emergency.cdc.gov/agent/smallpox/index.asp

Learning Activities (Non-Graded)

How can you prepare your family to react against biological agent attacks? Do Federal Emergency Management Agency (FEMA) preparedness forms exist to help families and communities prepare for biological issues? Write a one-page synopsis.

Non-graded Learning Activities are provided to aid students in their course of study. You do not have to submit them. If you have questions, contact your instructor for further guidance and information.