Osmosis Magazine

Volume 2020
Issue 1 *Osmosis Magazine - Spring 2020*

Article 3

2020

Living Lethal Weapons

Rilyn McKallip
University of Richmond

By Rilyn McKallip

Biological weapons, as defined by the Federation of American Scientists, are "toxins and microorganisms, such as viruses and bacteria, used to deliberately inflict disease among people, animals and agriculture."[1] Biological weapons have been used for hundreds of years on varying scales, from the catapulting of plague-infected corpses into enemy cities in the 14th century, to the testing of infectious diseases in China during WWII, to the 2001 anthrax attacks. These weapons act discreetly, as it is hard to trace an outbreak to a particular attacker and it takes several days for an infected individual to show signs of the disease. Moreover, because biological weapons are often highly infectious, their effect on society is far reaching. While state actors have made use of biological weapons in the past, the discreet and wide-reaching aspects of biological weapons make them increasingly appealing for terrorist groups, as they have the capability to disrupt society and cause panic.

A biological weapon can be developed in three steps—selecting a pathogen, growing and developing the microorganism, and preparing the disease for delivery. When selecting the pathogen, the designers of the weapon must consider how the biological agent spreads, how long it incubates, and how destructive it is. Generally, weapon developers aim to use biological agents that are highly contagious and have relatively short incubation periods, high mortality rates, and the potential to cause public panic. Some agents that fit these characteristics, and are hence popular choices for biological weapons, include anthrax and the plague.[2] Anthrax is the bacteria Bacillus anthracis, and it traditionally infects people who work with animals, but it can also be spread through aerosol. Gastrointestinal anthrax has a mortality rate of 25-75%, while inhaled anthrax can have a mortality rate of over 80%.[3] Another common pathogen used as a biological weapon, Yersinia pestis(plague) is a bacteria that causes painful, swollen lymph nodes, fever and extreme exhaustion. Though outbreaks traditionally began with rat-to-human transmission, plague bacteria can also be released through aerosol, and the infection easily spreads from person to person. Plague mortality rate is around 50%.[3] Both of these diseases are commonly used as biological weapons because of their ease of spread and high mortality rates. Scientists can obtain these biological agents from the environment, but they are more commonly acquired from pathogen banks. Individuals also donate samples of the pathogen, which scientists can genetically modify into a biological weapon.[1]

After choosing and acquiring the biological agent, scientists use genetic engineering technology to

alter the pathogen to be more resilient and lethal. Using gene editing technology, scientists can change the genetic material of pathogens by either inserting genes, deleting genes, or altering existing genes to produce pathogens with desired traits. Bacterial agents may also be altered to be resistant to antibiotics, which makes infections resulting from these bacteria difficult to treat.[4] This biotechnology is expensive, however, and acquiring it is a hurdle for groups attempting to develop effective biological weapons.

Once the pathogen is edited, scientists must choose a method of delivery. The most common methods of spreading biological weapons are through the air using bombs or sprays, through the water supply, and through the food supply. The Japanese commonly used aerosol pathogens in their tests on China in World War II, and there are documented instances of salmonella and E. coli being deliberately added to food, such as salad bars.[5] The chosen method of transmission will depend on how widespread or controlled the attack is intended to be.

International treaties have been implemented to slow or prevent the development of biological weapons. The 1925 Geneva Protocol banned use of biological weapons in warfare, and the 1972 Biological and Toxin Weapons Convention (BTWC) went a step further to prevent development, production, stockpiling, and acquisition of biological weapons.[1] However, it is nearly impossible to make sure that countries follow these treaties, and underground biological weapon programs continued, even in signatory countries. For example, the Soviet Union signed the BTWC but then started Biopreparat, a well-funded biological warfare research project. Through the program, the Soviet Union stockpiled anthrax bacteria and smallpox viruses undetected until the program's dissolution in 1992.[5] In addition to non-compliance in state actors, non-state actors have made use of biological weapons. The anthrax attacks of 2001 were carried out by a non-state actor, as was the spread of salmonella through salad bars by a religious sect in the 1990s.[5] The ease of access to biological agents makes bioterrorism, the use of biological weapons by a non-state actor to reach a political goal, a real and growing threat.

What can be done to combat the threat of bioterrorism? Perhaps the most important step is being prepared for an attack. The U.S. can invest in stockpiling vaccines for diseases like anthrax and the plague, researching possible new pathogens that could be used as biological weapons, and modeling possible outcomes of a biological attack. We can use what we know about the development of biological weapons to learn how to best protect ourselves from them, through modeling various diseases in different formats and mutations, and using these models to form plans to combat these pathogens. Additionally, there is the growing field of bioterrorism forensics, which aims to use DNA evidence to identify pathogens that could be developed into biological weapons.[6] While it is impossible to predict the exact timing and details of an attack, it is possible to prepare for possible attacks. Additionally, good hygiene practices, such as washing hands and staying up to date in vaccinations, can help individuals avoid contracting illnesses released by biological weapons. The threat posed by biological weapons and bioterrorism is present and growing, but there are measures that can be taken to protect us from a deadly attack.

References

1 Introduction to Biological Weapons. (2013).Federation of American Scientists.https://fas.org/programs/bio/bwintro.html.

2 Biological Agents/Diseases. Center for Disease Control. Retrieved March 6, 2020, fromhttps://emergency.cdc.gov/agent/agentlist-category.asp.

3 Thavaselvam, D., & Vijayaraghavan, R. (2010). Biological warfare agents. Journal ofpharmacy & bioallied sciences, 2(3), 179–188.https://doi.org/10.4103/0975-7406.68499

4 van Aken, J., & Hammond, E. (2003). Genetic engineering and biological weapons. Newtechnologies, desires and threats from biological research. EMBO reports, SpecNo(Suppl 1), S57–S60. https:doi.org/10.1038/sj.embor.embor860

5 Frischknecht F. (2003). The history of biological warfare. Human experimentation, modernnightmares and lone madmen in the twentieth century. EMBO reports, 4 Spec No(Suppl1), S47–S52. https://doi.org/10.1038/sj.embor.embor849.

6 National Research Council (US) Panel on Biological Issues. (2002). Prevention, Response and Recovery. Countering Terrorism: The Role of Science and Technology. National Academic Press.

Page Design: Lily Dickson