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An Examination of the Potential Threat of a State-Sponsored Biological Attack Against the United States: A Study of Policy Implications

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AN EXAMINATION OF THE POTENTIAL THREAT OF A STATE-SPONSORED BIOLOGICAL ATTACK AGAINST THE UNITED STATES: A STUDY OF POLICY IMPLICATIONS

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Master of Science, Defense and Strategic Studies

By

Courtney Anne Pfluke

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ABSTRACT

In 2002, US Navy Seals found a list of pathogens in an Afghanistan cave that Al Qaeda had planned to use in a series of biological attacks. Unique about the discovery was that the pathogens were not limited to human ones. Six pathogens targeted livestock and four targeted crops. Despite this discovery, limited attention has been given to the possibility of a state-sponsored terrorist attack utilizing biological agents against the US population, food source, or water supply. Throughout history, biological agents have been developed for use as an offensive weapon for both states and terrorist groups. The United States may soon see a successful biological attack by a state or nonstate actor against its troops in the Middle East, the Asia Pacific, or its homeland population and agricultural industry. While it is unlikely that such attacks will occur from traditional terrorist groups, it is possible that a state with a biological weapons program will sponsor a biological terrorist attack as a way of progressing its interests against the United States. This thesis provides a background for understanding biological attacks and examines the threat of a state-sponsored biological terrorist attack against the United States and its assets abroad, what the impact would be, possible scenarios for an attack, and policy recommendations to preventing and containing a futuristic attack.

KEYWORDS: biological weapons, pathogens, terrorism, state-sponsors, agriculture, biodefense, bioterrorism, agroterrorism

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I dedicate this thesis to my sister, Stormi Pfluke, for her part in the editing process.

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CHAPTER I: INTRODUCTION

The news only got worse the longer you watched it. Hundreds were dead and many more on their death beds, suffering from the plague. It had taken everyone by surprise when just two weeks ago a soldier deployed in the Middle East fell ill with symptoms resembling the modern flu. Just yesterday, entire regiments of soldiers abroad were reporting widespread sickness, and military hospitals were overrun. Upon closer examination of the disease, it was found out that the flu was not the culprit at all; the disease ravaging the United States military abroad was the Bubonic Plague. The suddenness and the seemingly unexplained onset of the disease left the world puzzled, and rumors began to spread about the possibility of a pointed and intentional attack against American military assets in the Middle East being the culprit. Then, everything got worse. Ten days after the first death was recorded, Al Qaeda claimed responsibility for the attack. The world was shocked. How could one terrorist organization obtain and weaponize such deadly pathogens? It turns out they were not working alone. While this scenario sounds like something out of the latest sci-fi movie, it is also set in reality. Every day the likelihood that a terrorist organization plans and executes a biological attack against American assets at home and abroad increases.

Biological warfare is not a new concept, but rather as old as war itself. The first recorded use of pathogens as weapons was in 14th century B.C.E. when the Hittites sent rams infected with Tularemia to their Arzawan enemies to spread disease and ravage the population.[1] Since then, Eastern and Western nations alike have used biological agents to tip the odds in their favor.

1. Siro Igino Trevisanato, "The 'Hittite Plague' an Epidemic of Tularemia and the First Record of Biological Warfare," *Medical Hypotheses* 69, no. 6 (2007): 1374

In the Middle Ages, military leaders did not weaponize the disease but rather the carrier by using the corpses of infected people as weapons of mass destruction. During the siege of Caffa, the military leaders of Tartar used the epidemic to their favor by "hurling the cadavers of their deceased into the city… forcing a retreat of the Genoese forces."[2] In the 15th century, it was said that Francisco Pizarro and Sir Jeffrey Amherst intentionally provided Native Americans with smallpox-laden blankets in hopes that the disease would spread and decrease the chance of Native American hostility toward the British.[3]

During the Civil War, confederates would sell the clothing of yellow fever victims to Union soldiers as a war strategy for defeating forces.[4] In the time since the Civil War, there have also been reports of biological agents being used during the First World War, the Second World War, and more recently after September 11, 2001, with the Anthrax Letters.

As technology advanced, so did people's methods for transferring diseases. Infected corpses turned into powdered pathogens, and smallpox blankets turned into bombs filled with fleas. The world watched in fear as nations globally developed and experimented with the same bacteria and viruses that caused the deaths of 25 million people during the Black Death,[5] 300

2. Stefan Riedel, "Biological Warfare and Bioterrorism: A Historical Review," *Baylor University Medical Center Proceedings* 17, no. 4 (2004): 402.

3. George W. Christopher et al. "Biological Warfare. A Historical Perspective," *JAMA* 278, no. 5 (1997): 414.

4. Jacob Roberts, "Yellow Fever Fiend," Science History Institute, 2014, https://www.sciencehistory.org/distillations/magazine/yellow-fever-fiend.

5. "Plague," National Geographic, https://www.nationalgeographic.com/science/health-and-human-body/human-diseases/the-plague/, (accessed November 14, 2018).

million during the smallpox pandemic,[6] and up to 50 million during the Spanish Flu pandemic of 1918.[7] What was once a rudimentary hit-or-miss bomb was being refined to more closely resemble precision-guided munitions.

Today, biological agents remain a lesser known, but no less powerful form of warfare, a weapon of mass destruction (WMD) that is limitless. Despite the devastating potential of biological weapons, terrorist organizations have yet to acquire, weaponize, or utilize biological weapons against their enemies. This is not for lack of trying. In 2002, American marines discovered documents in Al-Qaeda sanctuaries in the caves of eastern Afghanistan that documented United States' agriculture, trained Al-Qaeda operatives in targeting agriculture, and contained schematics on possible bioweapons including six human pathogens, six targeting livestock and poultry, and four targeting crops.[8] However, the expertise needed to create or weaponize diseases to the sophistication needed to pull off a widescale attack likely exceeds what most terrorist organizations have access to currently. This means that terrorists wishing to utilize weapons would need the help of a state that possesses a biological weapons program to supply them with the pathogens needed. In this way, state-sponsored biological terrorism could become a terrifying reality.

Despite global condemnation for terrorist organizations, the link between states and terrorist organizations is not obsolete. As recently as October 2018, it was reported that Iran was

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6. Colette Flight, "Smallpox: Eradicating the Scourge," *BBC,* February 07, 2011, http://www.bbc.co.uk/history/british/empire_seapower/smallpox_01.shtml#one.

7. John M. Barry, "How the Horrific 1918 Fly Spread Across America," Smithsonian Magazine, November 2017, https://www.smithsonianmag.com/history/journal-plague-year-180965222/.

8. Dean Olson, "U.S. Agriculture Represents a Large and Viable Terrorist Target," *FBI Law Enforcement Bulletin* 81, no. 2 (2012): 1.

utilizing civilian planes to transfer weapons to the terrorist organization Hezbollah. The report quoted a regional intelligence source as saying, "The Iranians are trying to come up with new ways and routes to smuggle weapons from Iran to its allies in the Middle East, testing and defying the West's abilities to track them down."[9] Nations already provide missiles, drones, and other weapons to terrorist organizations; it is not outrageous to predict that biological weapons could be next.

This possible advance in terrorism may spell danger for the United States. Biological weapons can devastate populations, destroy livestock, ravage crops, and contaminate sources of water. The foot-and-mouth disease outbreaks in the United Kingdom destroyed an estimated two million animals and cost the United Kingdom an accumulated six billion Euros in losses.[10] In Ireland, the Great Famine, now known to be caused by a mold that destroys the edible parts of the potato plant caused the deaths of nearly one million people and forced millions of others to leave their homes.[11] The cholera epidemic, in New York City, spread by contaminated water, killed nearly 3% of the population.[12] A biological attack against the United States will not go unnoticed and has the potential to devastate its resources and prevent economic growth.

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9. "Iran Smuggling Weapons to Hezbollah via Civilian Airline, Report Says," Haaretz, September 04, 2018, https://www.haaretz.com/middle-east-news/iran/iran-smuggling-weapons-to-hezbollah-via-civilian-airline-report-says-1.6445481.

10. Francisco Sobrino and Esteban Domingo, "Foot-and-Mouth Disease in Europe," *EMBO Reports* 2, no. 6 (2001): 460.

11. Joel Mokyr, "Great Famine," Britannica Encyclopedia, https://www.britannica.com/event/Great-Famine-Irish-history (accessed November 12, 2018).

12. John Noble Wilford, "How Epidemics Helped Shape the Modern Metropolis," *The New York Times,* April 15, 2008, https://www.nytimes.com/2008/04/15/science/15chol.html.

Despite this potential for devastation, it is important to note that biological weapons, like other WMD, remain part of this cache of weapons

This thesis will go through the possibility of a state-sponsored biological attack on United States' assets both at home and abroad, by providing a background on potential biological agents, examining the aggressors of a potential attack, and indicating areas where the United States can improve its defenses against biological attacks. This thesis is not meant to identify the potential for a biological attack on the United States by other nation-states, but rather explore the possibility that those nation-states will provide terrorist organizations with biological agents to use at their discretion.

To this end, Chapter II will explore the potential agents that can be used during biological attacks. This chapter is necessary to provide the reader with background information on the pathogens that will be mentioned later in the paper. This chapter is not meant to be a scientific analysis of each pathogen, but rather a layman explanation in how the disease spreads, who and what it affects, its potential for devastation, and which countries have easy access to the pathogens. This chapter will cover multiple pathogens that have human targets, agents that affect livestock, germs affecting crops, and even those that can affect water sources.

Chapter III offers an in-depth analysis of the state-ran biological weapons programs of five nations. The countries included are the Syrian Arab Republic, the Islamic Republic of Iran, the Democratic People's Republic of Korea, the People's Republic of China, and the Russian Federation, whose program was inherited from the Soviet Union. This chapter is meant to show what pathogens each program possesses, instances of experimentation, and its capabilities to weaponize the agent.

Chapter IV illustrates a historical timeline for biological incidents and threats of biological attacks against United States assets. This chapter also gives evidence that proves biological attacks are not just possible, but probable. It will begin with the first known instance of biological warfare between the Hittites and the Arzawans nearly 3,500 years ago and end with an in-depth look at more recent findings that indicate terrorists are planning for a future involving biological weapons.

Chapter V will offer sound definitions of biological terrorism (bioterrorism), agricultural terrorism (agroterrorism), and state-sponsored bioterrorism. This chapter will also serve to discuss why terrorist groups would choose to use biological agents to accomplish their goals over other weapons by examining the advantages and disadvantages of using biological weapons. On the other side, this chapter will also examine the reasons a nation would want to supply a terrorist organization with biological weapons, what pros and cons come from being a state-sponsor of terrorism, and what countries are most likely to act this way.

Chapter VI will continue to expand on the information provided in Chapter V by giving an in-depth analysis of what the threat of bioterrorism looks like in America. This chapter will revisit the biological programs of the states talked about in Chapter III and pair them with terrorist organizations while expanding on what a true biological attack would look like on American assets at home and abroad. This chapter will show the most likely weapon to be used, how it would spread, who and what it would affect, and the most likely places it would occur in each instance.

Chapter VII will switch focus from the threat of bioterrorism to the limited American biodefense structure. This chapter will be used to provide policy recommendations on how the

United States can work towards preventing and, in the unfortunate case of a biological terrorist attack, containing the threat.

Overall, the probability of a state-sponsored bioterrorist attack being an event the next generation must contend with becomes more likely every day. The United States has prepared for another anthrax attack, created vaccines for commonly seen pathogens, and even increased airport security, so we never experience 9/11 again. However, should a biological attack rain down on our nation, whether in our backyard or our home away from home, there is no procedure to follow. Therefore, it is so important for the United States to fully understand all the very real dangers of bioterrorism and make policy changes that ensure it is ready to prevent, contain, and respond to future attacks. We desperately need to stop pretending that these awful consequences will not befall us and realize that not only could an attack take place 'someday' but that 'someday' could be tomorrow.

CHAPTER II: DISEASES THAT AFFECT HUMANS, LIVESTOCK, CROPS, AND WATER

While this thesis could not possibly cover all disease that could prove to be a threat against the United States and its assets, it is important to cover the most pertinent ones, such as the Category A pathogens, as dictated by the Center for Disease Control (CDC). Category A pathogens are defined by the CDC as, "high priority agents that pose a risk to national security because they can be easily disseminated or transmitted from person to person, result in high mortality rates and have the potential for major public health impact, might cause public panic and social disruption, and require special action for public health preparedness."[13] These agents tend only to affect humans, but there can be some cross contamination. However, people are not the only United States' 'asset' that could be threatened. Agriculture, including livestock and crops, as well as water are at risk of being contaminated by diseases. While that type of infection does not directly affect humans, it has the potential to cause grave economic damage to the United States. As such, this chapter will review a variety of diseases grouped as follows:

- Diseases affecting humans,
- Diseases affecting livestock and crops; and
- Diseases affecting water

Within these groups the following aspects will be examined for each disease, although not necessarily in this order:

- Brief History of the Disease
- Scientific Nature

13. "Category A: Bioterrorism Agents/Diseases," *Centers for Disease Control and Prevention,* April 4, 2018, https://emergency.cdc.gov/agent/agentlist-category.asp#catdef.

- Symptoms
- How it Spreads
- What it Targets
- The Last Known Appearance of the Disease within the United States, if any
- Where it occurs naturally
- Potential for Use as a Biological Weapon
- Vaccines or Solutions

This chapter is not meant to be strictly technical but will look at some scientific aspects of the disease. The purpose of this chapter is to give a better understanding of the danger and lethality of the pathogens the United States must be concerned with and provide a reference for the rest of the thesis.

Diseases Affecting Humans

Perhaps most pertinent to this thesis are the diseases affecting humans and the ones affecting livestock as a biological attack of this nature would be the most devastating to the United States in terms of human lives lost and economic impact. While this chapter breaks down the two into separate categories as a way of simplifying the list, the two sections go hand in hand. Most of the diseases covered in these two sections can be devastating due to their zoonotic nature. Zoonotic diseases are defined as "diseases that can be transmitted from animals to people, or more specifically, diseases that normally exist in animals, but that can infect humans."[14] For example, the Bubonic plague was originally found in fleas on black rats but eventually spread to

14. "Medical Definition of Zoonotic," *Medicine Net,* December 11, 2018, https://www.medicinenet.com/script/main/art.asp?articlekey=12958.

humans due to close contact and unsanitary conditions.[15] Another example in these two sections comes from the Nipah virus. As recently as May 2018, an outbreak of the Nipah virus was reported to the World Health Organization (WHO). Four people died from the Nipah virus after contracting it from bats living in a well on the family's new property. Proximity to the bats was considered the source of the outbreak, indicating just how easily these pathogens can be transmitted from one subject to another, but also indicating how hard it is to eradicate these types of diseases. The first section will cover all Category A pathogens, as indicated by the CDC, including Anthrax, Botulism, Plague, Smallpox, Tularemia, and Viral Hemorrhagic fevers, specifically Ebola. This is by no means a complete list of diseases that could be used for biological weapons, but it covers the most common and most likely pathogens in question.

Anthrax. Anthrax is "an infectious disease caused by gram-positive, rod-shaped bacteria known as *Bacillus anthracis."*[16] Anthrax is thought to have originated from Egypt and the Mesopotamia as early as 700 B.C. It is believed that one of the plagues described as affecting hoofed animals could be describing anthrax.[17] The first clinical descriptions on anthrax did not occur until nearly 2,400 years later in the 1700s when Maret gave descriptions in 1752 and Fournier in 1769.[18] By the early 1900s, anthrax was well documented by the Americans, and later on that year it was being used in several biological weapons programs around the globe.

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15. Christian Nordqvist, "Origins of the Black Death Traced Back to China, Gene Sequencing has Revealed," *Medical News Today,* November 1, 2010, https://www.medicalnewstoday.com/articles/206309.php.

16. "Anthrax," *Centers for Disease Control and Prevention,* January 31, 2017, https://www.cdc.gov/anthrax/.

17. "A History of Anthrax," *Centers for Disease Control and Prevention,* August 15, 2016, https://www.cdc.gov/anthrax/resources/history/index.html.

18. "A History of Anthrax." *Centers for Disease Control and Prevention.*

Currently, anthrax is still suspected of being part of some biological weapons program, but mostly remains a rare disease found mostly in animals and those working with animals.

While anthrax is considered a serious disease, it is treatable if caught early. However, due to anthrax's long incubation period, it could be hard to catch early, allowing the disease to spread undetected for up to two months before medical professionals catch the infection.[19] For this reason, the disease makes for an effective biological weapon.

Symptoms of anthrax vary depending on how a person encountered the disease. If a person were to touch anthrax dust, an animal infected with anthrax, or contaminated animal products, then that person could expect to see small groups of blisters or bumps that itch, possible swelling or skin ulcers with black centers often appearing on the face, neck, arms, or hands.[20] However, if a person were to inhale or ingest anthrax, that person could expect to see more severe symptoms, including fever, chest discomfort, confusion or dizziness, a cough, nausea, vomiting, or stomach pains, headache, and swelling.[21] The onset of any of these symptoms could indicate a serious anthrax infection.

In their lifetime, most people will never be exposed to anthrax, but it is not impossible. People handling animal products, veterinarians, farmers, and laboratory professionals are all at risk. Anthrax is most commonly transferred through cuts on the skin. Therefore, people handling animal products like wool, hair, hides, and bones can encounter the bacteria and become infected if it enters a cut or scratch in the skin causing an infection. It is also possible for anthrax spores

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19. "Anthrax Symptoms," *Centers for Disease Control and Prevention,* July 23, 2014, https://www.cdc.gov/anthrax/basics/symptoms.html.

20. "Anthrax Symptoms." *Centers for Disease Control and Prevention.*

21. "Anthrax Symptoms." *Centers for Disease Control and Prevention.*

to be inhaled or ingested from contact with infected meat or other animal products.[22] However, in the case of a biological attack, an attacking entity would likely use anthrax powder sent through the mail reminiscent of the 2001 Anthrax attacks which resulted in the deaths of five people.[23] For this reason, the CDC mentions that mail handlers, military personnel, and response workers are also at risk if there is a bioterror attack involving anthrax spores.[24]

The last occurrence of an anthrax infection in the United States was in 2011. While on a cross-country road trip, a retired couple was forced to go to the emergency room because the husband was complaining of flu-like symptoms. It was diagnosed as anthrax. Naturally occurring anthrax infections are so rare in the United States that the Federal Bureau of Investigation was brought in to find out if this could have been a bioterror attack, but ultimately it was ruled as a strange occurrence. Luckily due to the anthrax vaccine and a specialized anthrax antitoxin, the man recovered and was sent home.[25]

Instances like the one above may indicate the need for mandatory country-wide vaccinations, but due to the rarity of anthrax outbreaks, the anthrax vaccine is only provided for those who are at an increased risk of becoming infected. Currently, the vaccine is not available for use on children under the age of 18, adults over the age of 65, or pregnant and nursing

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22. "Anthrax (Malignant Edema, Woolsorters' Disease)," *New York State Department of Health,* October 2011, https://www.health.ny.gov/diseases/communicable/anthrax/fact_sheet.htm.

23. "Timeline: How the Anthrax Terror Unfolded," *NPR,* February 15, 2011, https://www.npr.org/2011/02/15/93170200/timeline-how-the-anthrax-terror-unfolded.

24. "Anthrax." *New York State Department of Health.*

25. "A History of Anthrax." *Centers for Disease Control and Prevention.*

women. Despite these limitations, the anthrax vaccine's effectiveness is around 93% for people completing primary vaccines and occasional maintenance boosters.[26]

Despite the rarity of human infections, anthrax can be found worldwide in wild and domestic hoofed animals, like cattle, sheep, goats, camels, and antelopes.[27] Even so, its transfer to humans remains rare and unpredictable.

Botulism. Botulism is "a rare but serious illness caused by a toxin that attacks the body's nerves."[28] The toxin is made by the bacteria *Clostridium botulinum* or sometimes *Clostridium butyricum and Clostridium baratii* bacteria. While these bacteria do occur naturally around the world, it is unlikely to make people sick unless growing under certain conditions that include low-oxygen, low acid, low sugar, and low salt environments. For example, improperly canned goods can create an environment ripe for growing botulinum toxin.[29]

Botulism was first recorded in Europe in 1735 and was suspected of being associated with German sausage. For this reason, it was named after the Latin word for sausage, "botulus."[30] Since then Botulism has been classified into four different types:

1. Food-born Botulism
2. Wound Botulism

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26. "About the Anthrax Vaccine," *Centers for Disease Control and Prevention,* November 22, 2016, https://www.cdc.gov/vaccines/vpd/anthrax/hcp/about-vaccine.html.

27. "Anthrax." *New York State Department of Health*

28. "About Botulism," *Centers for Disease Control and Prevention,* October 4, 2018, https://www.cdc.gov/botulism/general.html.

29. "About Botulism." *Centers for Disease Control and Prevention.*

30. "James Sterba, "The History of Botulism," *The New York Times,* April 28, 1982, https://www.nytimes.com/1982/04/28/garden/the-history-of-botulism.html.

3. Infant Botulism, and

4. Adult Intestinal Colonization Botulism

All types of botulism are considered life-threatening and can produce symptoms like double vision, blurred vision, drooping eyelids, slurred speech, difficulty swallowing, dry mouth, muscle weakness, and flaccid, symmetric, descending paralysis.[31] However, if caught early botulism can be treated with antitoxins in a hospital. Modern antitoxins have improved the chances of surviving botulism from 50% to 95%.[32] At present, there is at least one vaccine, the Pentavalent botulinum toxoid (PBT) vaccine, in service today, and there are several more vaccines under development.[33]

Botulism is unique in that it cannot be transferred person to person, but instead must be transferred directly from contaminated food or naturally occurring bacteria. For this reason, botulism, while highly lethal and damaging, would be unlikely to make an effective biological weapon unless overwhelmingly infected into commonly bought canned goods that are widely distributed.

The CDC last reported in 2016 that there were 205 confirmed cases of botulism within the United States. Statistics for 2017 and 2018 have not yet been released, but based on reports in 2015 and 2016, cases of botulism are trending up.[34]

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31. "Botulism," *Ontario Ministry of Health and Long-Term Care,* http://www.health.gov.on.ca/en/public/publications/disease/botulism.aspx, (accessed January 12, 2019).

32. "Botulism Diagnosis and Treatment," *Centers for Disease Control and Prevention,* October 4, 2018, https://www.cdc.gov/botulism/testing-treatment.html.

33. Leonard Smith, "Botulism and Vaccines for its Prevention," *Vaccine* 27, no.4 (2009): 34.

34. "Botulism Surveillance," *Centers for Disease Control and Prevention,* October 4, 2018, https://www.cdc.gov/botulism/surveillance.html.

Plague. Plague, or more commonly known as the bubonic plague, is "a disease that affects humans and other mammals caused by the bacterium, *Yersinia pestis."*[35] Humans typically contract the disease after being bitten by an infected flea or by handling an infected animal. Historically, the plague is most known for killing a third of the European human population, an estimated 25 million people, in the 1300s; a period that was known as the Black Death.[36] However, the first recorded Plague pandemic happened nearly 1,000 years earlier in the Mediterranean basin. This pandemic also killed almost 25 million people over the next 300 years as it was nearly impossible to contain completely.[37] Most recently, a third pandemic, named the Modern Plague, appeared in China, killing approximately 10 million in 20 years.[38] Currently, there are limited outbreaks due to better sanitation and antibiotics that provide infected persons with a far higher chance of surviving the infection.

While it is most commonly transmitted by fleas and animals, it is possible to catch the plague from a transfer of bodily fluids like spit when coughing or sneezing, making it highly contagious. Due to its highly contagious nature, the plague has in the past often been used as a biological weapon. Some examples of these biological warfare strategies include throwing infected corpses over city walls, dropping flea bombs from airplanes, and even aerosolizing the

35. "Plague," *Centers for Disease Control and Prevention,* November 27, 2018, https://www.cdc.gov/plague/.

36. "Plague." *National Geographic.*

37. William Rosen, *Justinian's Flew: Plague, Empire, and the Birth of Europe* (New York City: Penguin Random House, 2007), p. 3.

38. Iqbal Khan, "Plague: The Dreadful Visitation Occupying the Human Mind for Centuries," *Transactions of the Royal Society of Tropical Medicine and Hygiene* 98, no.5 (2005): 274.

bacteria during the Cold War.[39] However, more recently plague has raised a national security concern for its potential to be used as a bioterror weapon due to its prevalence across the globe. The bacteria needed for a weapon can be easily collected and transported, making it an effective bioweapon choice. As of now, there are no known bioweapons utilizing plague bacteria in existence, but its potential for future use is high.

There are three forms that plague can take; Bubonic, Septicemic, and Pneumonic. Bubonic and Septicemic plague are both transmitted by the bite of an infected flea or the handling of an infected animal, while Pneumonic plague is often transmitted by inhaling infectious droplets of the plague, like for example, from someone's uncovered cough.[40] Despite these differences, most of the symptoms of all three plagues remain similar and include fever, headache, chills, and weakness. It can also include painful lymph nodes, internal bleeding, and sometimes a cough.[41]

Within the United States, an average of seven human cases of plague occur each year as plague bacteria is still naturally found in the Western United States. However, plague outbreaks and epidemics are still occurring in Africa, Asia, and South America; the biggest outbreak is currently occurring in Madagascar affecting over 1,000 people.[42] Today, cases of plague still occur anywhere that fleas and rats can be found, but typically it is more common in rural areas.

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39. NC Stenseth et al. "Plague: Past, Present, and Future," *PLOS Medicine* 5, no.1 (2008): 3.

40. "Plague Symptoms," *Centers for Disease Control and Prevention,* November 27, 2018, https://www.cdc.gov/plague/symptoms/index.html.

41. "Plague Symptoms." *Centers for Disease Control and Prevention.*

42. "Plague Map and Statistics," *Centers for Disease Control and Prevention,* November 27, 2018, https://www.cdc.gov/plague/maps/index.html.

While a plague vaccine exists, it is not recommended for anyone other than those at high risk of exposure. In most cases, the disease is treated retroactively using antibiotics in a hospital. If it is caught early enough, the survival rate is over 85% for bubonic and over 60% for those with septicemic and pneumonic.[43]

Smallpox. Smallpox is probably the world's most unique disease as it has been and can remain completely eradicated from human populations. Unlike most other diseases mentioned in this chapter, smallpox cannot be passed from animals to humans and therefore can be eradicated using mandatory vaccines and preventive measures. WHO declared smallpox eradicated in 1980 after the last known case of smallpox was reported in Somalia in 1977.[44]

Before its eradication, smallpox was a serious infection caused by a strand of the variola virus, the same virus that causes chickenpox.[45] The disease is thought to date back to the Egyptian Empire back in 3rd Century BCE, based on a rash found on mummies, but its true origin remains unknown.[46] From then on the disease is thought to have spread from country to country as part of trade routes and colonization. By the 18th century, smallpox had spread all over the world. This was around the same time that the basis for vaccination began. By the mid-

43. "Deadly Diseases: Plague," *PBS,* March 2006, https://www.pbs.org/wgbh/rxforsurvival/series/diseases/plague.html.

44. "Emergency Preparedness, Response: Smallpox," *World Health Organization,* https://www.who.int/csr/disease/smallpox/en/, (accessed January 5, 2019).

45. "What is Smallpox," *Centers for Disease Control and Prevention,* June 7, 2016, https://www.cdc.gov/smallpox/about/index.html.

46. "History of Smallpox," *Centers for Disease Control and Prevention,* August 30, 2016, https://www.cdc.gov/smallpox/history/history.html.

1800s, vaccination was slowly becoming the norm, then in 1959 WHO initiated a plan to rid the world of smallpox. By 1980, the disease was declared eradicated worldwide.[47]

After the eradication of smallpox, countries around the world recognized both the need for a continuing study on the variola virus and the need to limit the virus' continued existence in the world. As a solution, an international agreement was made to limit the number of research facilities to four different countries, the United States, England, Russia, and South Africa. Less than five years later, England and South Africa gave up their stockpiles to other approved labs.[48] Today, there are only two official locations where the variola virus is stored and handled under WHO supervision: the Centers for Disease Control and Prevention in Atlanta, Georgia, and the State Research Center for Virology and Biotechnology (VECTOR Institute) in Koltsovo, Russia.[49] However, there is speculation that multiple other countries may have gotten stockpiles of the vaccine from the former Soviet Union or kept parts of the disease from their last natural outbreaks, making it a possible disease for biological warfare. If smallpox were to be re-released on human populations, it would likely cause worldwide panic and contamination as younger generations are not as likely to be vaccinated because the disease is thought to have been eradicated.

Before the eradication of smallpox, it was spread through direct and prolonged face-to-face contact between a non-contaminated person and a contaminated one. But it could also be spread through coughing, sneezing, and other infectious droplets being passed between people.

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47. "History of Smallpox." *Centers for Disease Control and Prevention.*

48. "History of Smallpox." *Centers for Disease Control and Prevention.*

49. "History of Smallpox." *Centers for Disease Control and Prevention.*

As well, the virus could be spread through contaminated objects, like blankets or clothing.[50] This is what countries in Europe did to decimate Native American populations, by giving them smallpox-contaminated blankets. At first, the symptoms of smallpox tend to model the common cold, then a rash begins in the mouth and spreads all over the body. In the third stage, the rash turns into pustules before eventually scabbing over and falling off.[51]

Fortunately, there is a smallpox vaccine. The vaccine is made from a virus called vaccinia, which is considered a less harmful poxvirus. According to the CDC, "the vaccine does not contain the smallpox virus and cannot give you smallpox." However, unique to this vaccine is the fact that it contains a live virus and not a dead or weakened one like most other vaccines, but the vaccine was proven 95% effective at protecting people against smallpox.[52] Routine smallpox vaccinations were stopped in the United States in 1972 after smallpox was eradicated in the United States in 1949 during its last natural outbreak.

Despite the unlikelihood of a biological attack using smallpox, the CDC continues to prepare for the possibility of one by continuing research on the disease and creating contingency plans in case of an outbreak.

Tularemia. Tularemia affects both animals and humans and can be transmitted through tick and deer fly bites, skin contact with infected animals, drinking contaminated water, inhaling

50. "Smallpox Transmission," *Centers for Disease Control and Prevention,* June 7, 2016, https://www.cdc.gov/smallpox/transmission/index.html.

51. "Smallpox Signs and Symptoms," *Centers for Disease Control and Prevention,* June 7, 2016, https://www.cdc.gov/smallpox/symptoms/index.html.

52. "Smallpox Vaccine Basics," *Centers for Disease Control and Prevention,* July 12, 2017, https://www.cdc.gov/smallpox/vaccine-basics/index.html.

contaminated aerosols, or laboratory exposure.[53] The disease itself is a rare infectious disease that is caused by the bacterium Francisella tularensis.[54] It typically attacks the skin, eyes, lymph nodes, and lungs causing symptoms like skin lesions, high fevers, difficulty breathing, and swelling.[55] These symptoms usually appear within 3-5 days after exposure but could take up to 14 days.

The tularemia bacteria have been recognized as a human pathogen for nearly 100 years, but there are instances of the disease dating back hundreds of years before its recognition.[56] Tularemia is the disease that was used in the first ever recorded biological attack during the Hittite Plague. The attack consisted of the Hittites using infected or 'cursed rams' against their enemies to infect them, making it easier for them to win the war. However, it was not until the early 1900s that tularemia was officially discovered and nicknamed 'rabbit fever.'[57] Years later, multiple biological weapons programs around the world were studying its highly infectious nature as a possible biological weapon against their enemies. Soviet Union scientists allegedly developed a strand of tularemia that was vaccine-resistant to use as a biological weapon that it tested in the 1980s.[58] However, there is no proof that it was successful or ever used in combat.

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53. "Tularemia," *Centers for Disease Control and Prevention,* December 13, 2018, https://www.cdc.gov/tularemia/.

54. "Tularemia," *Mayo Clinic,* August 29, 2018, https://www.mayoclinic.org/diseases-conditions/tularemia/symptoms-causes/syc-20378635.

55. "Tularemia Signs and Symptoms," *Centers for Disease Control and Prevention,* December 13, 2018, https://www.cdc.gov/tularemia/signssymptoms/index.html.

56. Anders Sjostedt, "Tularemia: History, Epidemiology, Pathogen Physiology, and Clinical Manifestations," *Annals of the New York Academy of Sciences* 1105, no. 1 (2007): 12.

57. J. Hirschmann, "From Squirrels to Biological Weapons: The Early History of Tularemia," *The American Journal of the Medical Sciences* 356, no. 4 (2018), p. 324.

Today, tularemia continues to occur naturally in every state in the United States except Hawaii. The bacteria also occur in most other parts of the world. Due to its prolific nature, the disease can easily be isolated and grown in great quantities in laboratories. As well, its ability to be transmitted multiple ways can make it a versatile disease for weaponization, although developing an aerosol version is considered extremely sophisticated.[59] There is currently a vaccine under review by the Food and Drug Administration, but it isn't currently available in the United States.[60] Presently, if a person is diagnosed with tularemia, antibiotics can be prescribed to help a person beat the disease. In the case of an intentional release of the disease during a biological attack, the United States stockpiles antibiotics for treatment.

Viral Hemorrhagic Fevers (Ebola). Viral hemorrhagic fevers (VHFs) is a term used to define an entire group of illnesses caused by several families of viruses. The classification usually describes an illness that affects multiple organ systems and causes some form of bleeding (hemorrhaging).[61] Due to the high number of diseases that fall under this category, this section will focus primarily on the Ebola virus because it is considered a CDC Category A pathogen and it is a currently a very real threat in the world as outbreaks are continuing to occur at an accelerated rate.

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58. Hirschmann, "From Squirrels to Biological Weapons."

59. "Francisella Tularensis (Tularemia) Emergency Preparedness and Response, *Centers for Disease Control and Prevention,* April 4, 2018, https://emergency.cdc.gov/agent/tularemia/facts.asp.

60. "Francisella Tularensis (Tularemia) Emergency Preparedness and Response." *Centers for Disease Control and Prevention.*

61. "Viral Hemorrhagic Fevers (VHFs)," *Centers for Disease Control and Prevention,* January 14, 2019, https://www.cdc.gov/vhf/.

The Ebola Virus Disease (EVD) is considered a rare, but deadly disease found most commonly in people and nonhuman primates. The viruses thought to cause EVD are naturally found in sub-Saharan Africa, but anyone can be at risk of catching the disease if they happen to encounter an infected animal, normally a bat or nonhuman primate, or an infected person either dead or alive.[62] EVD is a group of viruses within the genus *Ebolavirus* that can cause infection. According to the CDC, there are currently six known viruses:

- Ebola virus (species *Zaire ebolavirus*)
- Sudan virus (species *Sudan ebolavirus*)
- Taï Forest virus (species *Taï Forest ebolavirus*, formerly *Côte d'Ivoire ebolavirus*)
- Bundibugyo virus (species *Bundibugyo ebolavirus*)
- Reston virus (species *Reston ebolavirus*)
- Bombali virus (species *Bombali ebolavirus)*

However, of these six, only four are known to cause infection in humans: the Ebola, Sudan, Tai Forest, and Bundibugyo viruses. [63]

EVD is a relatively new virus as it was only first discovered in 1976 near the Ebola River in what is now the Democratic Republic of Congo. Since 1976, the virus has caused severe outbreaks in multiple African nations and has even spread to nations outside of Africa because of infected aid workers.[64] EVD is a highly infectious disease that can spread through direct contact

62. "Ebola (Ebola Virus Disease)," *Centers for Disease Control and Prevention,* May 15, 2018, https://www.cdc.gov/vhf/ebola/.

63. "What is Ebola Virus Disease," *Centers for Disease Control and Prevention,* September 18, 2018, https://www.cdc.gov/vhf/ebola/about.html.

64. "What is Ebola Virus Disease," *Centers for Disease Control and Prevention.*

with bodily fluids of infected persons or items that have been contaminated. It can also be spread from animals (mainly nonhuman primates, but also bats) to humans.

Currently, there is no approved vaccine or treatment for EVD. The symptoms of the disease are treated as they appear, but the root cause cannot be treated yet. Those who contract EVD are often provided fluids, oxygen therapy, a medication that treats high blood pressure, reduce vomiting, and manage fevers and pain.[65]

All these factors, the infectiousness, lack of antiviral, and current prolific nature, make EVD an interesting, but a possibly effective biological weapon for enemy state and non-state actors to use against the United States. In 2014, at least four people within the United States were diagnosed with Ebola after the first travel-associated case of EVD was recorded.[66] It took weeks for the United States to contain a relatively small outbreak because hospitals were unprepared to deal with a disease that was only associated with Africa's poorest nations.

If EVD were to be released into the United States on a larger scale, it would be even harder to contain. Its early symptoms are nearly indistinguishable from other VHDs, and its rapid infection rate could rage across the population before the United States is aware it is happening.

Diseases Affecting Livestock and Crops

Biological terrorism is not unique to human populations. In 2002, a group of navy seals found Al-Qaeda plans for a biological attack on the United States agriculture and livestock,

65. "Ebola (Ebola Virus Disease) Treatment," *Centers for Disease Control,* December 27, 2017, https://www.cdc.gov/vhf/ebola/treatment/index.html.

66. "2014-2016 Ebola Outbreak in West Africa," *Centers for Disease Control,* December 27, 2017, https://www.cdc.gov/vhf/ebola/history/2014-2016-outbreak/index.html.

meant to devastate the U.S. economy instead of its population.[67] Given past examples of extreme agricultural epidemics, such as the potato famine, it is possible that an agricultural attack would have that exact given response. The United States is the world's largest beef producer and the second largest beef export, making livestock roughly a 50 billion dollar industry, with poultry in a close second at 42 billion dollars.[68] As well, the agricultural industry, in 2016, contributed 1.08 trillion dollars to the United States' GDP.[69] Both are significant industries that if interrupted could have devastating effects on the United States' overall economy. The diseases below were chosen for this section, in part, because of their devastating effects, but also their potential to be used as biological weapons. For this section, it will start with livestock diseases and then move on to agricultural ones.

Glanders. Glanders, caused by the bacterium *Burkholderia mallei,* is an infectious disease that mainly affects horses, but can also naturally occur in donkeys, mules, goats, dogs, and cats.[70] It is also classified as a zoonotic disease and is considered a Category B, second highest priority, for the CDC. It was first described by the Greeks in 450-425 BC and then again by the Romans nearly 1,000 years later. It wasn't until 1882 that the cause agent *B. mallei* was

67. Tom Daschle and Richard Myers, "A Threat to the Food System," *US News,* October 17, 2016, https://www.usnews.com/opinion/articles/2016-10-17/americas-food-supply-and-national-security-are-at-risk-to-bioterrorism.

68. "Overview of U.S. Livestock, Poultry, and Aquaculture Production in 2017," *National Agricultural Statistics Service,* November 3, 2017, https://www.aphis.usda.gov/animal_health/nahms/downloads/Demographics2017.pdf.

69. "Farm Contribution to Agricultural GDP at Record Low," *American Farm Bureau Federation,* June 12, 2018, https://www.fb.org/market-intel/farm-contribution-to-agricultural-gdp-at-record-low.

70. "Glanders," *Centers for Disease Control and Prevention,* October 31, 2017, https://www.cdc.gov/glanders/index.html.

isolated by multiple scientists in Germany.[71] Today, glanders is thought to be eradicated in most of the developed world but is still found naturally in Asia, the Middle East, Africa, and South America.[72] Its last natural occurrence in the United States was in the 1930s, but more recently, it has occasionally been reintroduced in Europe via imported horses.

The disease is normally marked by swellings, depression, lack of appetite, and increased respiratory rate. Most visibly, it causes puss-filled nodules that enlarge, ulcerate, and eventually drain.[73] It is through contact with these nodules that other animals and occasionally humans can catch the disease. At present, there is no vaccine for the disease.

The lethality of glanders and lack of a vaccine makes it an ideal biological warfare agent. There are even reports of the disease being used in this fashion in past wars. In World War 1, it is believed that the Germans intentionally spread glanders to decimate Russian horses and mules to disrupt weapon convoys, troop movements, and supply trains.[74] During the Cold War, the Former Soviet Union and the United States all studied the possibility of weaponizing glanders in biological warfare, but only the Former Soviet Union weaponized the disease, later deploying in Afghanistan in the 1980s.[75] This disease is tried and true for use as a biological weapon, and it isn't impossible to conceive that it could be released again in the future.

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71. Anthony Kettle and Paul Nicoletti, "Glanders," *Equine Infectious Diseases* 2, no. 1 (2014), 3.

72. Kettle and Nicoletti, "Glanders," 6.

73. Kettle and Nicoletti, "Glanders," 4.

74. Kettle and Nicoletti, "Glanders," 1.

75. Kettle and Nicoletti, "Glanders," 1.

Newcastle Disease Virus. Closely related to the measles virus, the Newcastle Disease Virus (NDV) is a neurotropic paramyxovirus that mainly affects poultry populations but is currently controlled in developed nations by mass vaccination.[76] It normally presents as an acute respiratory disease, but can also have symptoms like depression, nervous manifestations, or diarrhea.[77] The severity of the symptoms can often give clues to physicians on the virulence of the infectious disease.

NDV was first identified in Indonesia, and then again in Newcastle England in the late 1920s, although some scientists theorize that the disease was present as early as the 1890s were when a disease wiped out entire populations of wildfowl in Scotland.[78] From there, NDV ravaged bird populations all across England forcing the government to slaughter any bird they feared was infected by NDV.[79] This eradication policy didn't stop until the 1960s when vaccines were introduced for the disease, and the original epidemic was mostly contained.

NDV strains are indigenous to poultry in most of Asia, Africa, and some countries in both North and South America.[80] It is highly infectious, normally being passed through exhaled

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76. C.L. Parks, "Replication-Competent Viral Vectors for Vaccine Delivery," *Human Vaccines,* 2017, https://www.sciencedirect.com/topics/neuroscience/newcastle-disease-virus.

77. Patti Miller, "Newcastle Disease in Poultry," *Merck Manual,* https://www.merckvetmanual.com/poultry/newcastle-disease-and-other-paramyxovirus-infections/newcastle-disease-in-poultry, (accessed January 10, 2019).

78. LW Macpherson, "Some Observations on the Epizootiology of Newcastle Disease," *Canadian Journal of Comparative Medicine and Veterinary Science* 20, no. 5 (1956): 159.

79. "Newcastle Disease: Newcastle Disease Outbreaks in Great Britain," *Department for Environment Food and Rural Affairs,* December 29, 2006, https://web.archive.org/web/20070627003518/http:/www.defra.gov.uk/animalh/diseases/notifiable/newcastle/stats.htm.

80. Miller, "Newcastle Disease in Poultry."

air, respiratory discharges, and feces. It is also possible for the disease to be passed from a mother chicken to its eggs. [81] Fortunately, vaccines are available for most poultry, like chicken and turkeys, that can be used to help prevent the spread of the disease. These vaccines, plus strong import restrictions and eradication efforts have managed to keep the United States disease-free. As such, the last reported NDV outbreak within the United States occurred in 2002-2003, originating from illegally imported game fowl before moving on to domestic poultry.[82] The disease ultimately spread throughout four states affecting commercial markets before being contained.

Presently, a release of the NDV within the United States, especially at a higher concentration, would be devastating to the $42 billion-dollar poultry industry. Vienna Brown and Sarah Bevins explain, "a viral incursion of NDV into the U.S. could likely cause severe morbidity and mortality in the domestic poultry industry in addition to enormous economic losses primarily associated with trade restrictions."[83] An NDV biological attack against the United States would be devastating on multiple fronts.

Foot and Mouth Disease. Foot-and-Mouth Disease (FMD), not to be confused with Hand, Foot, and Mouth Disease that primarily affects children is a highly infectious animal disease caused by an *Aphthovirus* that mainly affects cloven-hooved animals such as cattle, pigs,

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81. Miller, "Newcastle Disease in Poultry."

82. "Newcastle Disease Standard Operating Procedures: Overview of Etiology and Ecology," *United States Department of Agriculture,* December 2013, https://www.aphis.usda.gov/animal_health/emergency_management/downloads/sop/sop_nd_e-e.pdf.

83. Vienna Brown and Sarah Bevins, "A Review of Virulent Newcastle Disease Viruses in the United States and the Role of Wild Birds in Viral Persistence and Spread," *Veterinary Research* 48, no. 68 (2017), 20.

sheep, goats, and possibly alpacas and llamas.[84] Infection of the disease is characterized by fever and fluid-filled cysts that normally appear around the mouth and feet, giving it its name 'Foot-and-Mouth Disease.[85] Any outbreak of FMD could have devastating effects, especially given the United States' massive cattle industry.

The earliest description of what was likely FMD occurred in 1514 in Italy. Hieronymi Fracastorii described a disease only affecting cattle resulting in blisters appearing around the mouth and feet of infected animals.[86] From then on, reports all around the world emerged about a disease ravaging cattle population. It seemed no country was safe. Beginning in the 1900s, scientists started to isolate different strands of the FMD virus, resulting in at least seven variations that were unique to the areas affected.[87] Today, the disease continues to exist in Asia, Africa, and the Middle East. Australia, New Zealand, Indonesia, Central and North America (the last outbreak in the United States occurred in 1929)[88], and continental Western Europe have been developed free of FMD, but due to the contagious nature of FMD, could fall victim to the disease at any time in the future.

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84. David Ashford, "Overview of Foot-and-Mouth Disease," *Merck Manual,* https://www.merckvetmanual.com/generalized-conditions/foot-and-mouth-disease/overview-of-foot-and-mouth-disease, (accessed January 10, 2019).

85. Ashford, "Overview of Foot-and-Mouth."

86. NJ Knowles, "Molecular and Antigenic Variation of Foot-and-Mouth Virus," *Council for National Academic Awards,* March 1990, http://www.picornaviridae.com/aphthovirus/fmdv/fmd_history.htm.

87. Knowles, "Molecular and Antigenic Variation of Foot-and-Mouth Virus."

88. "Foot and Mouth Disease Factsheet," *ACVP,* July 2012, https://www.acvp.org/page/Foot_Mouth_Disease.

FMD is considered the most dangerous threat to cattle populations around the world, mostly due to its contagious and infectious nature. While its fatality rate is low, its morbidity rate is nearly 100% meaning that if even one animal were to catch the disease, it would nearly always infect the rest of the herd, as the disease can be spread through both contact and the air.[89] For these reasons, FMD countries must remain constantly vigilant of a possible FMD infection. A naturally occurring outbreak of FMD would be hurtful, but an intentional release of FMD on cattle populations around the country would be devastating. For example, the 2001 FMD outbreak in the United Kingdom caused losses of more than 10 billion dollars. An FMD outbreak in South Korea cost the government nearly $2.7 billion.[90] An outbreak in the United States could cost the government even more.

Nipah Virus. The Nipah Virus (NiV) is considered a Category C pathogen by the CDC, essentially meaning it is a third priority disease because it is still emerging and could be weaponized in the future. Like Ebola, NiV is a relatively new virus whose causative agent was first identified in 1999 during an outbreak in Malaysia.[91] The disease is typically found in pigs and, due to its zoonotic nature, humans in close contact with pigs. It has theorized that the disease was originally transmitted from bats to pigs and then from pigs to humans. The disease

89. "Foot and Mouth Disease (FMD)," *World Organization for Animal Health,* August 2018, http://www.oie.int/animal-health-in-the-world/animal-diseases/foot-and-mouth-disease/.

90. "Foot and Mouth Disease," *Australian Government Department of Agriculture and Water Resources,* January 18, 2017, http://www.agriculture.gov.au/pests-diseases-weeds/animal/fmd.

91. "Nipah Virus (NiV)," *Centers for Disease Control and Prevention,* May 30, 2018, https://www.cdc.gov/vhf/nipah/index.html.

can be transmitted directly from bats to humans and humans to humans with direct contact.[92] It is also possible to catch the disease with direct contact with infected items, like clothing or food.

Most commonly, NiV presents with inflammation of the brain after a five to 14-day incubation period. Other common symptoms include fever, headache, drowsiness, disorientation, mental confusion, and serious nervous system deterioration. Within 48 hours of presenting these symptoms, infected patients can go into a coma.[93] Approximately 40% of the infected die from their symptoms.[94]

As for pigs, the disease manifests with difficulty breathing, convulsions, harsh coughs, and pneumonia.[95] Like FMD, NiV has high morbidity rates, but low mortality rates. Its harsh effects on populations and the economy often stem from the need to euthanize contaminated pig populations to protect human populations and prevent further spread. There is no true treatment for NiV; doctors normally focus on treating the symptoms in hopes that the patient will recover.

Currently, the disease has only been reported in India and some South Asian nations, although since the disease is so new, it is impossible to know where else the disease may naturally occur.[96] Given this lack of information, a release of NiV within the United States could be devastating, as the U.S. has never had to contend with this disease and there are no treatments

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92. "Nipah Virus (NiV) Transmission," *Centers for Disease Control and Prevention,* March 20, 2014, https://www.cdc.gov/vhf/nipah/transmission/index.html.

93. "Nipah Virus (NiV) Signs and Symptoms," *Centers for Disease Control and Prevention,* March 20, 2014, https://www.cdc.gov/vhf/nipah/symptoms/index.html.

94. "Nipah Virus (NiV) Signs and Symptoms," *Centers for Disease Control and Prevention.*

95. "Controlling and Storing Medicines," *The Pig Site,* http://www.thepigsite.com/diseaseinfo/74/nipah-virus-disease/, (accessed January 10, 2019).

96. "Nipah Virus (NiV)," *Centers for Disease Control and Prevention.*

available. Its high morbidity rate and long incubation period also lead to more widespread contamination without knowledge of an outbreak. However, its relative newness also makes the disease harder to weaponize and is likely an emerging threat over a present one.

Citrus Greening. Citrus greening, also known as *Huanglongbing* (HLB) or yellow dragon disease, is a serious citrus plant disease caused by the disease-infected insects, called the Asian citrus psyllid.[97] While the disease causes no harm to humans, it can be devastating for American citrus plants. The disease causes trees to produce plants that are green, misshapen, bitter, and unsuitable for sale. Once a tree has been infected, it is impossible to cure, and the tree normally dies within a few years.[98] Even though there is no cure, citrus greening can normally be prevented with proper use of pesticides and increased vigilance in monitoring insect populations near citrus trees.

Currently, the disease is mainly found in multiple citrus-producing states and the U.S. Virgin Islands, as well as China and Brazil, however; the disease has also been reported in all Asian nations except Japan and multiple other South American nations.[99] It is believed that the disease originated from China almost a hundred years ago and then spread with the help of migrating insects as well as increased trade routes to multiple other countries. Its first reported occurrence in the United States was in 2005, and within three years the disease had spread to

97. "Citrus Greening," *United States Department of Agriculture,* https://www.aphis.usda.gov/aphis/resources/pests-diseases/hungry-pests/the-threat/citrus-greening/citrus-greening-hp, (accessed January 10, 2018).

98. "Citrus Greening." *United States Department of Agriculture.*

99. "A History of Citrus Greening," *Florida Citrus,* https://www.floridacitrus.org/newsroom/citrus-411/citrus-greening/a-history-of-citrus-greening/, (accessed January 10, 2019).

affect nearly 80% of all citrus within Florida.[100] Today, the disease is still being reported in six US states and as such citrus from those states is heavily regulated.

The devastating effects from naturally occurring outbreaks of citrus greening, showcase just how devastating an intentional release of the disease could be, especially in places like California, which does not always maintain consistent pesticide use.[101] Citrus greening is an easily acquired disease that can be released on unsuspecting citrus farms, turning a once profitable expenditure into a very costly one.

Bacterial Wilt, Brown Rot. Ralstonia, also known as Bacterial Wilt, Brown Rot because of its symptoms, is a plant disease caused by the bacterium *Ralstonia solanacearum.*[102] It is a soil-borne disease that causes bacterial wilting and brown rotting in a variety of host plants, but most notably potatoes and tomatoes.[103] In potatoes, the first symptoms of the disease include general wilting and yellowing of leaves. Once cut open, the potatoes often produce bacterial slime, a unique indicator of the infection. In contrast, tomatoes showcase their symptoms in their youngest leaves beginning with wilting and then the rest of the plant will wilt soon after. Tomatoes also ooze bacterial slime when cut open and normally seem stunted in growth.[104]

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100. "Citrus Greening." *United States Department of Agriculture.*

101. Ian Lovett, "Threat to California Citrus May Finish Backyard Trees," *The New York Times,* April 17, 2012, https://www.nytimes.com/2012/04/18/us/citrus-greening-disease-threatens-california-trees.html.

102. "Bacterial Wilt, Brown Rot," *Koppert Biological Systems,* https://www.koppertus.com/challenges/disease-control/bacterial-wilt-brown-rot/, (accessed January 10, 2019).

103. "Bacterial Wilt, Brown Rot." *Koppert Biological Systems.*

104. "Bacterial Wilt, Brown Rot." *Koppert Biological Systems.*

The disease is thought to have originated from Brazil in the early 1920s, where it is still present today, but it is possible that the disease could have originated from any tropical, sub-tropical, or temperate nation as it is mostly found in those climates.[105] Not much else is known overall about its exact origins or history.

While Ralstonia is not found in the United States, there have been isolated cases in 2003 and 2004 where it was imported via tropical climate nations to private greenhouses.[106] In both cases, the disease was quickly isolated and eradicated. Despite its lack of appearances in the United States, or perhaps because of it, Ralstonia is considered a bioterrorist organism in the United States.[107] In this way, any occurrence of the disease within the United States is treated as a biological attack against its agriculture and requires an in-depth response to ensure the disease's containment and eradication.

Brown Stripe Downy Mildew. Maize is the most widely produced grain in the United States, so any disruption to that production would be devastating. Brown Stripe Downy Mildew is a plant disease caused by the pathogen *Sclerophthora rayssiae* and has been deemed as a potential biological weapon threat against the United States. Estimates in 2005 suggest that "even if only 20% of the [maize] crop was affected, this could translate into a $4 billion loss.[108]

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105. Carlos Lopes and Mauricio Rossato, "History and Status of Selected Hosts of the Ralstonia Solanacearum Species Complex Causing Bacterial Wilt in Brazil," *Frontiers in Microbiology* 9, no. 1 (2018): 1228.

106. "Ralstonia," *United States Department of Agriculture,* July 27, 2018, https://www.aphis.usda.gov/aphis/ourfocus/planthealth/plant-pest-and-disease-programs/pests-and-diseases/sa_plant_disease/sa_ralstonia/ct_ralstonia.

107. "Bacterial Wilt, Brown Rot." *Koppert Biological Systems.*

108. Melodie Putnam, "Brown Stripe Downy Mildew (Sclerophtora Rayssiae Var. Zeae) of Maize," *Plant Health Progress,* November 8, 2007, https://www.plantmanagementnetwork.org/pub/php/diagnosticguide/2007/stripe/.

Due to these devastating effects, it is important for the United States to be able to quickly recognize, diagnose, and contain any possible outbreaks of brown stripe downy mildew.

Maize that has been infected with brown stripe downy mildew tend to have leaves with yellow, red, or purple stripes that run parallel to each other from one end of the leaf to the other. Leaves on the bottom of the maize plant will show more severe signs of infection than those at the top; however, in most cases the actual maize is unaffected.[109] The disease is often spread through infected plant debris traveling by wind to other maize plants, reminiscent of pollination, but with a far more severe result.

The disease is not normally found in the United States, but rather in places with extremely heavy rainfall. It was first discovered in 1962 in India and has since spread across Asia to infect fields in Myanmar, Nepal, Pakistan, and Thailand.[110] As a result, any introduction into the United States has the potential to be extremely devastating as we have not yet had to deal with this type of pathogen.

Bacterial Leaf Streak. Bacterial Leaf Streak is a disease found primarily in corn, but also in sugarcane, caused by the bacteria *Xanthomonas vasicola.*[111] The disease was first confirmed in the United States in 2016 on Nebraskan corn. Since that diagnosis, the bacteria have spread to Colorado, Illinois, Iowa, and Kansas.[112] Before this, the bacteria had only been found in corn fields in South Africa.

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109. Putnam, "Brown Stripe Downy Mildew."

110. Putnam, "Brown Stripe Downy Mildew."

111. Tamra Jackson-Ziems, "Bacterial Leaf Streak," *Institute of Agriculture and Natural Resources Cropwatch,* https://cropwatch.unl.edu/bacterial-leaf-streak, (accessed January 10, 2019).

112. Jackson-Ziems, "Bacterial Leaf Streak."

Symptoms for bacterial leaf streak can present like other diseases, causing misdiagnoses and confusion. Normally, bacterial leaf streak manifests as narrow stripes between the leaf veins that can be brown, orange, or yellow and have slightly wavy edges, in contrast to more common fungi.[113] In terms of prevention, not much is known how to prevent the disease, but most commonly farmers use foliar fungicides and other bacterial management processes in hopes to stem the spread; however, these processes are unlikely to treat or eradicate the disease.[114] The lack of treatment leaves all corn populations within the United States at risk.

Most recently, the disease was confirmed in Wisconsin corn in 2018. Wisconsin was said to have had one of their best production seasons for corn before diseases began devastating their supply.[115] However, after previous diagnoses in the United States of the same disease, Wisconsin was better prepared to handle an outbreak and is said to be managing it quite well despite the lack of research done on bacterial leaf streak.

Given this unknown quality, bacterial leaf streak could make for a devastating agricultural biological attack because so little research has been done and there are no current 'tried and true' containment methods. A successful attack on corn populations within the United States could devastate production, exports, and eventually the overall economy.

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113. Jackson-Ziems, "Bacterial Leaf Streak."

114. Jackson-Ziems, "Bacterial Leaf Streak."

115. Damon Smith, "Bacterial Leaf Streak of Corn Confirmed for the First Time in Wisconsin," *Integrated Pest and Crop Management,* September 13, 2018, https://ipcm.wisc.edu/blog/2018/09/bacterial-leaf-streak-of-corn-confirmed-for-the-first-time-in-wisconsin/.

Diseases Affecting Water

In addition to diseases directly affecting humans, livestock, and crops, some diseases indirectly affect these groups as well. Specifically, diseases affecting water, such as cholera, have the potential to devastate fresh water supply within the United States and lead to population and economic downfall. The CDC classifies all water toxins as Category B pathogens, indicating that they are the second highest priority for the United States behind highly contagious diseases like smallpox and Ebola. For this thesis, this chapter will look at two different toxins affecting water supply: the bacteria-caused Cholera and the parasite-caused Crypto.

Cholera *(Vibrio cholerae).* Cholera is most infamously known because of cholera pandemics in the United States in 1832 and 1849. It is believed that nearly 150,000 people died as a result of cholera-contaminated water.[116] Despite its high notoriety, these two incidents were only small parts of the overall second and third cholera pandemics. Cholera pandemics have been broken down into seven different pandemics, separated by the years in which each smaller outbreak occurred. The first pandemic was reported in 1817 in Bengal but had spread across India by 1820. It is estimated that hundreds of thousands of British troops in India, as well as Indians, died as a result of the pandemic.[117] Almost exactly two hundred years later, the world is experiencing the biggest cholera pandemic to date within Yemen. Nearly one million people have been infected, and the death toll continues to rise as the country is amid a civil war.

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116. William Beardslee, "The 1832 Cholera Epidemic in New York State: 19th Century Responses to Cholerae Vibrio," *Varsity Tutors,* https://www.varsitytutors.com/earlyamerica/early-america-review/volume-4/the-1832-cholera-epidemic-part-2, (accessed January 10, 2019).

117. J. Pike, "Cholera-Biological Weapons," *Global Security,* October 23, 2007, https://www.globalsecurity.org/wmd/intro/bio_cholera.htm.

In contrast, the disease has been practically eradicated from the developed world. The last known case in the United States was in the early 1900s, and now cholera is mostly found in sub-Saharan Africa, the Middle East, and parts of Asia.[118] War-torn nations are particularly vulnerable.

At its core, cholera is an acute diarrhoeal infection caused by the bacterium *Vibrio cholerae* that typically infects people via contaminated food and water.[119] While it is most commonly caused by infected water, it is also possible to 'catch' cholera from a person who has already been infected as their bodily fluids tend to contain large amounts of *Vibrio cholerae.* A cholera infection can manifest itself in many ways including profuse diarrhea, vomiting, rapid heart rate, loss of skin elasticity, dry mucous membranes, low blood pressure, unquenchable thirst, muscle cramps, and restlessness.[120] Despite these nightmare-ish symptoms, cholera is very treatable and normally only a small percentage of the infected pass away. The disease can be treated by common antibiotics and replenishing fluids.

As an easily treated disease, it might seem like cholera would not be a great biological weapon choice, but its utility lies in its ability to disrupt agriculture and livestock production as well as cause panic across the United States. By infecting a regularly used clean water supply that may be used for irrigating fields, terrorists have the potential to contaminate entire farms full of produce and livestock, spreading the disease easily and likely causing a severe economic disruption while the United States' government works to contain such an outbreak.

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118. "Cholera," *World Health Organization,* http://www.emro.who.int/health-topics/cholera-outbreak/index.html," (accessed January 10, 2017).

119. "Cholera." *World Health Organization.*

120. "Cholera Infection Illness and Symptoms," *Centers of Disease Control and Prevention,* October 3, 2014, https://www.cdc.gov/cholera/illness.html.

Cryptosporidiosis. *Cryptosporidium* is not a pathogen, but rather a microscopic parasite that, like cholera, is a diarrheal disease called cryptosporidiosis. Both the parasite and the disease are more commonly known as "Crypto."[121] The parasite is unique in that its outer shell allows it to protect itself from common disinfection methods, making it the leading cause of waterborne illness within the United States.[122] The disease is most commonly spread through water, drinking and recreational, but it can also be spread through other contaminated materials.

The disease manifests in much the same way as cholera. It has similar symptoms like vomiting, watery diarrhea, dehydration, and fever.[123] For this reason, the disease can often be misdiagnosed in areas where both crypto and cholera are common.

Crypto was first discovered in 1907 after scientists recorded the disease in mice. The first human case wasn't reported until 1976, and by 1980 only seven human cases had been confirmed.[124] Today, the parasite can be found worldwide and contributes to nearly half of all waterborne parasitic diseases.[125] Within developing nations, nearly 8-19% of the population is infected, but the number lowers to 1-3% in developed nations.[126] In the United States, it is

121. "Parasites: Cryptosporidium (Also Known as Crypto)," *Centers for Disease Control and Prevention,* January 12, 2017, https://www.cdc.gov/parasites/crypto/index.html.

122. "Parasites: Cryptosporidium." *Centers for Disease Control and Prevention.*

123. "Parasites: Cryptosporidium (Also Known as Crypto) Illness and Symptoms," *Centers for Disease Control and Prevention,* February 20, 2015, https://www.cdc.gov/parasites/crypto/illness.html.

124. Jerlyn Sponseller, Jeffrey Griffiths, and Saul Tzipori, "The Evolution of Respiratory Cryptosporidiosis: Evidence for Transmission by Inhalation," *Clinical Microbiology Reviews* 27, no. 3 (2014): 580.

125. "Parasites: Cryptosporidium." *Centers for Disease Control and Prevention.*

estimated that nearly 30% of the population has contracted the parasite at least once in their lifetimes.[127] Presently, other than anti-parasitic drugs, there is no recommended treatment for Crypto and doctors tend to treat the symptoms while patients wait for recovery.

As a Category B disease, Crypto, like cholera, would be best used intentionally as a disruptive and panic-causing biological agent. Its quick infection rate and ability to infect water and spread to both animals and humans would likely cause economic damage due to disrupted agricultural exports and human panic given an unprecedented nation-wide infection.

Summary

All diseases in this section have the potential to be devastating to the United States in some way. Some of these diseases could cause human turmoil, while others' utility lies in their panic-inducing possibilities. Still, others could become a significant threat to the economy. Either way, a clear understanding of the diseases that the United States is most notably at risk for during a biological attack creates the basis for which the rest of this thesis is built.

126. Wangeci Gatei et al, "Cryptosporidiosis: Prevalence, Genotype Analysis, and Symptoms Associated with Infections in Children in Kenya," *The American Society of Tropical Medicine and Hygiene* 75, no. 1 (2006): 79.

127. Ali Mumar et al, "Prevalence, Clinical Presentation and Treatment Outcome of Cryptosporidiosis in Immunocompetent Adult Patients Presenting with Acute Diarrhea," *Journal of Pakistan Medical Association* 64, no. 6 (2014): 615.

CHAPTER III: ANALYSIS OF STATE BIOLOGICAL WEAPONS PROGRAMS

Biological warfare has become synonymous with images of grotesque diseases and biohazardous shallow graves full of corpses. Their innate destructive nature is what has led multiple countries to pursue biological weapons programs throughout the 20th and 21st centuries. Biological weapons were especially sought by nations that think they face an existential threat in the Middle East and felt they needed better weapons for a more effective deterrent. While most biological weapons programs focus on human-targeted pathogens, some programs also focus on agents that can attack food sources, like crops and livestock, or water sources. This chapter will discuss the biological weapons programs of Syria, Iran, North Korea, China, and Russia. This list is most certainly not comprehensive but is enough to demonstrate the threat faced by American assets at home and abroad.

These five nations were chosen because there is adequate information available on their programs and all these nations are considered adversaries of the United States. The following country profiles will analyze a variety of aspects of the biological weapons program including the history of the program, what weapons it has studied and tested, any anti-agricultural uses, what actors in the state potentially have access to the weapons and their intent to use the weapons, and any previous instances of use of biological weapons.

Syria

Syria has one of the most significant biological weapons programs known to the Middle East. Syria has signed, but has not ratified, the Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons

and their Destruction (BWC) on April 14, 1972.[128] However, just two years later in February 1974, the current U.S. Army Chief of Staff General Creighton Abrams mentioned the 'sophistication, completeness, and extensiveness'[129] of Syria's biological weapons program as seen during the Arab-Israeli war of October 1973. That was the last official mention of Syria's biological program until nearly 20 years later when the then current Director of U.S. Naval Intelligence, Rear Admiral Thomas A. Brooks, made a statement in front of the then Seapower, Strategic, and Critical Materials Subcommittee of the House Armed Services Committee confirming Syria's offensive biological weapons capability.[130]

The next 30 years were marked by consistent reports from various governments remarking on the likelihood of a covert Syrian biological weapons program. The resulting program was likely a Frankenstein'ed version of the cold war powers' biological weapons programs including assistance and materials from the former Soviet Union, North Korea, China, and other axis powers. However, despite this evidence, Syria continued to deny the program. In November 2005, Syria submitted a report to the United Nations stating, "The Syrian Arab Republic is a State that neither possesses nor intends to acquire weapons of mass destruction, their means of delivery, or related materials, as Syria has made it clear in a number of statements presented to the United Nations, the Conference on Disarmament in Geneva, and the First

128. Kelsey Davenport, "Biological Weapons Convention Signatories and States-Parties," *Arms Control Association,* September 2018, https://www.armscontrol.org/factsheets/bwcsig.

129. John W. Finney, "Abrams Cites Intelligence Gained from Soviet Arms in Mideast," *New York Times,* February 15, 1974, p. 4.

130. Rear Admiral Thomas A. Brooks, "Intelligence Issues," *Seapower, Strategic, and Critical Materials Subcommittee of the House Armed Services Committee,* March 7, 1991, pp. 56-59.

Committee of the General Assembly in New York, which deals with disarmament issues."[131] The document also explicitly mentions Syria's lack of biological weapons. But just two years later, American Biodefense expert Jill Bellamy-Dekker theorized that Syria was willing and ready to use biological weapons in Europe and Israel if the United States moved against Iran's nuclear facilities. Bellamy-Dekker also hypothesized that Syria's study of the camel-pox virus could lead to a weaponized version of smallpox.[132] Despite these theories that Syria had a limited biological agent development program, it was unclear whether Syria could successfully weaponize the diseases. It was not until 2012 that a spokesman for the Syrian Foreign Ministry confirmed that the country possessed biological warfare materials.[133] In 2013, the US Director of National Intelligence confirmed Syria's stated biological warfare program after the Syrian government sent the Syrian military to guard all biological stockpiles and testing sites.[134]

Despite the confirmation, not much is known about Syria's biological program. Syria's runs its suspected primary biological-weapon programs out of the Scientific Studies and Research Center (SSRC) in Damascus, with additional laboratories in Aleppo and Homs.[135] However, it has hard to confirm biological weapon development because the infrastructure

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131. "Amended National Report of the Syrian Arab Republic," *Permanent Mission of the Syrian Republic to the United Nations,* United Nations Security Council, 10 November 2005.

132. Jerome R. Corsi, "Syria ready with bio-terror if U.S. hits Iran: Damascus reportedly hiding WMD among commercial pharmaceuticals," World Net Daily, 5 March 2007 www.worldnetdaily.com.

133 "Chemical and Biological Weapons Status at a Glance," *Arms Control Association,* June 22, 2018, https://www.armscontrol.org/factsheets/cbwprolif.

134. Jill Bellamy Van Aalst and Olivier Guitta, "Syria's Real Threat: Biological Weapons," September 19, 2013, http://nationalinterest.org/commentary/syrias-real-threat-biological-weapons-9093.

135. Van Aalst and Guitta, "Syria's Real Threat."

needed for creating weaponized viruses and vaccines is typically the same. Unlike chemical weapons, which can be counted, and stockpiled, biological weapons are living organisms that are not generally stockpiled so it is hard to know exactly where, what, and how much the government may be researching and for what purposes.

As well, due to the nature of Syria's government, it is likely that any biological program is run out of several facilities, including military and civilian veterinary labs, pharmaceutical labs, agro-industries, and even public-health institutes.[136] This situation embodies the threat that the United States faces from dual-use technology. Nations that benefit from state-run public medicine have valid excuses if caught studying infectious diseases, especially since the process of making a disease a weapon and a disease a vaccine are nearly identical until the end.

By analyzing research in both the private and public spheres in Syria, experts have been able to speculate on what diseases Syria possesses and how much of a threat those diseases pose. To help designate threat levels, the Center for Disease Control has categorized different pathogens into three different categories: Category A, Category B, and Category C. They intend to better prepare for biological attacks, by recognizing and designating which pathogens are the most threatening. Category A, the highest priority disease agents is defined as, "organisms that pose a risk to national security because they can be easily disseminated or transmitted from person to person, result in high mortality rates and have the potential for major public health impact, might cause public panic and social disruption, and require special action for public health preparedness."[137] Category B agents are defined as "moderately easy to disseminate,

136. Van Aalst and Guitta, "Syria's Real Threat."

137. "Category A: Bioterrorism Agents/Diseases," *Centers for Disease Control and Prevention.*

result in moderate morbidity rates and low mortality rates, and require specific enhancements of the CDC's diagnostic capacity and enhanced disease surveillance."[138] Category C agents include "emerging pathogens that could be engineered for mass dissemination in the future because of availability, ease of production and dissemination, and potential for high morbidity and mortality rates and major health impact."[139]

Syrian Biological Weapon expert Dr. Jill Dekker explains that Syria has done work on most Category A pathogens, including anthrax, plague, tularemia, botulinum, smallpox, aflatoxin, cholera, ricin, and camelpox, likely making their program one of the deadliest in the Middle East.[140] Its work on anthrax and smallpox specifically was very advanced. Dr. Dekker noted that Syria has extensive expertise in the industrial cultivation of germs and viruses for the civilian production of anthrax vaccines, also mentioning that Syria had contacted Russian biological experts to help it create an anthrax germ capable of being installed in missile warheads.[141]

However, most notable about Syria is that it likely stockpiles the smallpox virus. The smallpox disease is not a zoonotic disease, meaning that it cannot transfer between humans and animals and vice versa, so when the world successfully eradicated smallpox, it should have been

138. "Category B," *Centers for Disease Control and Prevention,* April 4, 2018, https://emergency.cdc.gov/agent/agentlist-category.asp#catdef.

139. "Category C," *Centers for Disease Control and Prevention,* April 4, 2018, https://emergency.cdc.gov/agent/agentlist-category.asp#catdef.

140. Jerry Gordon, "Syria's Bio-Warfare Threat: An Interview with Dr. Jill Dekker," *New English Review,* December 2007, https://www.newenglishreview.org/custpage.cfm/frm/13108/sec_id/13108.

141. Gordon, "Syria's Bio-Warfare Threat."

gone for good.[142] The only two confirmed stockpiles of smallpox are contained within the United States and Russia. However, it is speculated that Syria may have used its smallpox outbreak in 1972 to stockpile the disease. It could have also stolen the illness from the former Soviet Union's stockpiles. As smallpox was eradicated nearly 40 years ago, countries have become more relaxed about requiring vaccinations, so an intentional release of smallpox today would be devastating.

However, just the existence of a program is not enough to indicate a valid threat to the United States. Threat is derived from two things: capability and intent. To measure the threat posed to the American assets by Syria's biological weapons program, we must look at both its capabilities and its intent. It is clear from the above information that Syria has the skill to produce weaponized pathogens. Its research into several Category A pathogens, especially smallpox and anthrax, shows that if Syria wants to weaponize and deploy a biological agent, it can do so, but now we must also look at whether Syria has the intent to deploy a biological attack against the United States. To do this, it is essential to look at what actors play a role in the Syrian government and could potentially have access to these biological weapons. In the case of Syria, four main actors could gain access to Syria's biological weapons. This includes the ruling government of President Bashar al-Assad and his Arab Socialist Ba'ath Party, two opposition forces, the Free Syrian Army and the Syrian Democratic Forces, and the Islamic State in Iraq and Syria (ISIS). By looking at the intentions of all four of these actors, we can determine the possibility of any of these government using biological weapons to achieve their means.

First, let's discuss the government of President Bashar al-Assad. After a long civil war, President Bashar al-Assad regained victory in Syria, minus one terrorist stronghold and

142. "Smallpox: Emergencies Preparedness, Response," *World Health Organization,* 2018, https://www.who.int/csr/disease/smallpox/en/.

opposition holdout, with the help of its allies Russia and Iran. Through the Syrian civil war, President Assad has had one primary goal, to reunify his nation under his control and defeat the so-called 'terrorist opposition forces.'[143] He has shown with his previous actions that he is willing to do nearly anything to achieve his goal. In the past, this has included using chemical weapons against his people.

As recently as April 2018, Assad has been accused of using chemical weapons against his citizens in Douma.[144] This previous use of chemical weapons proves that Assad's Syrian State is not afraid to use Weapons of Mass Destruction, it isn't difficult to suggest that Assad would also be willing to use biological weapons as well. However, biological weapons do pose a secondary threat to the Assad regime that chemical weapons do not, namely the danger of contamination. Biological agents are living organisms that are not easily contained once released. Diseases like smallpox and anthrax are highly contagious and are not constrained by borders. If Assad were to use biological weapons, it is possible he could infect those loyal to him, which in theory could decrease his will to use them. However, expert Dr. Jill Dekker asserts that it may not be an issue. She explained, "in a retaliatory strike, biological weapons could be effectively released on an unsuspecting population in a geographic region that would not pose a direct health threat to Assad's government or military."[145] This essentially means that the Assad regime could release the pathogen without adverse effects returning on his party.

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143. "Syrian President Bashar al-Assad: Facing Down Rebellion," *BBC News,* September 3, 2018, https://www.bbc.com/news/10338256.

144. "Syria War: What we know about Douma 'Chemical Attack,'" *BBC News,* July 10, 2018, https://www.bbc.com/news/world-middle-east-43697084.

145. Van Aalst and Guitta, "Syria's Real Threat."

As well, Syria's former Minister of Foreign Affairs during Assad's reign had this to say on the use of biological weapons, "No chemical or biological weapons will ever be used… unless Syria is exposed to external aggression."[146] This statement in itself is proof that Syria does have the will to use biological weapons if it feels the need to do so. In this case, the United States military presence in Syria may meet the criteria.

As for the two opposition forces, their intent with biological weapons is unclear at best. The Free Syrian Army aims to be "the military wing of the Syrian people's opposition to the regime[147] , and it aims to bring down the government by armed operations, encouraging army defections and by carrying out armed action."[148] Nothing in their stated goal would lead to the belief that they would use biological weapons, conventional weapons yes, but not biological. Also given their proclivity for more closely following international laws surrounding warfare, like avoiding attacking civilians when possible, indicates a lower willingness to utilize WMD. The same can be said of the Syrian Democratic Forces (SDF). The SDF is an alliance of Kurdish, Arab, Turkmen, Assyrian, and Armenian militias mainly fighting against ISIS and other Jihadist groups in the Syrian Civil War. The group holds territory in the Northeast, and its primary goal

146. "Biological Warfare in Syria: The Silent Weapon," *News Activist,* March 12, 2017, http://newsactivist.com/en/news-summary/contemporary-issues-winter-2017-centennial-college/biological-warfare-syria-silent.

147. Ruth Sherlock, "15,000 Strong Army Gathers to take on Syria," *The Telegraph,* November 3, 2011, https://www.telegraph.co.uk/news/worldnews/middleeast/syria/8868027/15000-strong-army-gathers-to-take-on-Syria.html.

148. "Syrian Army Colonel Defects forms Free Syrian Army," *Asharq Alawsat*, August 1, 2011, https://web.archive.org/web/20151126063655/http:/english.aawsat.com/2011/08/article55245595/syrian-army-colonel-defects-forms-free-syrian-army.

remains to "establish and protect the federal region Rojava-Northern Syria."[149] Again nothing in their doctrine or proclamations indicate that they would be willing to use biological weapons. Also, as this group and the Free Syrian Army are both backed with American support, it would be highly unlikely that either group would use biological weapons.

The wildcard player remains the remnants of the terrorist group, ISIS, that still resides in the area. ISIS is a Salafi jihadist militant group that follows a strict, fundamentalist Salafi doctrine of Sunni Islam.[150] Its goal is to return to the early days of Islam, and it rejects any newer innovations in the religion as it believes it to be corrupt. Its strict interpretation of Islam allows for no deviations. Non-believers and believers in a different interpretation are apostates and must be eliminated.[151] ISIS also believes in the coming apocalypse and is willing to do what is necessary to bring about the apocalypse as it is when the "glorious moment of divine comeuppance finally arrived."[152] As well, ISIS has indicated that if the opportunity to use WMD came about, they would unleash them to bring about the apocalypse. It then is not hard to argue that should the Islamic State find a way to possess biological weapons in Syria, then American troops in the Middle East would be at risk.

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149. "Syrian Democratic Forces (SDF)," *Syrian Civil War Map,* https://syriancivilwarmap.com/syrian-democratic-forces/.

150. Michael Kerr and Craig Larkin, "The Alawis of Syria: War, Faith, and Politics in the Levant," *Oxford University Press,* p. 21, ISBN 978-0-19-045811-9.

151. "Islamic State," *Australian National Security*, Australian Government, (accessed November 30, 2018).

152. Graeme Wood, "What ISIS Really Wants," *The Atlantic,* March 2015, http://www.theatlantic.com/magazine/archive/2015/03/whatisisreallywants/384980/ p. 22.

In the case of Syria, the biggest threat continues to come from the possibility of ISIS gaining control of biological weapons, while the second biggest comes from the potential of the Assad regime using biological weapons. In both cases, the threat is credible and must be taken seriously and monitored carefully.

Iran

Historically, Iran has denied the existence of a biological weapons program. The regime signed and ratified the BTWC in 1973, but the United States intelligence community has reported that while it does not have conclusive evidence that Iran has a military-ran biological weapons program, it does have an extensive dual-use infrastructure for biotechnology.[153] It is believed that Iran began its biological warfare research program during the Iran-Iraq War. Iran's interest was likely piqued because it was revealed that Iraq had increased its efforts to develop biological weapons to use against Iran possibly. As well, due to the high costs of war, biological weapons provided a cost-effective weapon that could also do substantial damage to enemy populations.[154] Just three years later, it was reported that high-level Iranian officials were approaching former Soviet Scientists to recruit them for Iran's burgeoning biological weapons program. Most of the offers were turned away, but some former Soviet scientists say that at least five of their colleagues took jobs with Iran continuing work on pathogen weaponization and several more accepted contracts that allowed them to remain in Russia while researching biological agent weapons for Iran.[155] The former Soviet Union's biological weapons program

153. "Iran," *NTI,* May 2018, https://www.nti.org/learn/countries/iran/.

154. "Biological Weapons," *Global Security,* https://www.globalsecurity.org/wmd/world/iran/bw.htm, (accessed December 8, 2018).

was considered the most extensive in the world, so by luring its former scientists to Iran, it had the chance to significantly increase the size and possible effectiveness of Tehran's biological weapons program. At that time, there was direct evidence that supported the claim that the former Soviet Union and modern Russia had helped Iran develop its chemical and nuclear missile capabilities, so it isn't hard to believe that Russia also helped develop Iran's biological weapons program.[156] The two countries are long-standing allies that have maintained that alliance even today with their work in Syria.

In a 2001 unclassified report to Congress, the U.S. Director of National Intelligence assessed that Iran, "probably has the capability to produce some biological warfare (BW) agents for offensive purposes, if it made the decision to do so [as] Iran continues to expand its biotechnology infrastructure and seek dual-use technologies that could be used for BW."[157] That same year, a plan called the Comprehensive National Microbial Defense Plan was adopted by Iran.[158] The project gave each ministry a specific task for increasing its biological warfare capabilities. Soona Samsami, a former U.S. representative of the National Council of Resistance, speculated that the Iranian biological research program primarily took place at the Tehran's

155. Judith Miller and William J. Broad, "Iranians, Bioweapons in Mind, Lure Needed Ex-Soviet Scientist," *The New York Times,* December 8, 1998, http://online.sfsu.edu/rone/GEessays/Iranians%20Bioweapons%20ExSoviet%20Scientists.htm.

156. Miller and Broad, "Iranians, Bioweapons in Mind."

157. "Acquisition of Technology Relating to Weapons of Mass Destruction and Advanced Conventional Munitions," *Unclassified Report to Congress,* 1 January - 30 June 2002, Central Intelligence Agency, www.fas.org.

158. Soona Samsami and Alireza Jafarzadeh, "Iranian Regime's Programs for Biological and Microbial Weapons," *Iran Watch,* May 15, 2003, https://www.iranwatch.org/library/ncri-iranian-regimes-programs-biological-weapons-5-15-03.

Pasteur Institute and the Vira Laboratory. However, there were also reports that research was ongoing at several state universities around the nation.[159]

Like Syria, Iran boasts an impressive dual-use biological research industry. Universities around the country like the Revolutionary Guard Imam Hussein University and the Malek Ashtar University were instrumental in researching several biological agents, both for vaccines and offensive weapons. According to Ms. Samsami, anthrax is still studied at Imam Hussein University, while the other has moved onto researching cloning and genetic alterations.[160] Iran also has considerable expertise with the commercial and military infrastructure needed to create and disseminate pathogens. Its pharmaceutical industry can be used for both offensive and vaccine-related reasons.

Also, like Syria, Iran studied most Category A diseases with some notable differences. Iran specifically attempted to make microbial bombs utilizing powdered versions of diseases, including anthrax, smallpox, and typhoid fever.[161] It is speculated that Iran's possible smallpox stockpile and delivery mechanisms are due to the Soviet scientists they possibly have on staff. In 2008, it was reported that Iran as likely produced both toxins and live organisms as biological warfare agents, perhaps even weaponizing a small portion of its arsenal. The same report indicated that within ten years, Iran's military forces "may be able to deliver biological agents effectively."[162]

159. Samsami and Jafarzadeh, "Iranian Regime's Programs."

160. Samsami and Jafarzadeh, "Iranian Regime's Programs."

161. Samsami and Jafarzadeh, "Iranian Regime's Programs."

162. "Biological Weapons," *Global Security.*

As with Syria, we need to examine Iran's will to use the biological warfare capability it likely possesses. Fortunately, unlike Syria, Iran is not amid a civil war, meaning that there are fewer actors within Iran that could gain access to biological weapons. Unfortunately, Iran is a continuing sponsor of terrorism meaning that there is a slight change Iran could provide its sponsored terrorist groups with biological weapons. In the case of Iran, we will examine the intent of Iran's president Hassan Rouhani, and then we will explore the aims of the terrorist groups Hezbollah and Hamas if either were to obtain biological weapons.

The government of Iran has not publicly confirmed the existence of its biological warfare program or its willingness to use such weapons. However, it has come out against the use of chemical weapons because Iran's soldiers were targeted with chemical weapons in the Iran-Iraq War.[163] While some people might believe that this would put Iran off using chemical and biological weapons, Iran has given no indication that it would limit itself in such a way. It is notable that Iran has expressed its desire to gain nuclear capabilities and has recently tested new missiles with the ability to reach American troops in the Middle East.[164] Iran's recent aggression towards the United States, since its withdrawal from the Iran deal, could indicate a willingness to attack American bases in the Middle East and given that the majority of Iran's biological weapons program focused on bombs that could carry microbes, it isn't too far of a leap to think that Iran using biological warfare is a possibility.

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163. "Expert: Don't Ignore Iran's Chemical, Biological Weapons Threat While Enforcing Nuclear Deal," *The Tower,* December 06, 2016, http://www.thetower.org/4249-expert-dont-ignore-irans-chemical-biological-weapons-threat-while-enforcing-nuclear-deal/.

164. Lucas Tomlinson, "Iran Test-fires Ballistic Missile for First Time in 2018, Officials Say," *Fox News,* August 10, 2018, https://www.foxnews.com/world/iran-test-fires-ballistic-missile-for-first-time-in-2018-officials-say.

As for the terrorist organizations that have close working ties with Iran, both groups are likely willing to use biological weapons, especially against Israel and its allies, including the United States. The primary goal of Hamas is to liberate Palestine from Israeli occupation by resisting the Israeli government.[165] Most recently, Hamas has worked towards this goal by launching rocket strikes against Israel in Gaza.[166] There have been no indications that Hamas would refuse to use certain weapons, like biological ones, to achieve their objectives in Palestine. However, it would pose a significant risk for Hamas to use biological weapons because the effects of pathogens, like infection, are harder to contain and could contaminate Hamas fighters.

On the other hand, the goals of Hezbollah revolve around expelling the 'colonist entity' from their land in Lebanon. This includes getting rid of all American, French, and other allied forces from the area.[167] Its founding Manifesto indicates that it has little to no problem utilizing whatever weapons at their disposal to achieve their means. It reads,

> Whatever touches or strikes the Muslims in Afghanistan, Iraq, the Philippines and elsewhere reverberates throughout the whole Muslim umma of which we are an integral part... No one can imagine the importance of our military potential as our military apparatus is not separate from our overall social fabric. Each of us is a fighting soldier. And when it becomes necessary to carry out the Holy War, each of us takes up his assignment in the fight by the injunctions of the Law, and that in the framework of the mission carried out under the tutelage of the Commanding Jurist.[168]

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165. "About Hamas," *The Islamic Resistance Movement*, http://hamas.ps/en/page/2/, (accessed December 2, 2018).

166. "Over 150 Rockets Launched into Israel, Woman Seriously Injured," *The Times of Israel,* August 9, 2018, https://www.timesofisrael.com/as-rocket-launches-top-150-idf-says-it-struck-over-100-hamas-targets/.

167. "The Hezballah Program: An Open Letter to the Downtrodden in Lebanon and the World," *International Institute for Counterterrorism,* February 16, 1985, https://web.archive.org/web/20060821215729/http:/www.ict.org.il/Articles/Hiz_letter.htm.

168. "The Hezballah Program," *International Institute for Counterterrorism.*

More specifically, Hezbollah describes any act of violence committed against an Israeli as 'legitimate resistance."[169] Both instances indicate that Hezbollah would be ready and willing to use biological weapons if they gain access to them.

But the likelihood of Iran giving either group biological weapons is small. According to Daniel Byman at the Brookings Institute, "Despite Iran's [genuine] support for terrorism for more than the last 25 years and its possession of chemical weapons for over 15 years, Tehran has not transferred unconventional systems to terrorists. Iran is likely to continue this restraint and not transfer chemical, biological, or nuclear weapons."[170] However, past precedent does not confirm that Iran would continue this restraint and it would be naïve to hope so. Iran continues to provide terrorist groups with conventional weapons; the next logical step would be providing those same organizations with WMD. However, even if Iran does provide biological weapons to these terrorist groups, they could still obtain these weapons by theft from the Iranian government. In all three instances: a biological attack from Iran itself, Hamas, or Hezbollah remains low risk/high impact, but possible.

North Korea

North Korea made a name for itself with its aggressive testing of ballistic weapons and nuclear capabilities, but the country has remained uncharacteristically quiet on the state of its biological weapons program. It was not until February 2017, when Kim Jong-Un's half-brother

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169. Hassan Nasrallah, "A Lethal Obsession," *Al-Manar TV,* May 22, 2002 in Wistrich, p. 774.

170. Daniel L. Byman, "Iran, Terrorism, and Weapons of Mass Destruction," *The Brookings Institute,* March 9, 2008, https://www.brookings.edu/articles/iran-terrorism-and-weapons-of-mass-destruction-2/.

was assassinated with the VX nerve agent, that the world shifted its focus from North Korea's nuclear program to the whole of its WMD program.[171] It has now been realized that North Korea has been acquiring biological weapons since the beginning of the Cold War.

As early as the 1960s, North Korea began a biological weapons programs according to South Korean intelligence reports and North Korea defectors.[172] Its biological weapons program is suspected of having been an entirely indigenous effort, unlike its chemical weapons program which was created with outside help.[173] Since then, North Korea has steadily been advancing its biological weapons program to match the rest of the world in military might, in both conventional and unconventional means. A 2016 White Paper from South Korea's Ministry of National Defense (MND) assessed that North Korea could cultivate various biological agents including anthrax and smallpox.[174] Both smallpox and anthrax are considered high priority biological agents due to their destructive nature.

At first, North Korea only imported cultures of causative agents for diseases like plague and cholera, but starting in the early 1980s, North Korea switched from pure research to production of biological weapons agents and began conducting tests on political prisoners.[175] To

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171. Elizabeth Philipp, Hyun-Kyung Kim, and Hattie Chung, "North Korea's Biological Weapons Program: The Known and Unknown," *Harvard Kennedy School Belfer Center,* October 2017, https://www.belfercenter.org/publication/north-koreas-biological-weapons-program-known-and-unknown.

172. "North Korea," *NTI,* July 2018, https://www.nti.org/learn/countries/north-korea/biological/.

173. Eric Croddy, Perez Armendariz, and John Hart, *Chemical and Biological Warfare: A Comprehensive Survey for the Concerned Citizen,* (New York: Springer-Verlag, 2002).

174. Republic of Korea, Ministry of National Defense, "2012 Defense White Paper," p. 36, www.mnd.go.kr.

stem the production of biological weapons by North Korea, countries around the world attempted to strengthen export controls that would prevent North Korea from acquiring dual-use technologies that would enable it to continue its biological weapons program. However, North Korea proved resourceful in finding ways around these protocols. For example, in 2006, it was discovered that North Korea had obtained a freeze dryer that could be used to freeze-dry pathogens for extended storage of pathogens from a Tokyo-based company.[176] This resourcefulness combined with a strong desire for a biological weapon capability enabled North Korea to grow its biological program from the small research-based entity it once was into a flourishing new capability.

More recently, Kim Jong Un was seen touring one of North Korea's biotechnology facilities, and the images showed that not only does the site have dual-use capabilities, but it could also produce large batches of weaponized anthrax.[177] Still, due to the opacity of the North Korean regime, knowledge on the extent of North Korea's current biological weapons program is lacking. The most recent report comes from an analysis issued by the Middlebury Institute of International Studies at Monterey in December 2018. It reports that North Korea has been working with foreign nations and researchers to build better biotechnology skills and machinery, hence increasing their current biological capabilities.[178] But it's a 2017 report from Harvard's

175. "Strategic Weapon System, Korea, North," *Jane's Sentinel Security Assessment,* July 5, 2010.

176. Kim Cheol-hoon, "DPRK Probably Produced Centrifuge to Produce Biological Agents," *U.S. Army Asian Studies Detachment,* November 22, 2006, www.kinds.or.kr.

177. Melissa Hanham, "Kim Jong Un Tours Pesticide Facility Capable of Producing Biological Weapons: A 38 North Special Report," *38 North,* July 9, 2015, www.38north.org.

Belfer Center that touches on the extent and readiness of North Korea's capabilities, explaining that North Korea possesses several types of pathogens and dual-use facilities capable of biological agent production.[179] The South Korea government even estimates that North Korea could have its biological agents weaponized and ready to deploy in under ten days.[180] All of these reports lead to one assured conclusion; the North Korean government possesses biological weapons and is capable of using them.

North Korea has multiple labs where it can produce and weaponize biological agents, but its lead research facility, according to North Korean defector Colonel Ju-Hwal Choi, is the Germ Research Institute of the Armed Forces Ministry.[181] Other facilities include the Pyongyang Biotechnical Institute and the Academy of National Defense. While the world agrees over the fact that North Korea has biological weapons, there are conflicting reports on what types pathogens are used in North Korea's program. Jane's Sentinel Security Assessments suggests the Korean People's Army (KPA) inventory might include the causative agents "Bacillus antrhacis (Anthrax), Clostridium botulinum (Botulism), Vibrio cholera (Cholera), Hantavirus (Korean Hemorrhagic Fever), Yersinia pestis (Plague), Variola (Smallpox), Salmonella typhi (Typhoid Fever), and Coquillettida fuscopennata (Yellow Fever)."[182] However, audit documents done by

178. Emily Baumgaertner and William J. Broad, "North Korea's Less-Known Military Threat: Biological Weapons," *The New York Times,* January 15, 2019, https://www.nytimes.com/2019/01/15/science/north-korea-biological-weapons.html

179. Philipp, "North Korea's Biological Weapons Program."

180. John Donnelly, "The Other North Korean Threat: Chemical and Biological Weapons," *Roll Call,* June 12, 2018, https://www.rollcall.com/news/politics/the-other-north-korean-threat-chemical-and-biological-weapons.

181. Ju-Hwal Choi, "Testimony of Colonel Ju-Hwal Choi, Colonel of KPA, before 105th Congress, Sess. 1, North Korean Missile Proliferation," 1997, p.8.

the Ministry of National Defense (MND) assert that North Korea has nearly 13 different types of pathogens in its program, adding that in addition to those mentioned above, North Korea also uses Crimean-Congo hemorrhagic fever virus, Entamoeba histolyca (Dysentery), Staphylococcus aureus (Staph), Rickettsia (Rocky Mountain Spotted Fever), and T-2 mycotoxins (Alimentary Toxic Aleukia.[183] Most important about North Korea's collection is its alleged possession of smallpox, anthrax, plague, and cholera. Three of these diseases are included in the CDC's Category A pathogen list, and the forth (cholera) is considered a Category B pathogen. Any release of these pathogens within the United States would prove devastating.

As for dispersal methods of these diseases, it has been speculated that North Korea can put canisters of the agents on drones and deliver them to other nations. Recently, South Korea has seen an increase in drones infiltrating its borders. An article by the Washington Post quotes a high-level defector who stated, "I witnessed the mounting of undisclosed biological or chemical weapons on drones, and the drones' dispersal capabilities were tested on animal populations."[184] He ends with some chilling words about how these drones could be readied and deployed to South Korea within an hour.[185] This technology is not unlike what is being seen in other countries like Iran and Syria, but there are differences in who might have access to these diseases.

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182. "Strategic Weapon System, Korea, North."

183. Kim Nam-gwon, "Kim Ok-i Said Korean Military does not have vaccine for North Korean Biochemical Weapons," *Yonhap News,* October 3, 2010, www.yonhapnews.co.kr.

184. Guy Taylor, "North Korea Attack Drones Carrying Biological, Chemical Weapons can Strike Seoul Within 1 Hour," *The Washington Times,* May 22, 2017, www.thewashingtontimes.com.

185. Taylor, "North Korea Attack Drones."

Unlike Syria, North Korea is not facing an internal civil war where multiple actors could have access to government resources. Instead, Kim Jong-Un is the sole leader of North Korea and has the capability and authority to launch biological attacks. However, due to North Korea's status as a state-sponsor of terrorism, there is a high possibility that North Korea could provide weapons to resistance groups in the Middle East as well as groups in Asia that serve to terrorize South Korea. For example, North Korea could provide advanced technology to terrorists in Syria fighting against the resistance as well as groups aimed at intimidating South Korea and Japan. Consequently, despite its designation as a State-Sponsor of terrorism, the specific terrorist groups it has supported remain unknown.

Like with Iran and Syria, a calculation needs to be made to estimate the threat of a biological attack by North Korea or a terrorist organization supported by them. It is clear from the above information that North Korea can launch a biological attack, but its intent is less clear. Andrew C. Weber, a Pentagon official in charge of nuclear chemical and biological defense programs under the Obama Administration, said, "North Korea is far more likely to use biological weapons than nuclear ones. The program is advanced, underestimated, and highly lethal."[186] While this isn't a direct declaration of intent by the regime, it does make it clear that there are distinct advantages for the North Korean regime to use biological weapons over other WMD. Since its program is consistently underestimated and less known, North Korea has an advantage in using a lesser known program for an attack. While North Korea's nuclear program has been thrust into the spotlight, its biological weapons program remains an unknown element. The United States would be more prepared for North Korea to use nuclear weapons over

186. Julian Ryall, "North Korea's Bioweapons 'More of a Threat than Nuclear Arsenal,'" *The Telegraph,* January 18, 2019, https://www.telegraph.co.uk/news/2019/01/18/north-koreas-bio-weapons-threat-nuclear-arsenal/.

biological ones, so North Korea is more likely to cause more destruction using a program that the United States is less prepared to handle.

North Korean leadership has also made statements indicating that they are willing to use other WMD, so it is not a far leap to conclude that North Korea would also be ready to use biological weapons. As well, there are reports from defectors that indicate prisoners of war, criminals with a death sentence, and other enemies of the state have been used as test subjects for biological weapons.[187] North Korea's willingness to use biological weapons on its population indicates a desire to use those same weapons on other countries' populations. If a war breaks out between North Korea and South Korea, North Korea could easily choose to use biological weapons over nuclear weapons because the use of biological weapons is less likely to cause a nuclear response from South Korea and its allies. While any WMD attack by North Korea on South Korea is likely to cause the United States and South Korea to seek regime change, biological weapons would be harder to attribute and depending on the disease could even be deemed as a natural outbreak.

China

In 1952 and 1984, the People's Republic of China signed the Geneva Protocol and BTWC respectively.[188] During WWII, China was the victim of countless biological attacks by Japan, leading to its future efforts to develop a stronger biodefense infrastructure and a biotechnology industry with substantial dual-use capabilities. Due to its experience with

187. Ryall, "North Korea's Bioweapons."

188. "China," *NTI,* November 2014, https://www.nti.org/learn/countries/china/biological/.

biological attacks, China maintains that it does not have an offensive biological program, but its dual-use infrastructure is plenty big enough to accommodate a shift in that public policy.[189] Despite these declarations, it has been suspected that China has maintained a biological weapons program since before the signing of the BTWC.

A 2005 State Department compliance report noted that "China maintains some elements of an offensive [biological weapon] capability in violation of its BTWC obligations. Despite China's declarations to the contrary, indications suggest that China maintained an offensive [biological weapon] program before acceding to the Convention in 1984."[190] Since signing the BTWC, China has been a stringent supporter of the treaty desiring to improve both the verification mechanism of the treaty as well as strengthen export controls to prevent the proliferation of biological materials. But according to a U.S. intelligence official, China was the biggest export violator of all as it had sold dual-use equipment and vaccines with both civilian medical applications and biological weapons applications. These exports likely turned into the beginnings of the Iranian Biological Weapons program. Then in 2006, China updated its export control list to restrict 14 additional biological agents from being exported from the mainland.[191] Despite these actions, it is still believed that China has helped Iran and other Middle Eastern nations build their biological weapons programs.

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189. "Adherence to and Compliance with Arms Control, Nonproliferation and Disarmament Agreements and Commitments," *U.S. Department of State,* August 2012, www.state.gov.

190. "Adherence to and Compliance with Arms Control," August 2012.

191. "China Revises Export Control List for Dual-use Biological Agents," *Xinhua*, July 28, 2006, www.lexisnexis.com.

Even so, reports from the United States in 2010, 2012, and 2014 all-state essentially the same thing, that China likely possesses a biological weapons program, but the extent of the program remains unknown to the public.[192] According to the Nuclear Threat Initiative, it is clear that "China possess the required technology and resources to mass-produce traditional [biological weapon] agents as well as expertise in aerobiology."[193] Today, it is likely that China's current dual-use infrastructure acts as the basis for its offensive biological capability.

The 2005 State Department report also identifies two facilities that have links to an offensive biological weapons program including the Chinese Ministry of Defense's Academy of Military Medical Sciences (AMMS) Institute of Microbiology and Epidemiology (IME) in Beijing, and the Lanzhou Institute of Biological Produces (LIBP).[194] China responds that the former is a biodefense-focused facility and the latter is a vaccine production facility. In addition to these two central laboratories, it is estimated that there are at least 50 other laboratories and hospitals being used as biological weapons research facilities.

China's dual-use infrastructure also gives outsiders an idea of the make-up of its offensive program. In 2007, China created a 20-year plant to study natural and human-made epidemics to create protective equipment for biodefense.[195] It was part of China's very public

192. "Adherence to and Compliance with Arms Control, Nonproliferation and Disarmament Agreements and Commitments," *U.S. Department of State,* July 2014, www.state.gov.

193. "Adherence to and Compliance with Arms Control," July 2014.

194. "Adherence to and Compliance with Arms Control, Nonproliferation and Disarmament Agreements and Commitments," *U.S. Department of State,* August 2005, www.state.gov.

195. "China to Establish Anti-Bioterrorism System," *Xinhua*, June 26, 2007, www.xinhuanet.com.

biodefense efforts. China has also established its first Biosafety Level 4 laboratory for research into biodefense and vaccines.[196] This facility will house pathogens that are considered especially dangerous including multiple Category A and Category B pathogens. Aside from pathogens, China is also known for its advancements in dispersal and delivery systems. A journal article titled, "China's Biological Warfare Programme: An Integrative Study with Special Reference to Biological Weapons Capabilities" reports that

> It is fairly clear that certain RF have fully mastered the aerobiological technologies needed for effective dispersal of BWA, both pathogens and toxins, and probably infected vectors (insects) as well. The quality, extensiveness, and characteristics of aerobiological works—including the component of nano-aerobiology—conducted by the related facilities, unambiguously lead to that postulation. They are also able, in all likelihood, to construct the functional conjunction combining dispersal devices, various warheads and delivery systems—including surface-to-surface missiles—in terms of operational biological weaponry.[197]

This report makes it clear that China has an advanced capability for deploying and dispersing aerosolized biological weapons. This sort of advanced capability is especially worrying because aerosolized diseases are the most contagious types of disease and have the potential to infect the most amount of people.

An advanced biological weapons program is not enough to classify as a threat; there also needs to be a real intent to use those weapons, either by China or by terrorist groups that China might support. When it comes to China's intention, it is possible that China would not choose to use biological weapons in any capacity because of the suffering the country saw due to Japan's use of Shigella and Plague against the nation. During the 1991 BTWC Review Conference, the

196. "Wuhan Institute of Virology, Chinese Academy of Sciences (CAS)," *Wuhan Branch,* Chinese Academy of Sciences, April 2007, http://english.whb.cas.cn.

197. Dany Shoham, "China's Biological Warfare Programme: An Integrative Study with Special Reference to Biological Weapons Capabilities," *Journal of Defence Studies* 9, no. (2015): 145.

Chinese delegation stated, “Of bacteriological weapons, China has always advocated the complete prohibition and thorough destruction of biological weapons and pursues a policy of not developing, producing, or stockpiling this type of weapon.”[198] More recently, the Chinese Foreign Ministry’s came out in 2011 stating that China continues to support the “complete prohibition and thorough destruction of all kinds of weapons of mass destruction, including biological weapons.[199] At the same time, China was not involved in the BTWC negotiations and before signing the treaty ensured it had a clause that meant the treaty was only binding if all other countries in the treaty were also following the guidelines, essentially giving the state an out to not only pursue biological weapons but to use them if necessary.[200] This action indicates that the Chinese wish to leave the possibility of using biological weapons open as a policy weapon, which in turns means a certain amount of willingness to utilize the weapons if the need arose. Overall, this proves that while China likely has the capability, China, due to its experience with biological warfare, seems to be the least likely country out of the five examined in this thesis to use biological weapons.

However, other entities that might gain access to Chinese biological weapons with China’s support, like the Taliban, might not have the same reservations. While China has publicly decried acts of terrorism around the globe, its actions do not necessarily support its words. In December 2000, The UN security council voted 13-0 to place an embargo on arms

198. "Position of Principle of the Chinese Delegation on the Biological Weapons Convention and Its Third Review Conference," *BWC Third Review Conference*, September 20, 1991, www.opbw.org.

199. Ministry of Foreign Affairs of the People's Republic of China, "The Biological and Toxin Weapons Convention," April 7, 2011, www.mfa.gov.cn.

200. Eric Croddy, "China's Role in the Chemical and Biological Disarmament Regimes," *The Nonproliferation Review*, Spring 2002, p. 34.

sales to the Taliban. China, however, chose to abstain.[201] In the following months, China continued to hold secret meetings with Taliban leadership on a possible communications lines deal and possible arms sales.[202] Since the 1980s, China has increasingly shipped large quantities of conventional arms, technologies for nuclear, chemical, and ballistic missiles, and other hardware used in the military to rogue regimes in the Middle East including the Taliban government.[203] China continues to meet with the Taliban today. As recently as August 2018, the PRC and the Taliban met to discuss a peace deal in Afghanistan and China continues to diplomatically back the Taliban with its allies over the other parties.[204] This established relationship with the Taliban creates a foundation for future arms sales to occur. The prospective transfer of biological weapons from China to the Taliban is not outside the realm of possibility.

To understand the threat from the Taliban, the Taliban's goals must be realized. According to Stanford's "Mapping Militant Organizations" page, the Taliban is a far-right Islamist militant organization whose purpose is to establish an Afghanistan that is under Taliban control and reinstate Sharia law.[205] Since their emergence, the Taliban has used suicide bombings, car bombings, and other war tactics to achieve their means. This willingness to use

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201. Maggie Farley, "U.N. to Tighten Afghan Sanctions," *Los Angeles Times,* December 20, 2000, http://articles.latimes.com/2000/dec/20/news/mn-2468.

202. Vremya Novostei, "China trades with Taliban," *Intelligence,* March 15, 2001.

203. "China's Arm Sales: Motivations and Implications," *Project Air Force,* www.rand.org/paf/highlights/china.html, (accessed January 12, 2019).

204. Farhan Bokhari, Kiran Stacey, and Emily Feng, "China Courted Afghan Taliban in Secret Meetings," *Financial Times,* August 6, 2018, https://www.ft.com/content/66b0906a-993d-11e8-9702-5946bae86e6d.

205. "The Taliban," *Mapping Militant Organizations,* Stanford University, July 15, 2016, http://web.stanford.edu/group/mappingmilitants/cgi-bin/groups/view/367.

nearly any means necessary to accomplish their political aspirations indicate that the Taliban may also be willing to use biological weapons to attack the Afghani government.

Overall, the risk of a biological attack by China or the Taliban is likely pretty low, but evidence indicates there is a more significant change of a biological attack carried out by the Taliban than the government of China, although neither possibility is impossible.

Russia

Russia has inherited nearly all its biological weapon capabilities from the former Soviet Union after it fell in 1991. The biological weapons program of the former Soviet Union was herald as the most extensive covert biological weapons program ever in existence. In 1928, the Soviet Union signed and ratified the Geneva Protocol, but due to the wording of the Protocol justified their pursuit of a biological weapons program because the Protocol only prohibited 'use' and not research and production.[206] In its early years, the program established many different testing sites, specifically on islands to test the effectiveness of dispersal methods.

During a tumultuous period in the Soviet Union's history, three events stand out as shaping the future of the Soviet Union's offensive biological weapons program. First, in the late 1930s, Stalin purged many of the scientists that had been integral in developing the original program.[207] Those that did not escape were often sent to prison or executed to root out traitors and those who might oppose Stalin.

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206. "The Taliban," *Mapping Militant Organizations.*

207. Anthony Rimmington, "The Soviet Union's Offensive Program: The Implications for Contemporary Arms Control," in *Biological Warfare and Disarmament: New Problems/New Perspectives*, Susan Wright (Lanham: Rowman and Littlefield Publishers, Inc., 2002), p. 107-108.

Second, Stalin actively supported Trofim Lysenko, a scientist who believed that biological inheritance led to the suppression of Mendelian genetics. These beliefs significantly influenced the Soviet offensive biological weapons programs for years, by suppressing advances in biological sciences, putting the Soviet Union at a disadvantage, until Lysenko's theories were disproved.

Lastly, the events of WWII changed the direction of the Soviet Biological Weapons program. Initially, the purpose of the Soviet biological weapons program was to create tactical battlefield weapons to be used on the enemy's front lines and rear areas.[208] Its goal was to develop weapons that could be used in place of conventional ones, so instead of an exploding bomb with shrapnel, it would be a bomb with anthrax powder. According to Ken Alibek, a key former Soviet scientist, "A devastating tularemia outbreak in the Red Army at Stalingrad in 1942, caused by Soviet use of Tularemia against the German army, demonstrated the danger and unpredictability of biological warfare in a tactical setting, and forced the Soviet Union to shift their biological weapon military doctrine away from tactical battlefield use."[209] This shift led to what is now Russia's current biological weapons program.

In 1975, while the Soviet Union was acceding to the BTWC, it was also expanding its biological weapons program, beginning with a secret decree by Brezhnev that aimed at modernizing the current program. Ken Alibek explains that the directive included aims at

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208. Valentin Bojtzov and Erhard Geissler, "Military Biology in the USSR, 1920-45," in *Biological and Toxin Weapons: Research, Development and Use from the Middle Ages to 1945*, eds. Erhard Geissler and John E. van Courtland Moon (New York: Oxford University Press, 1999), p. 156.

209. Ken Alibek with Stephen Handelman, *Biohazard: The Chilling True Story of the Largest Covert Biological Weapons Program in the World—Told from Inside by the Man Who Ran It* (New York: Random House, Inc., 1999), p. 30-31 and 35.

weaponizing anthrax into a battle strain that could be used on a massive scale.[210] Specifically, Anthrax 836 was meant to be "reproducible in large quantities, of high virulence, and transportable."[211] The Soviet Union wanted to be able to use highly contagious diseases to wreak havoc on enemy populations in the case of strategic war. For this purpose, anthrax, smallpox, and plague bacteria were used as test subjects, but tragedy struck in 1979 when an accident caused the release of dry anthrax spores leading to the killing of about 67 people and infecting an addition 77.[212] At this time, it became apparent to the outside world that the Soviet Union had not halted its biological weapons program. Ten years later it became even more apparent when Soviet scientists began to defect to Western nations and pass the information on to the governments of the United Kingdom and the United States.[213] Most devastating to the Soviet Union was Ken Alibek, the former First Deputy Director of Biopreparat, which made him privy to all the inner workings of the Soviet Union's biological weapons advantages.

The next 30 years were marked by diplomatic efforts by Western powers to convince Russia to dismantle the Soviet Union's biological weapons programs. Initially, Russia's first president, Boris Yeltsin, admitted to the Soviet Union's biological weapons program, but just seven years later, Vladimir Putin, Russia's new president, reversed that admission stating that the Soviet Union's program had been completely defensive in nature.[214] This statement made it clear

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210. Alibek, *Biohazard,* 41.

211. Alibek, *Biohazard,* 87.

212. Matthew Meselson et al, "The Sverdlovsk Anthrax Outbreak of 1979," *Science 266*, 1994, www.anthrax.osd.mil, pp. 1202-1208.

213. Michael Moodie, "The Soviet Union, Russia, and the Biological and Toxin Weapons Convention," *The Nonproliferation Review* 8, no. 1 (2001): 61.

that Vladimir Putin would not be forced into dismantling this offensive biological weapons program. In 2012, during his second presidency, Putin tasked his ministers with implementing plans for new weapons including genetic ones. The Russian Ministry of Defense defines genetic weapons as,

> A type of weapon able to damage the genetic (hereditary) apparatus of people. It is assumed/expected that some viruses can/may serve as the active principle. These viruses are in possession of mutagenic activity (with the capability to cause hereditary changes) and can introduce into chromosome cells that contain deoxyribonucleic acid (DNA) and even chemical mutations, taken from natural sources by chemical synthesis or biotechnological methods. The primary result of the use of genetic weapons is damage/injury and changes to basic/primary structure of DNA, which can lead to serious diseases and their hereditary transition.[215]

Simply put, this definition gives a new, more advanced version of a biological weapon that affects the internal structure, but still causes death and destruction. While modern Russia has given biological weapons a new name, the concept is the same. Biological weapons are still a genuine threat from Russia.

Due to the extensiveness of the Soviet Union's biological weapons program, the list of diseases studied is unusually long. Scientists in the Soviet Union studied the causative agents of anthrax, brucellosis, cholera, glanders, leprosy, melioidosis, plague, tetanus, tuberculosis, tularemia, typhus, and Q fever.[216] Early manifestations of the program also studied the foot-and-mouth disease virus for use against cattle.[217] A majority of these diseases result from pathogens

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214. Raymond Zilinskas, *The Soviet Biological Weapons Program and its Legacy in Today's Russia* (Washington DC: National Defense University Press, 2016) p. 45.

215. Zilinskas, *The Soviet Biological Weapons Program,* p. 45.

216. "Russia," *NTI,* January 2015, https://www.nti.org/learn/countries/russia/biological/.

217. Milton Leitenberg and Raymond A. Zilinskas, "The Soviet Biological Weapons Program: A History," (Cambridge: Harvard University Press, 2012), pp. 20-21.

that the United States is particularly worried about affecting the United States. Also, the Soviet Union's focus on agricultural diseases like glanders and foot-and-mouth disease is indicative of a desire to possess a capability that can cause economic damage within the United States agricultural sector.

Additionally, the Soviet Union assessed advanced methods of dispersal for efficiency during the 1930s. These methods included aerosol generators, bacteria-filled containers dropped from aircraft, explosive capsules, and insect/rodent vectors that used fleas and rats to transmit the diseases.[218] These dispersal methods were meant to cause the most amount of harm and proved useful in Germany during World War II with the use of tularemia.

Today, Russia still possesses stockpiles of this disease. Most of the once military-ran facilities have been turned into civilian facilities for vaccine and infectious disease research. These dual-use facilities have brought about a dilemma in the area of biodefense vs. compliance. Like the other countries mentioned in this chapter, it is impossible to distinguish between biodefense facilities and offensive bioweapons facilities as the materials needed for each are very similar. Today, Russia still has access to a vast network of private biotechnology laboratories that could eventually be used for biological weapons in the future.

Another threat that comes from the Russian bioweapons' programs does not come from the diseases themselves, but rather from the lack of security surrounding Russia's biohazardous facilities. A 2004 report by the U.S. Government Accountability Office (GAO) indicated that

218. John Hart, "The Soviet Biological Weapons Program," in *Deadly Cultures: Biological Weapons Since 1945*, eds. Mark Wheelis, Lajos Rózsa, and Malcolm Dando (Cambridge: Harvard University Press, 2006), p. 134.

little progress was made in securing bioweapon facilities in Russia.[219] This is because it is possible for terrorist organizations to break into current Russian biological facilities to steal vials of disease to begin their biological weapons programs. This was especially true of Al Qaeda as there were reports regarding a link between Al Qaeda and plans to steal biological agents from Russia. Moreover, the exodus of biological scientists from Russia to other countries presented an interesting opportunity for terrorist groups around the country to try and hire Soviet experts to begin their biological weapons programs. In December 2001, Osama bin Laden's Deputy Ayman Zawahiri stated, "If you have $30 million, go to the black market in central Asia, contact any disgruntled Soviet scientist and a lot of dozens of smart briefcase bombs are available."[220] So while it might be hard to directly link Russia to the proliferation of biological weapons to terrorist organizations, it isn't hard to connect its ex-scientists to the same thing.

As for threat calculus, there are two actors that this section will look at for Russia, the Russian government and the terrorist organization Al Qaeda. The above analysis has proven that Russia has a useful biological weapons capability, but that is only half of the threat calculus, their willingness to utilize biological weapons also must be realized. The same is true for Al Qaeda.

Beginning with the Russian government, President Putin's declaration in 2012 to look at ways to build genetic weapons makes it clear that Russia is not shying away from the research and production of biological weapons. While it is true that the Soviet Union's use of biological

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219."Weapons of Mass Destruction: Defense Threat Reduction Agency Addresses Broad Range of Threats, but Performance Reporting Can Be Improved," *U.S. Government Accountability Office,* February 2004, p. 12.

220. Rolf Mowatt-Larssen, "Al Qaeda Weapons of Mass Destruction Threat: Hyper or Reality," *Harvard Kennedy School Belfer Center for Science and International Affairs,* January 2010, https://www.belfercenter.org/sites/default/files/legacy/files/al-qaeda-wmd-threat.pdf, p.2.

weapons has backfired on it in the past, the threat of contamination is unlikely to stop a determined adversary, and it is nonetheless possible that modern Russia would still be willing to use biological weapons defensively and offensively if Putin felt it was to his advantage. President Putin does not have any statements that outright declares his willingness to use biological weapons, but given that biological weapons are considered WMD, it is beneficial to look at his statements regarding other WMD. In December 2014, Russian President Putin announced that under Russia's military doctrine it "reserves the right to use nuclear weapons in response to the use of nuclear and other types of weapons of mass destruction against it or its allies, as well as in response to aggression against the Russian Federation that utilizes conventional weapons that threatens the very existence of the state."[221] This statement indicates a willingness on the part of the Russian government to utilize nuclear weapons in any situation, against enemies and allies, to achieve its objectives. It would not be a jump to say that if forced to defend itself or to win a war, Russia may very well use biological weapons.

As for Al Qaeda, the goals of the organization must be looked at before a decision can be made on the will of this organization to use biological weapons. Al Qaeda has spent nearly 15 years attempting to obtain WMD to launch a devastating attack against the United States. In 2002, Al Qaeda announced its goal to kill four million Americans.[222] This goal combined with their desire for a weapon of mass destruction illustrates that the organization would be willing to use biological weapons to accomplish their goals, so long as they can devastate the United States in the attack.

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221. "Arms Control and Proliferation Profile: Russia," *Arms Control Association,* October 2018, https://www.armscontrol.org/factsheets/russiaprofile.

222. Mowatt-Larssen, "Al Qaeda Weapons of Mass Destruction."

Summary

Throughout this chapter, it should have been made clear that biological warfare and biological terrorism is a genuine threat that the United States is facing from state and non-state actors alike. All over the world, capabilities are being researched, tested, and advanced to improve the threat, while the United States makes limited efforts to improve its defenses. The extent of the above programs should be enough to prove that not only do U.S. adversaries have the capability to attack the United States, but they also have the will. It is time the United States finds the will to defend against such capabilities.

CHAPTER IV: INCIDENTS AND THREATS OF BIOLOGICAL ATTACKS

Biological warfare is not a new concept, but rather as old as war itself. People have been finding ways to manipulate natural diseases for their benefit since the 14th century B.C. The first attempts at biological warfare were rudimentary at best, often utilizing the cadavers of the infected to attempt to infect others. But as conventional methods of warfare progressed throughout the years, so did biological methods until countries were not just weaponizing cadavers but instead were weaponizing bacterial strands.

The purpose of this chapter is not to give a historical overview of some significant biological incidents since the beginning of biological warfare, but rather to illustrate the occurrences of biological warfare in history and showcase how devastating the effects can be for the ongoing war. This chapter will go over six separate incidents and, in each episode, will look at the period, the disease used, how it was transmitted, how many people were affected, what it meant for the war then, and what it could mean for the United States now. This chapter is intended to show that there is a precedent for biological warfare that only grows more realistic as more time passes.

The Hittite Plague

During the 14th century B.C., a long-lasting tularemia epidemic started within the Eastern Mediterranean. When traced to its source, it is theorized that the disease began in Canaan along the Arwad-Euphrates trading route.[223] The infection started in Cyprus and spread naturally to

223. Trevisanato, "The Hittite Plague."

Iraq, Israel, and Syria, but it spared Egypt and Anatolia due to quarantine boundaries. These boundaries are what led to the first recorded use of pathogenic warfare.

By the 14th century B.C., the Hittites had conquered much of what is now Turkey, Iraq, and Syria, creating an empire that was allegedly built due to severe biological warfare techniques. Dr. Trevisanato, a molecular biochemist, claims that the Hittites battlefield successes were due to their use of 'cursed rams' or tularemia-infected animals that were left outside cities the Hittites desired to conquer.[224] Then, the city patrons would bring the contaminated animals inside the city gates to breed or eat, thus instigating a spread of disease. Dr. Trevisanato says, "There is no doubt that these were the first weapons of mass destruction. They were waging bioterrorism."[225] This instance, known as the Hittite Plague.[226]

Initially, the Hittites sought to conquer western Anatolia to spread their empire further, but due to quarantine and political boundaries, the Hittites had trouble securing the city. It was at this point that the Hittites deliberately brought these 'cursed rams' to the town to infect their Arzawan enemies.[227] The spread of tularemia ravaged the town, changing the favor of the war. In a time, where modern medicine was a distant imagining, nearly 15% of all infected die and many more suffered. The new epidemic changed the tide of the war, allowing the Hittites to claim victory against the Arzawan, in a battle they should have lost.

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224. Malcolm Moore, "Hittites Used Germ Warfare 3,500 Years Ago," *The Telegraph,* December 8, 2007, https://www.telegraph.co.uk/news/worldnews/1571927/Hittites-used-germ-warfare-3500-years-ago.html.

225. Moore, "Hittites Used Germ Warfare."

226. Trevisanato, "The Hittite Plague."

227. Roxanne Khamsi, "Were 'Cursed' Rams the First Biological Weapons," *New Scientist,* November 26, 2007, https://www.newscientist.com/article/dn12960-were-cursed-rams-the-first-biological-weapons/.

However, the use of biological weapons did not come without costs. Dr. Trevisanato notes that just a few years after this attack, the Hittites recorded an epidemic within ranks, that severely weakened their military, ultimately contributing to the fall of the Hittite empire.[228] Regardless of their limited success and eventual demise, this instance is what led the rest of the world into an era of biological warfare. Today, leaving infected cattle outside city walls will not have nearly the same effect, but even still the Hittites set a precedent that pathogenic warfare may clear the path for a quick, almost effortless victory.

Swedish-Russian War of 1710

Thousands of years later, countries were continuing to use infected animals and even the corpses of infected people to turn the tides in a war. In the 1700s, Russia declared siege upon the Swedish-held city of Revel to spread its empire. However, the town of Revel was well-protected and perfectly capable of holding steady during a prolonged siege, so the Russians had to find a way to go around this issue. Their answer was biological warfare.

During the Swedish-Russian War of 1710, Dr. Thalassinou alleges that the Russians disposed of the bodies of infected plague victims in a river that flowed into the Swedish-held city of Revel to contaminate the water supply and spread the plague to make the siege more successful.[229] This attack is thought to be reminiscent of the siege of Caffa during the Middle Ages. During the siege of Caffa, the military leaders of Tartar used the epidemic to their favor by

228. Khamsi, "Were 'Cursed' Rams the First."

229. Eleni Thalassinou, Costas Tsiamis, Effie Poulakou-Rebelakou, and Angelos Hatzakis, "Biological Warfare Plan in the 17th Century – The Siege of Candia, 1648-1669," *Emerging Infectious Diseases* 21, no. 12 (2015): 2150.

"hurling the cadavers of their deceased into the city… forcing a retreat of the Genoese forces."[230] It is believed that the Russians followed Tartar's example during the Swedish-Russian War of 1710 by catapulting bodies of plague victims into the Swedish-held city of Reval.[231] However, more recently, it has also been alleged that the disposal of plague victims by the Russians may have also been an intentional biological warfare tactic meant to spread the plague in Revel.[232]

It is estimated by Danish historian, Karl-Erik Frandsen, that nearly ¾ of the 20,000 people in Revel died due to the plague outbreak, leaving the city vulnerable for the Russians trying to conquer it.[233] In the modern age, it isn't inconceivable that an enemy nation would employ similar tactics to defeat their adversaries by using bodies or infected materials to spread disease throughout their opponents' ranks. This tactic was applied during the 15th century to expedite the spread of smallpox.

Spread of Smallpox

Europe had a lot going for them when it began to colonize the new world. It had better weapons, more advanced materials, and most interestingly, it had different pathogens. The Native Americans that spread across both North and South America had never been exposed to germs that were thought of as common in Europe. In the early stages of colonization, the Native Americans worked hard to get along with the newcomers, but the colonizers were afraid that

230. Riedel, "Biological Warfare and Bioterrorism."

231. W. Seth Carus, "Biological Warfare in the 17th Century," *Emerging Infectious Diseases,* 22, no. 9 (2016): 1663.

232. Carus, "Biological Warfare in the 17th Century."

233. Carus, "Biological Warfare in the 17th Century."

their cooperation would give way to hatred and eventually lead to a physical clash, so with them they brought 'Guns and Germs and Steel.'

In the 15th century, it was said that Francisco Pizarro and Sir Jeffrey Amherst, while providing aid to the Native Americans in a burst of cooperation, intentionally provided Native Americans with smallpox-laden blankets in hopes that the disease would spread and decrease the possibility of hostility against the British.[234] A population devastated by disease is unlikely to wage a war that they cannot win, allowing the British to colonize sought after land in an almost effortlessly manner.

Today, the spread of smallpox across Native American populations is considered one of the critical events that lead to the success of the European conquest over the Americas. The unprotected community in newly found America was at a severe disadvantage against a disease for which they had no immune system. While smallpox ravaged communities across the world at this time, it seemed to ruin the Native Americans at an even faster rate. The PBS documentary, "Guns, Germs, and Steel," estimates that the disease, smallpox, brought to the Americas killed an estimated 90% of Native Americans.[235] A once thriving population was reduced to shambles by way of conquest by pathogens. While it may be true that more advanced weapons likely were the main reason that Native Americans fell so quickly to invaders, the diseases that ravaged populations in the New World played no small part.

This type of biological warfare, especially with a disease such as smallpox, is likely to be the most devastating to the United States in the case of an intentional release. While smallpox

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234. George W. Christopher et al. "Biological Warfare. A Historical Perspective," *JAMA* 278, no. 5 (1997): 414.

235. "The Story of… Smallpox – and other Deadly Eurasian Germs," *Guns, Germs, and Steel,* 2005, https://www.pbs.org/gunsgermssteel/variables/smallpox.html.

vaccinations used to be a mandatory occurrence during the eradication of smallpox, the new generations of the United States have been left unprotected since its elimination. The United States stopped routine smallpox vaccinations in 1972.[236] According to the U.S. Census Bureau, the United States population in 1972 was approximately 210 million compared to today's approximate population of 329 million people.[237] This means that there are approximately 119 million Americans unprotected against smallpox. Given smallpox's fatality rate of 30%, an intentional release of smallpox in this modern environment would likely lead to similar devastation among Americans as it did against Native Americans in the 1400s, causing nearly 40 million deaths.

Second Sino-Japanese War

It was the level of destruction caused by smallpox in Native American populations that led modern countries to develop more advanced and capable biological weapons programs. Nations realized that soldiers are essential in waging and winning wars on both sides, so what better way to get rid of people than to infect them with deadly agents that tend to look natural. The Japanese took that thinking to heart during World War II. Beginning as early as 1930, Japan created an entire department, called Unit 731, that was explicitly used to research and create chemical and biological weapons for use in WWII.[238] The Unit was responsible for testing

236. "Smallpox Questions and Answers: The Disease and the Vaccine," *New York State Department of Health,* April 2003, https://www.health.ny.gov/publications/7004/.

237. "Population Clock," *United States Census Bureau,* February 11, 2019, https://www.census.gov/.

238. Daniel Barenblatt, *A Plague upon Humanity: The Hidden History of Japan's Biological Warfare Program* (New York City: Harper Perennial, 2004), 173.

weapons and carried out consistent human experimentation on prisoners of war and Japanese citizens to ensure the viability of their weapons.

However, it was during the Second Sino-Japanese War of the 1940s, that the Japanese hit their peak with biological warfare. It is reported that the Japanese encased bubonic plague, cholera, smallpox, botulism, anthrax, and other diseases into bombs that it repeatedly dropped on the Chinese to win the war.[239] Around the same time, the Japanese considered dropping 'flea bombs' on American populations but surrendered before the plan could be put in operation. If it had been carried out, the flea bombs would have contained 90kg of plague-carrying fleas, approximately 150 million insects in ten separate attacks.[240] The resulting infection would have been devastating.

According to Daniel Barenblatt, the 2002 International Symposium on the Crimes of Bacteriological Warfare*,* the number of people estimated to have died from diseases due to Japan's biological warfare was around 580,000.[241] If a similar attack had been carried out on the United States, it is possible that the death toll would have been two to three times that much.

Today, 'flea bombs' are considered a more rudimentary form of biological warfare, as it is harder to contain, but easy to deploy and usually quite effective. The United States must remain in a state of constant vigilance to ensure that wayward planes or other transportation devices are not used to infect American populations. A more modern, and likely example over

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239. Christopher Hudson, "Doctors of Depravity," *Daily Mail,* March 2, 2007, https://www.dailymail.co.uk/news/article-439776/Doctors-Depravity.html.

240. Tom Mangold and Jeff Goldberg, *Plague Wars: The Terrifying Reality of Biological Warfare* (New York City: St. Martin's Griffin, 2001), 24-25.

241. Barenblatt, *A Plague upon Humanity.*

flea bombs, would be using conventional trade routes for exports and imports, where U.S. adversaries could try to export contaminated materials to spread disease and mayhem.

The above four examples have mostly focused on cases occurring outside of the United States. However, the final two selections will showcase scenarios that bring this issue closer to home.

2001 Anthrax Attacks

In what may have been the only successful biological attack against the United States to date, the 2001 Anthrax attacks are often overlooked due to its proximity to the 9/11 terrorist attacks. However, this event is no less critical. Just one week after 9/11, anonymous letters began arriving at media companies and congressional offices. Each letter contained a powdered form of anthrax spores.[242] Within five months, five people will be dead, and 17 more will have been infected, from a disease not present in the United States since the 1970s.

On October 5, 2001, Bob Stevens of American Media died from anthrax. It is classified as the first anthrax death within the United States in over 25 years. Stevens death is followed by the deaths of two postal workers from Washington DC, Kathy Nguyen, an employee of Manhattan Eye, Ear, and Throat Hospital, and Ottilie Lundgren of Connecticut, who had no actual connection to the rest of the deaths.[243] If the disease had been left unchecked, it is likely that far more people would have died.

242. "Timeline: How the Anthrax Terror Unfolded," *NPR The Anthrax Investigation,* February 15, 2011, https://www.npr.org/2011/02/15/93170200/timeline-how-the-anthrax-terror-unfolded.

243. "Timeline: How the Anthrax Terror Unfolded."

But the impacts of the disease went far beyond the physical deaths. The American Media Inc. building was quarantined for more than five years until it got the A-Okay by federal health officials to reopen in 2007.[244] Along the same lines, the Brentwood postal facility took nearly two years to reopen for public use and the renovations and cleanup of the facility cost roughly 130 million dollars.[245] These economic impacts were devastating and caused by a relatively small biological attack. Just imagine what a large-scale attack could due to the United States.

But in the case of the 2001 Anthrax attacks, fortunately for all that received letters or encountered those people, anthrax can be treated with antibiotics if it is caught early enough, but a surprise outbreak of a nearly eradicated disease within the United States will catch any hospital by surprise and can lead to panic and slow containment methods. Today, the United States has learned from these attacks by tightening postal protocol and stockpiling vaccines. Should the 2019 Anthrax attacks happen tomorrow, it is valid to assume that the United States is more equipped to deal with the scenario than in the past.

Terrorist Cave Findings

Despite the increased preparedness against future biological weapons completed by the United States in 2001, it did not stop United States' adversaries from their desire to obtain, weaponize, and deploy biological weapons against the United States in the future. With the rise of terrorism in the Middle East and increasingly anti-American sentiment among these terrorist groups, it should come as no surprise that the evidence was found indicating a possible future biological attack against the United States by the terrorist group Al-Qaeda.

244. "Timeline: How the Anthrax Terror Unfolded."

245. "Timeline: How the Anthrax Terror Unfolded."

In 2002, US Navy Seals found a list of pathogens in an Afghanistan cave that Al-Qaeda could use as biological weapons. Unique about this discovery was that the pathogens were not limited human pathogens. Six pathogens targeted livestock and poultry and four targeted crops.[246] These findings not only indicated a willingness to use biological weapons, but also a comprehensive plan on how to use them.

This discovery was also the first report of plans by a terrorist group to attack more than just human populations. These plans seemed to show an increased sophistication among terrorist groups that the United States had not been expecting. Terrorist groups could now not only plan on decimating populations, but also economic centers. Cutting off the two biggest livestock exports, cattle, and poultry, would be devastating for the United States economy and killing crops at an expedited pace would be detrimental to most farms in the Midwest. While navy seals managed to confiscate these plans in 2002, there is no telling what other plans terrorist groups may have for 2019. The best the United States can do at this point is to prepare for anything, by maintaining strict import/export controls, increasing prevention methods, and preparing for the worse (as cliché as that sounds.) A biological attack of this nature would likely start small, but if not caught in time could become nearly uncontainable.

Summary

These examples are just a few of many, where diseases were used to change the tide of war. Since then, the methods of biological warfare have advanced, but the knowledge remains rudimentary enough for non-state actors to access. Whereas the experience needed to create and use nuclear weapons remains out of reach for most states and especially non-state actors, the

246. Daschle "A Threat to the Food System."

knowledge necessary to manufacture biological weapons remains available on the internet. The CDC says, "recipes for preparing homemade agents are readily available, and reports of arsenals of military bioweapons raise the possibility that terrorists might have access to highly dangerous agents, which have been engineered for mass dissemination as small-particle aerosols."[247]

Biological weapons provide a wealth of advantages for terrorists and states wanting to inflict damage on the United States at a relatively low-cost. Bioweapons are inexpensive, can be easily transported, stockpiled, and can cause more deaths than a tactical nuclear weapon. Terrorist groups have also shown more interest in acquiring bioweapons than atomic weapons. A laptop recovered from an ISIL hideout in Syria contained plans and instructions on how to weaponize the bubonic plague. Later that same year, chatter on terrorist social media sites discussed weaponizing Ebola and other pathogens as weapons against the United States.[248] Besides ISIL, Al Qaeda has also worked on plans to send groups of their members, called bio-martyrs, into the West who would purposely infect themselves with a bird flu virus to spread the disease around the world, by traveling on consecutive international flights.[249] Biological weapons provide a relatively easy method to inflict a high human cost on enemies.

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247. Ali Khan and Michael Sage, "Biological and Chemical Terrorism: Strategic Plan for Preparedness and Response," *Center for Disease Control and Prevention,* https://www.cdc.gov/mmwr/preview/mmwrhtml/rr4904a1.htm.

248. Amanda Vicinanzo, "DHS Biological Terrorist Attack on US An Urgent and Serious Threat," *Homeland Security Today US,* April 23, 2015, http://www.hstoday.us/channels/dhs/single-article-page/biological-terrorist-attack-on-us-an-urgent-and-serious-threat/0ce6ebf3524d83c537b1f4f0cc578547.html.

249. James Phelps and Monica Koenigsberg, "Bio-Martyrs: A Very Real Threat at Unique Moment in Time," August 28, 2014, *Homeland Security Today*, http://www.hstoday.us/channels/global/single-article-page/exclusive-bio-martyrs-a-very-real-threat-at-unique-moment-in-time/2a07ea5072bf5060cb8da27240135041.html

CHAPTER V: BIOTERRORISM

While it is clear from previous chapters that biological warfare is not as uncommon as one might think, the exact definition of biological warfare, especially regarding terrorism may remain unclear. The purpose of this chapter is to breakdown biological warfare into smaller subcategories to come away with a more well-rounded understanding of what biological warfare means. To accomplish this feat, this chapter begins with the definition of biological warfare before moving on to the definition of biological terrorism. Then to provide explanations using examples, this chapter will offer a scenario that shows rather than tells what biological terrorism is. Next, this chapter will cover agricultural biological terrorism in much the same fashion, beginning with a definition and then an example.

However, the purpose of this chapter is two-fold. This chapter is meant to define biological terrorism and agricultural biological terrorism better, but it is also intended to explain why terrorist groups would choose this method of attack over other methods and why they might not. To this end, this chapter will analyze different reasonings for and against the use of biological agents as weapons, allowing the reader to draw their conclusions to the utility of these pathogens. Lastly, this chapter will explore the possibility of state-sponsored biological terrorism to show the relationship between states with biological weapons programs and the terrorists those states might support.

Biological Terrorism

Biological Warfare is defined by the Center for Disease Control (CDC) as, “the intentional release of viruses, bacteria, or other germs that can sicken or kill people, livestock, or

crops."[250] Any situation described in the historical section of this paper, aside from the 2001 anthrax attacks and the cave findings, would be an example of biological warfare as the instances occurred between one state and another.

Biological terrorism or bioterrorism, on the other hand, would occur between a terrorist organization and another party, be it another terrorist organization or a state, for a specific purpose. The CDC defines bioterrorism as, "biological agents used as weapons to further personal or political agendas."[251] For example, in 2001, letters that contained anthrax spores were mailed to several people in the United States, killing five and infecting 17 others. However, given advances in technology, a modern-day biological attack could kill and affect many more. A scenario described in the Blue-Ribbon Panel on Biodefense shows possible impacts,

> Nine weeks ago, terrorists unleashed insidious biological attacks on our Nation's Capitol during our Independence Day celebrations. The infectious agent they used ultimately led to the deaths of 6,053 Americans. Many of our colleagues and staff fell ill and died. Thousands more were killed in coordinated attacks in allied nations in the days that followed. The attack here in Washington, D.C. used aerosol delivery devices we could see but did not know contained dangerous organisms. We discovered later that other attacks had already begun elsewhere in the Nation, using methods we have yet to identify that spread the disease among livestock in rural communities. Delays in recognition – because most veterinarians and physicians had never seen Nipah virus – meant animals and people were sick for more than a week before we realized what had happened. And now we are being told that the virus, which in nature does not spread easily among people, was genetically modified to increase its ability to spread from animal to animal, animal to person, and person to person.[252]

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250. "Bioterrorism," *Center for Disease Control and Prevention,* January 16, 2014, https://www.cdc.gov/anthrax/bioterrorism/index.html.

251. "Bioterrorism," *Gateway to Health Communication and Social Marketing Practice,* Center for Disease Control, September 15, 2017, https://www.cdc.gov/healthcommunication/toolstemplates/entertainmented/tips/Bioterrorism.html.

252. "A National Blueprint for Biodefense: Leadership and Major Reform Needed to Optimize Efforts," *Bipartisan Report of the Blue Ribbon Study Panel on Biodefense,* October 2015, https://www.biodefensestudy.org/LiteratureRetrieve.aspx?ID=144258, p. 2.

This scenario accurately represents the effects a small-scale terrorist attack could cause to the American populous. The longer the disease goes unchecked or uncontained, the further the spread, and the more significant the impact. If a widespread, simultaneous bioterrorist attack were to happen in multiple areas across the United States, the resulting effect would be devastating domestically and abroad. It could become a pandemic the world has no chance of containing.

Agricultural Biological Terrorism

When people think about the effects of bioweapons, they tend to think in terms of human lives lost, but diseases can affect more than just humans. Biological weapons can be used to attack agriculture and animals causing just as severe damage to the United States as an attack against the population. While specific animal pathogens may not be enough to cause a worldwide catastrophe, individual crop disease could be. Wheat and rice account for almost 40 percent of the world's total calorie consumption.[253] An attack on multiple sources of the wheat supply in the west or a rice supply in the east simultaneously could cause a significant disruption in supplies that could in turn cause worldwide famine leading to potential starvation by millions of people could occur.

Agricultural biological terrorism or agroterrorism refers to bioterrorist attacks on livestock or crops. Rocco Casagrande, author of the article, "Agricultural Bioterrorism (Agricultural Biosecurity, Agroterrorism)" defines agroterrorism as, "the intentional spread of

253. Daschle, "A Threat to the Food System."

pathogens livestock or crops to cause economic harm."[254] This type of biological terrorism is markedly different from general bioterrorism as the target and goal of the attack differ severely. Bioterrorism is for political means and generally targets human populations, while agroterrorism attacks livestock and crops with the aim to cause economic devastation. However, despite these differences, both types of biological terrorism can be destructive, and the threat of either one holds the population and agriculture at risk.

The 2015 Avian influenza epidemic provides an excellent example of what an agroterrorism attack would resemble in the United States. The Emergency Management website describes,

> Avian influenza struck Minnesota — the nation's largest turkey producer — first, striking hardest where turkey production was the dominant industry. It then jumped to Missouri, then Arkansas, then north to Kansas and north again to South Dakota, defying the migration patterns of the wild birds suspected of carrying the virus, before striking Minnesota a second time. It sickened and killed both turkeys and chickens. In Iowa, avian influenza struck a turkey farm first, then a huge egg farm with more than 4 million layers. Before the outbreak subsided, 77 properties in Iowa were hit. Millions of birds were killed, either by the virus or in the attempt to keep it from spreading. Across the country, it had affected nearly 50 million birds in 21 states.[255]

Although this outbreak had natural causes, experts from Emergency Management believe this is what a bioterrorism attack would look like aimed at agriculture. It should be the goal of the world to prevent any intentional spread of biological weapons. While the United States has

254. Rocco Casagrande, "Agricultural Bioterrorism (Agricultural Biosecurity, Agroterrorism)," *Wiley Online Library,* April 15, 2005, https://onlinelibrary.wiley.com/doi/abs/10.1002/0471686786.ebd0003.

255. Madeline Bodin, "US Remains Unprepared for Agricultural Disease Outbreaks," *Emergency Management Preparedness and Recovery,* November 13, 2017, http://www.govtech.com/em/disaster/US-Remains-Unprepared-for-Agricultural-Disease-Outbreaks.html.

created a new policy and contingency plans, it is likely not enough to combat a quick-spreading, deadly biological attack.

Why Choose Biological Terrorism?

Historical instances of biological warfare are not hard to come by, but modern examples are few and far between. Due to this discrepancy, it is essential for this chapter to contain a section that explains why terrorist groups would choose to use biological agents as their method of warfare. This section will go over many of the advantages of using biological agents during terrorist attacks to provide solid reasoning for why biological terrorism is a viable threat against the United States. The main advantages this section will cover include low cost and rudimentary skills required, attribution problems, lack of protection in the United States, and most importantly its potential for a high impact.

Biological agents provide terrorist groups with a low cost and relatively easy way to make a weapon that has the potential to be felt around the world. Bioweapons are inexpensive, can be easily transported, stockpiled, and has the potential to cause destruction worldwide. Crystal Ayres, a war veteran turned reporter, writes 'in a literal sense, anyone can create their crude biological weapon if he had [the] flu and would leave samples of the virus in a container, wherein he can manage to keep it alive over time."[256] This indicates that anyone with access to an infected person can put together a crude biological weapon design that could cause an outbreak at a meager price. Tim Downs, an author and terrorism expert, says, "experts have estimated that for a terrorist group to develop a nuclear weapon could cost them a billion

256. Crystal Ayres, "12 Integral Pros and Cons of Biological Warfare," *Connect Us Fund,* August 5, 2015, https://connectusfund.org/12-integral-pros-and-cons-of-biological-warfare.

dollars… But to develop a very good biological arsenal you would need about ten million dollars and a very small lab and a master's degree in chemical engineering."[257] As stated in chapter 3, there are many diseases that are no longer found in the United States but can still be found in the Middle East. This means that terrorist groups in the Middle East could harvest contaminates that the United States has not seen in years and released them to cause panic in North America for nearly no cost.

However, low cost alone is not enough to entice terrorist organizations to give up their dreams of obtaining nuclear weapons, but lower effort and knowledge requirements might be. While the knowledge needed to create and use atomic weapons remains out of reach for most states and especially non-state actors, the knowledge necessary to manufacture biological weapons remains available on the internet. The CDC agrees stating that any person can find instructions on how to make a bioweapon on the internet."[258] This ease of acquisition makes biological weapons an appealing option for terrorist organizations.

Another reason terrorist groups might choose biological weapons is due to how natural 'intentional outbreaks' can look and the resulting attribution problems. The pathogens used for biological attacks are often naturally occurring agents over synthetically created ones. This means a deliberate bioterrorist attack can be mistaken as a naturally occurring outbreak. To this end, it would hard to attribute attacks to any one entity and as such terrorist organizations can claim the credit on their terms. However, this only works when the disease already naturally occurs in the United States. For example, an outbreak of avian influenza that affects the United

257. "Agro-terrorism Threat is Real," *Homeland Security News Wire,* September 3, 2009, http://www.homelandsecuritynewswire.com/agro-terrorism-threat-real.

258. Khan and Sage, "Biological and Chemical Terrorism."

States' poultry may be classified as an unfortunate, but a natural incident. However, an outbreak of smallpox in the United States would be immediately suspicious because the disease has been declared eradicated for nearly 40 years and therefore would be immediately classified as an intentional attack.

A second issue with this, however, would be attribution. While the United States may be able to quickly mark an attack as natural or intentional, finding out exactly who or what organization is responsible for the attack is markedly harder. Paula A. DeSutter, a former Assistant Secretary for Verification, Compliance and Implementation, states, "Scientists must be able to determine, first, what was the source of the event that caused the disease; second, determine if the event was natural or deliberately caused; and third, be able to track down its origins. That is an EXTREMELY difficult set of tasks."[259] Attribution can be a hard task during any event conventional or otherwise but attributing something that could have happened naturally becomes even more challenging. DeSutter continues by explaining how air travel has made attribution even harder. Someone can be in Washington D.C. one day and in Paris, France the next.[260] Globalization has made attribution impossible at worse and challenging at best.

We can use smallpox as an example. If there was a smallpox outbreak in the United States tomorrow, then it can be easy to assume that this outbreak is an intentional one and not a natural one, but attribution can be tricky. While it might be smart to believe that the attack came from Russia because Russia is the only other country besides the United States to *have smallpox officially*, it is alleged that there are many other nations to have kept smallpox stockpiles from

259. Paula DeSutter, "Attribution and Deterrence of Biological Weapon Use," *US Department of State Archive,* October 27, 2008, https://2001-2009.state.gov/t/vci/rls/rm/111767.htm

260. DeSutter, "Attribution and Deterrence."

that the former Soviet Union gave to them before the end of the Cold War. This means that while Russia is a logical answer, it is not the only one.

Another reason that terrorist organizations might choose biological weapons over conventional ones is that they can be more effective. The United States has ramped up protections against terrorism since the 9/11 hijacks; however, the United States still trails when it comes to biodefense. The United States has continued to cut funding to biodefense even has the new Administration boasts that its new Biodefense Strategy will protect the American people.[261] Dr. John Fischer, the director of the Department of Homeland Security's (DHS) Chemical and Biological Defense Division, stated that "the chemical-biological defense division is taking a cut [of more than 28%] in the fiscal year 2018."[262] The 2018 budget document listed several programs critical to biodefense that are all facing budget restrictions including:

- Biosurveillance systems to collect and exploit data
- Reliable chemical detectors development
- Development of repositories of biothreat agents that could be used for detection, response, and recovery.

These programs are considered critical to a comprehensive United States biodefense.[263] Also facing budget constraints in 2018 is the Department of Defense (DoD) where military

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261. "President Donald J. Trump is Strengthening America's Biodefense," *White House Briefings,* September 18, 2018, https://www.whitehouse.gov/briefings-statements/president-donald-j-trump-strengthening-americas-biodefense/.

262. Vivienne Machi, "Homeland Security Struggling to Fund Chem-Bio Defense," *National Defense Magazine,* http://www.nationaldefensemagazine.org/articles/2017/9/22/homeland-security-struggling-to-fund-chem-bio-defense.

263. Machi, "Homeland Security Struggling."

programs that develop chemical and biological countermeasures are seeing significant cuts to their funding. James Dillman, the Director of Research at US Army Medical Research Institute of Chemical Defense, states "[current] budget constraints have caused the organization to narrow our focus in research opportunities."[264] Budget reductions on programs that have proven an effective defense against bioterrorism are damaging to the United States' overall budget defense.

Even more worrisome is that the current United States' health infrastructure remains unable to respond to an attack. Using the Ebola crisis as an example, the United States showed that it is not prepared to deal with a widespread biological attack. While Ebola was not a biological attack, the situation does an excellent job of showing how the United States might react to an intentional outbreak. Air Force Col. Randall Larsen says, "We can see how easy it was to overwhelm one pretty good hospital in Dallas. If this is a sign of how well we're prepared for the big one, we're in trouble."[265] While there were only a couple of cases of Ebola during the 2014 outbreak, hospitals were quickly overwhelmed. If the United States has trouble containing a small outbreak with advanced notice, it will likely struggle even more with an unexpected intentional attack.

Without a comprehensive biodefense infrastructure, the effectiveness of a bioterrorist attack increases. At this moment it is unlikely that terrorists could successfully attack the United States by firing a missile at one of its cities. Not only does the United States possess a competent missile defense layer, that includes ground-based interceptors in California and Alaska, ballistic missile defense (BMD) capable ships stationed around the world, as well as short-range defense

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264. Machi, "Homeland Security Struggling."

265. Kristina Wong, "Could US Handle Biological Attacks," *The Hill,* October 21, 2014, http://thehill.com/policy/defense/221329-after-ebola-experts-fear-nation-isnt-ready-for-a-biological-attack.

systems including the Terminal High Altitude Area Defense (THAAD) and the Patriot air defense system,[266] but the rockets that terrorists often have access to are frequently not powerful enough to reach the United States. However, it is not nearly as hard for terrorists to infect their people with contagious diseases and then put them on planes and have them fly back and forth until they have affected hundreds of people on their way home to infect even more people unknowingly. It is also possible for homegrown terrorists to use agents found in the United States to affect farms by spreading agricultural diseases, like avian flu, across different poultry farms until the United States has no choice but to slaughter entire populations of poultry to contain the disease. This type of effect can often be extremely appealing to terrorists who want to inflict damage at a high level with a relatively low level of effort.

Lastly, terrorists are likely to choose biological agents because of their high impact. In this case, high impact is different from high effectiveness. Effectiveness refers to whether a terrorist group could successfully carry out a bio- or agroterrorist attack against the United States, while impact applies to the number of people infected, how badly agriculture was contaminated, or how hard the attack hit the economy. Ayres says, "a single gram of agents, like the botulinum toxin, used in a biological weapon can kill millions of individuals."[267] However, this impact only refers to diseases that affect humans. Diseases affecting agriculture can have just as high of an impact on the United States. Carlton Gyles writes in his article "Agroterrorism," that

> The effects of an act of agroterrorism might include animal suffering, loss of valuable animals, cost of containment of outbreaks and disposal of carcasses, lost trade, and other economic effects involving suppliers, transporters, distributors, and restaurants. The $1

266. "The Ballistic Missile Defense System (BMDS)," *U.S. Department of Defense Missile Defense Agency,* January 23, 2019, https://www.mda.mil/system/system.html.

267. Ayres, "12 Integral Pros and Cons."

> billion price tag on the dioxin-contaminated animal in the Netherlands in 2006 and the $21 billion cost of the UK foot-and-mouth disease (FMD) outbreak in 2001 illustrate the potential economic impact of chemical contamination or infectious disease affecting animals.[268]

Targeting food sources in the United States could have spillover effects that later affect the human population. Viruses that affect animals and produce often can also affect humans. The viruses can spread between these three elements indiscriminately causing a prominent level of disruption in the US. This is the type of impact that terrorist organizations tend to want when they are planning an attack against their enemies. A tremendous economic or human loss sends a message to any country opposing them that they mean business and are not afraid to use any method necessary to accomplish their means.

Summary

These reasons are just some of the many advantages of using biological weapons as opposed to conventional ones. However, like every method of warfare, there are also plenty of disadvantages that may prevent terrorists from turning to pathogens to create a panic and accomplish political goals. This next section covers some of the reasons that terrorists might shy away from using disease and instead remain focused on conventional weapons.

Why Not Biological Terrorism?

Terrorist organizations have been around for years now, and most groups have, at one point or another, expressed interest in obtaining and using biological weapons. However, no terrorist group has yet to launch a biological attack against the United States. This does not mean

268. Carlton Gyles, "Agroterrorism," *The Canadian Veterinary Journal* 51, no. 4 (2010): 347-348.

that a bioterrorist attack is an impossibility; it just says that there are significant disadvantages to using biological agents as weapons. This section will serve to analyze some of the reasons why terrorist groups might not choose biological weapons, including the possibility of asymmetric retaliation, possible ineffectiveness, general dislike, and maybe most important diseases are uncontrollable.

Pathogenic warfare shares similarities to cyber and space warfare. All three seem to be new domains in which fighting wars are becoming more and more possible. Now, if the United States were attacked in space or over the internet, the United States might have more trouble responding than it would to a conventional attack. This is not because the United States is incapable of responding, but rather because there is not internationally accepted escalation ladder for unconventional warfare. The same applies to bioterrorism. Since bioterrorism is a relatively unused type of warfare, the world has not yet established a set escalation ladder for how to respond to biological attacks. The lack of escalation ladder could lead to confusion among victimized nations in how to respond and delay an appropriate response or prevent nations from responding altogether.

Officially, the United States does not have a biological weapons program, so if its population was attacked using pathogens, the United States does not have the option to respond symmetrically as it would in the case of other types of attacks. Normally, if the United States was attacked, it would respond in a symmetric fashion, but it cannot do that during a biological attack. Instead, the United States would likely have to respond using an asymmetric form of warfare, possibly an escalatory one. Dr. Edward Eitzen says,

> A major disadvantage to the use of biological weapons is that, since they are widely viewed as weapons of mass destruction and out of the ordinary, their use may bring about the escalation of military conflict (i.e., in the type of a retaliatory attack). Since there are no biological weapons in the current arsenal of the United

> States, and since the effect of chemical weapons is so much more limited in scale and area covered, we can only speculate on the response of the United States if our military forces or civilian populations were attacked with biological weapons. Such concerns may be one reason why Iraq elected not to use chemical or biological weapons in the Persian Gulf War.[269]

The threat of retaliation, if an attack can be attributed, may be enough to act as a deterrent for bio- and agroterrorism. However, some terrorist organizations may continue a path that uses biological weapons because of the impact of a successful attack outweighs possible retaliation. However, fear of retaliation is only one of many disadvantages of biological weapons. Another reason counters a previous advantage of effectiveness. As with any attack, there is a chance that biological weapons may not have the desired effect when used against adversaries. Pathogens are live, active viruses and bacteria, which makes them inherently unpredictable. It is possible the disease could die when released because of an inhospitable environment. However, it is possible that it might not infect enough people or gain enough traction to spread prolifically. Research even found that between 1 and 10 percent of the world's population has a natural immunity to many of the compounds found in biological weapons, which means that it is possible that the disease may not even take depending on where the infection was supposed to start.[270] If terrorist organizations want a 'sure bet' type of weapon, biological weapons are not the best choice.

Next, there is a possibility, albeit a small one, that international stigma may act as a deterrent against the use of biological weapons. This is a strong argument when it comes to recognized nations in the world, but substantially weaker when it refers to terrorist organizations. Currently, the Biological Weapons Convention has 182 States Parties and five Signatory States.

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269. Edward Eitzen, "Use of Biological Weapons," *Medical Aspects of Chemical and Biological Warfare,* https://phsource.us/PH/CBRNE/MABCW/Ch20.pdf p. 441.

270. Ayres, "12 Integral Pros and Cons."

There are only ten states that have neither signed nor ratified the Convention.[271] This unity signifies that there is an almost unanimous agreement that using biological weapons is unacceptable.

However, terrorist organizations are unlikely to hold themselves to the same standard as nations because they are not afforded the same status as nations are in the international order; it is likely this unity will not matter to them. Still, global stigma can be a strong deterrent. Bioterrorism and agroterrorism are usually done to accomplish a political goal, so it is possible that terrorist organizations will hold their political purposes higher than their desire to cause a large amount of destruction. Some organizations may be more likely to keep to international standards because they desire recognition as a state, i.e., Hamas, or because they believe the stigma will take away from their overall message. In this case, international aversion could serve as an effortless deterrent.

Lastly, and possibly most importantly in deterring bio- and agroterrorism is unpredictability. Biological weapons are not like conventional weapons. They are not one explosion, one impact type of weapon. It does not just explode, cause damage, and then stops. Pathogens are live bacteria and viruses that can continue to spread past the original target until it becomes nearly impossible to contain. In the past, there have been examples of countries attempting to use biological weapons to cause harm and instead causing outbreaks among their troops, essentially providing instant karma to the attacker.

Science Clarified says, “Biological warfare is among the least commonly used military strategies. Most military leaders have been reluctant to release microorganisms that might cause

271. Kelsey Davenport, “Biological Weapons Convention Signatories and States-Parties.”

an uncontrolled outbreak of disease, affecting not only the enemy but friendly populations as well."[272] Even though there is plenty of terrorists willing to die for their cause, some terrorist organizations' goals are less in line with 'total annihilation' than others, so this uncontrollable aspect of germ warfare might be off-putting to terrorist leaders.

State-Sponsored Biological Terrorism

Most of this chapter has been spent explaining and analyzing biological terrorism, but so far it has lacked an analysis of state-sponsored biological terrorism. This section serves to remedy that by describing what state-sponsored biological terrorism is, listing current states that are designated state-sponsors of terrorism, and explain why some countries might choose to sponsor terrorist groups by giving them the resources needed for biological terrorism.

The U.S. Department of State says that state-sponsors of terrorism are determined based on whether they have "repeatedly provided support for acts of international terrorism."[273] Very simply put, state-sponsors of terrorism provide terrorist groups with money, weapons, or recognition that allow those terrorist organizations to achieve more of their goals. States can also use terrorist organizations as proxies to accomplish actions the state itself cannot perform without severe consequences.

Currently, the State Department designates just four nations as state-sponsors of terrorism: The Democratic People's Republic of Korea (North Korea), Iran, Sudan, and Syria.[274]

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272. "Biological Warfare," *Science Clarified,* http://www.scienceclarified.com/Bi-Ca/Biological-Warfare.html, (accessed January 25, 2019).

273. "State Sponsors of Terrorism," *U.S. Department of State,* November 2017, https://www.state.gov/j/ct/list/c14151.htm.

274. "State Sponsors of Terrorism." *U.S. Department of State.*

Of these four countries, this paper has covered three (North Korea, Iran, and Syria) due to their biological weapons programs and dislike of the United States. During the analysis of their biological weapons programs, it was explained what terrorist organizations each country might support. In Chapter VI, descriptions of what a state-sponsored biological attack would look like if it proved successful and productive will be provided.

However, just because a country does not make the list as an official state sponsor of terrorism, it does not mean that that country does not support terrorism in its way. During the Cold War, the former Soviet Union consistently provided support to communist nations and rogue states that attempted to use attacks to accomplish their goals. To this day, modern Russia continues to support organizations that could help achieve their political purposes and to stand against the United States. In the next chapter, it will be shown how these countries can support terrorist organizations and what that support might look like in the form of an attack.

But knowing that some countries support terrorism is far different from understanding why they serve as supporters. Likely, the biggest reason that countries support terrorist organizations is that it offers plausible deniability, while still helping nations accomplish their defense and foreign policy objectives. For example, if Iran wants to make a move against Israel, but due to international stigma and possible retaliation cannot make such a move, it could offer to support a terrorist group that also wants to strike against Israel but may not have the resources to do so. In this way, both the terrorist organization and the supporting nation can accomplish their means. The terrorist organization acquires the resources needed to attack Israel, and Iran can watch Israel suffer without leading the actual attack, giving Iran the ability to deny involvement.

Summary

Overall, bio- and agroterrorism are unfortunate threats that the United States needs to be aware of to prepare for an attack adequately. This chapter was meant to give a better understanding of what both bioterrorism and agroterrorism mean, explain what advantages and disadvantages that biological weapons have for terrorists, and lastly explain what state-sponsored biological terrorism means. This analysis is necessary to understand the next chapter which provides imaginative biological and agricultural attack scenarios and what it would say for the United States.

CHAPTER VI: THE THREAT

Biological weapons, no matter how crude, are not just weapons of the state but have become accessible to non-state actors as well. Rapid advances in medical technologies and the relative simplicity of weaponizing biological agents have increased the bioterror threat. Advanced degrees in biology are no longer needed to weaponize biological agents and actors do not need exuberant amounts of money to create a program. The possibility of a biological attack against the United States and its assets remains an unprecedented threat against the US that it is not likely prepared to handle. A report from 2008 called World at Risk stated,

> We accept the validity of current intelligence estimates about the current rudimentary nature of terrorist capabilities in the area of biological weapons but caution that the terrorists are trying to upgrade their capabilities and could do so by recruiting skilled scientists. In this regard, the biological threat is greater than the nuclear; the acquisition of deadly pathogens and their weaponization and dissemination in aerosol form would entail fewer technical hurdles than the theft of production of weapons-grade uranium and plutonium and its assembly into an improvised nuclear device.[275]

The homeland boasts a population of over 300 million citizens and hundreds of thousands of acres of agriculture. A successful attack that utilizes a disease with a high fatality and infection rate against the United States has the potential to kill millions of people. For example, Bruce Lee, an associate professor of international health at John Hopkins Bloomberg School of Health estimates that since the smallpox virus alone kills approximately 1/3 of all infected people, it has

275. Bob Graham et al, "World at Risk: The Report of the Commission on the Prevention of WMD Proliferation and Terrorism," *Commission on the Prevention of Weapons of Mass Destruction Proliferation and Terrorism,* December 2008, http://www.dtic.mil/docs/citations/ADA510559.

the potential to kill 100 million people in the United States.[276] It is becoming increasingly clear to the United States that it is under threat, not just at home, but abroad as well.

The United States has approximately 15,000 U.S. personnel based in Kuwait spread among Camp Arifjan, Ahmed Al Jaber Air Base, and Ali Al Salem Air Base[277], about 5,000 found at the Al Dhafra Air Base in the United Arab Emirates[278], just over 200 at the U.S. military base in Oman[279], 7,000 in Bahrain, which hosts the U.S. Fifth Fleet[280], and around 10,000 U.S. personnel at Al Udeid Air Base in Qatar[281], which is considered one of the most strategic U.S. air bases in the world. However, for this paper, we will only focus on the impact of a biological attack on American assets in Bahrain and Qatar, given their large concentrations of U.S. personnel and their proximity to potential adversarial actors.

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276. Bruce Lee, "Smallpox Could Return Years After Eradication," *Forbes,* August 28, 2016, https://www.forbes.com/sites/brucelee/2016/08/28/smallpox-could-return-years-after-eradication/.

277. Daniel Brown and Sky Gould, "The US Has 1.3 Million Troops Stationed Around the World—Here Are the Major Hotspots," *Business Insider*, August 31, 2017, http://www.businessinsider.com/us-military-deployments-may-2017-5.

278. Kenneth Katzman, "The United Arab Emirates (UAE): Issues for U.S. Policy," Congressional Research Service *Report for Members and Committees of Congress*, January 25 , 2018, https://www.hsdl.org/?view&did=807913, p. 20.

279. Kenneth Katzman, "Oman: Reform, Security, and U.S. Policy," Congressional Research Service *Report for Members and Committees of Congress*, March 8, 2018, https://fas.org/sgp/crs/mideast/RS21534.pdf, p. 14.

280. Kenneth Katzman, "Bahrain: Reform, Security, and U.S. Policy," Congressional Research Service *Report for Members and Committees of Congress*, February 15, 2018, https://fas.org/sgp/crs/mideast/95-1013.pdf, p. 2.

281. General Joseph L. Votel, Commander, U.S. Central Command, statement on "The Posture of U.S. Central Command" before the Committee on Armed Services, U.S. Senate, March 13, 2018, http://www.centcom.mil/Portals/6/Documents/Transcripts/Votel_03-13-18.pdf, p. 31.

In the Asia-Pacific, the United States has nearly 28,000 military troops in South Korea alone and an estimated additional 200,000 U.S. citizens living in Seoul, South Korea. As for Guam, a second location in proximity to North Korea, there are nearly 90,000 American Civilians and an additional 7,000 U.S. troops.[282] But human lives are not the only ones under threat.

Biological weapons can be used to attack agriculture and animals causing just as severe damage to the United States as an attack against the population. William Karesh, and advisor to the Blue-Ribbon Study on Biodefense says, "The consequences of an agroterror attack would be grave. It could be devastating to the economy because agriculture makes up 5.5 percent of the country's gross domestic product and employs 11 percent of Americans. It could cause food shortages and even starvation."[283] Any attack on the US agricultural sector could have devastating economic, social, and political impacts due to the size of the farming industry, which is why it should be the goal of the world to prevent any intentional spread of biological weapons. While the United States has created a new policy and contingency plans, it is likely not enough to combat a quick-spreading, deadly biological attack.

Biological weapons are likely to be chosen because of their propensity to do a lot of damage. Past instances of disease pandemics have shown the world that pathogens, when released on the planet, are worrisome. The impact of a biological weapon issued on American assets in the Middle East has the potential to be devastating. Today, American soldiers lack

282. John Donnelly, "The Other North Korean Threat: Chemical and Biological Weapons," *Roll Call,* June 12, 2018, https://www.rollcall.com/news/politics/the-other-north-korean-threat-chemical-and-biological-weapons.

283. Donnelly, "The Other North Korean Threat."

preparedness against a biological attack on bases in the Middle East. These attacks have the potential to affect thousands of soldiers, directly and indirectly, affect millions of others.

The purpose of this chapter is to look at different scenarios where biological contaminants could be used and how they might affect the United States. This chapter will look at five unique situations that showcase the destructive power of biological weapons. The first scenario will deal with a possible ISIS attack against American soldiers at the Naval base in Bahrain. The second scenario will look at an Iranian attack utilizing anthrax at U.S. air bases in Qatar. The third scenario will demonstrate a possible attack by North Korea on South Korea using smallpox bacteria. The next situation would illustrate what an attack would look like by the Taliban in Afghanistan if they got ahold of Chinese biological agents and dispersal materials. The last scenario will represent what might happen if Al Qaeda used former Russian scientists to develop agricultural viruses and released them on the United States cattle industry.

Bahrain and Tularemia

It had not taken much for the terrorist group, ISIS, to get ahold of a tularemia stockpile. The civil war in Syria had left much of the laboratories unprotected, and easy pickings for any brave person and ISIS had happened to send people there to get the job done. From there it was not that hard to figure out where and how they wanted to spread the disease. The Naval base in Bahrain was their first target. The station in Bahrain, which is shared by many countries, notably the United States and Bahrain, was ripe with unsuspecting military personnel and potential radicals. ISIS leaders had found foot soldiers willing to die for their cause already stationed on the base. ISIS used the stockpile of tularemia to infect supplies coming into the base, including

things like linens and uniforms. It was a trojan horse, by the time the contaminated materials were distributed, it would likely be too late.

However, the issue did not stop with the soldiers. ISIS leaders had planned the attack to coincide with changes of personnel. Old soldiers were going home, and new ones were coming on base. Every possibly infected person would bring the disease home with them as most symptoms of tularemia are not detectable for nearly seven days after infection.[284] As soldiers came and went, it became clear that something was wrong. As more and more people fell sick, the world watched in terror as an eradicated disease ravaged the United States. Luckily the United States keeps tularemia vaccines stockpiled for possible outbreaks and were able to vaccinate the population, but by then the damage had been done. Thousands were dead and even more still sick. The United States' most strategic naval base in the Middle East was overrun by contaminates, and the United States' Fifth Fleet was without a home. The United States could only ask how it had happened.

Qatar and Anthrax

Every day the United States-Iranian relationship worsened. Iran was constantly threatening attacks and testing new missiles capable of reaching American assets in the Middle East. Most notably at risk was the American Air Base in Qatar, where nearly 10,000 Americans made their home each night. All it took was one more nasty tweet from President Trump before the Iranians had had enough and planned an offensive attack where it would hurt the United States the most. The Iranian government had several options including new missiles and

284. "Smallpox Questions and Answers: The Disease and the Vaccine." *Department of Health.*

chemical weapons, but Iran wanted a semblance of deniability and instead chose biological weapons because they are naturally occurring.

Iran excels at creating bombs that can deliver microbes, so within days it had unmarked planes and drones carrying the deadly virus anthrax to bomb on the American Air Base in Qatar. The Americans tried their best, but their missile and air defenses were overrun, and multiple planes got through to dump anthrax powder across the Air Base. Within a week, thousands of people were infected, and hundreds were dying. The United States quarantined the base at once, and vaccines were flown out to contain the attack, but unfortunately, pathogens are not always constrained by normal means. The anthrax infection spreads beyond the base infecting surrounding nations in the Middle East eventually causing a full-scale pandemic. Hospitals across the area hurry to set up biohazard facilities to handle the infected, but the efforts are not enough. Ultimately, the disease was contained, but not before it has killed hundreds of thousands and infected many more. The Air Base in Qatar, one of the most strategic in the world, is unusable for the time being and the United States is left in an unfortunate place strategically.

South Korea and the Plague

Going to South Korea had been a dream of yours since your grandmother first sat you down and told you the stories of her ancestors and today your dream was finally being realized. You had just become one of the 200,000 Americans living, working, and studying abroad in Seoul, South Korea. The day had started like any other. You had woken up, gone to school, and was now sitting outside going through flashcards to help improve your Korean when what sounded like a small aircraft passed overhead. You looked up and could not believe your eyes. Hundreds of mini-drones were flying overhead releasing what looked to be millions of small

insects. Immediately, you took cover going back inside until you could get more information about what was going.

Four days later, it was all over the news. North Korea had used hundreds of drones carrying fleas infected with plague to launch a biological attack against South Korea due to deteriorating relations between the two countries. The entire situation was like something out of a comic book and reminiscent of what the Japanese had done to the Chinese during WWII. The South Korean government had already declared a State of Emergency urging its populations to be careful going outside and report to a hospital immediately if you began exhibiting signs of the Bubonic Plague.

However, no amount of retrospective precautions could save the situation; within a month hundreds of thousands of people were dead, including nearly 50,000 Americans and Plague was spreading beyond country borders. What had once been believed to be another surveillance drone incursion by North Korea, ended up being something far worse.

Afghanistan and Smallpox

The Taliban had been fighting for dominance in Afghanistan for years, and every time it seemed close to a peace deal, something sabotaged their efforts. However, the Taliban had never forgotten its original goal to run Afghanistan under Sharia law. With the rising threat of biological attacks, the Taliban convinced China under pretenses of providing it with stockpiles of the smallpox vaccine to protect its populations from possible future releases. The development of synthetic horsepox in Canada became the primary justification for the Taliban's desire to be prepared, but their real reasons were far more nefarious.

After receiving the vaccines, the Taliban did begin to inoculate their population, but they also took the vaccine and began to separate the live virus from the vaccine to weaponize smallpox for an infection. Just months later, their scientists had had a breakthrough, and the Taliban had officially weaponized smallpox.

Early in the morning, during routine delivery of aid to the current government, the Taliban quietly ambushed and contaminated the supplies before delivering them as scheduled. The wait was agonizing, but within weeks of the initial infection government officials across Afghanistan were exhibiting symptoms of a disease once thought to be extinct. An incapacitated government made it that much easier for the Taliban to take charge, no more peace talks needed.

U.S. Cattle Industry and Foot-and-Mouth Disease

After years of searching, homegrown terrorists in the United States had finally found a former Russian biological scientist willing to recreate the former Soviet Union's weaponized version of the foot-and-mouth disease. Due to a recent natural outbreak, it was not hard for the scientist to obtain samples of the virus and by using a basic laboratory, he was able to make small changes to the condition to make it more virulent. Once the virus was ready, Al Qaeda leaders sent out these homegrown terrorists in small groups dressed as farmers to release the disease on unsuspecting cattle populations across the country.

Starting in Kansas, the terrorist spread out staying in each place for no more than a few days to ensure that the cattle herds were infected correctly before moving onto the next. At first, the United States government did not even realize that anything suspicious was going on. The United States government originally assumed that a past natural outbreak had spread, but then cattle populations across the United States began to fall ill in a way that was entirely unnatural.

The United States had to stop cattle exports until the outbreak could be contained costing the United States billions of dollars in profits.

Once the United States finally contained the disease, it began searching for the culprits, but by that time the terrorists were far gone, and Al Qaeda was taking credit. Maybe Al Qaeda did not kill the four million Americans that it originally desired to, but it had done something much worse. It had devastated the American economy in a way that could take decades to recover.

Summary

These scenarios showcase the destructive capability of biological weapons if the United States does not have a viable biodefense infrastructure in place. The threat of biological warfare is no longer linear. The United States cannot just be worried about offensive biological weapons program from enemy states but must also worry about dual-use research programs and technology. The term dual use is most often applied to research that can be used for both civilian and military purposes. For example, research into nuclear fission can be used for both nuclear energy production and the production of atomic weapons. In the case of biological research, this term can be used to include the research used by biomedical scientists to create vaccines for highly infectious diseases but can also be used by enemy states to create weaponized versions of the same disease. A highly publicized version of this was when a group led by David Evans at the University of Alberta created a complete synthetic version of the horsepox virus to create a better vaccine for smallpox potentially.[285] Synthetic biology is "a maturing scientific discipline

285. RS Noyce, S Lederman, DH Evans, "Construction of an Infectious Horsepox Virus Vaccine from Chemically Synthesized DNA Fragments," *PubMed Central,* January 20, 2018, PMCID: PMCPMC5774680.

that combines science and engineering to design and build novel biological functions and systems. This includes the design and construction of new biological parts, devices, and as well as the re-design of existing, natural biological systems for useful purposes."[286]

However, the research was very controversial as many believed the reward of a new vaccine for an eradicated virus did not outweigh the threat of an accidental release, or intentional release (as the research was made public) of the virus on a largely unvaccinated public. Other labs around the world have run into this exact ethical dilemma with other diseases. While research into synthetic biology can be instrumental in creating new vaccines and possibly cures for chronic illnesses, the risk of biological attacks increases, in the case of synthetic horsepox, the research into how they made the disease was made public potentially allowing threat actors to create their version of horsepox and maybe even smallpox. This creates a worrying situation where the benefits must be weighed against the threat and research better protected or possibly not done at all. In the words of Ian Malcolm from Jurassic Park, "Your scientists were so preoccupied with whether they could, they didn't stop to think if they should."[287]

286. "What is Synthetic Biology," *Engineering Biology Research Consortium,* 2018, https://www.ebrc.org/what-is-synbio.

287. "Jurassic Park Quotes," *Rotten Tomatoes,* 2018, https://www.rottentomatoes.com/m/jurassic_park/quotes/.

CHAPTER VII: POLICY RECOMMENDATIONS FOR BIODEFENSE

Biodefense is defined by the United States Government Accountability Office (GAO) in its biodefense report as, "plans to prevent, protect against, and mitigate biological threats that could have catastrophic consequences to the nation."[288] It incorporates any infrastructure used to defend against a biological attack, from stockpiles of vaccines at hospitals to tightened airport security. The United States biodefense infrastructure spans across multiple agencies including the DHS, the DoD, the Department of Agriculture (USDA), Health and Human Services (HHS), and the Environmental Protection Agency (EPA).[289] The National Institute of Allergies and Infectious Diseases (NIAID), the CDC, and the Army also play roles in developing technologies for biodefense.

In 2001, the DHS created the four essential pillars of national biodefense consisting of Threat Awareness, Biosurveillance, Detection and Diagnostics, and Response and Recovery.[290] Each pillar covers different aspects of the biodefense infrastructure. Threat Awareness "identifies, assesses and prioritizes chemical and biological risks and threats to enable planning, response, countermeasures, and remediation."[291] Biosurveillance prioritizes "developing effective surveillance, prevention, and operational capabilities for detecting and countering

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288. "Biodefense: Federal Efforts to Develop Biological Threat Awareness," *United States Government Accountability Office Report to Congressional Requesters,* October 2017, http://www.gao.gov/assets/690/687675.pdf, 2.

289. "Biodefense," *U.S. GAO Report,* 2.

290. "Biological Security," *Department of Homeland Security,* July 10, 2015, https://www.dhs.gov/topic/biological-security.

291. "CBD Focus Areas Threat Awareness," *Department of Homeland Security* https://www.dhs.gov/science-and-technology/threat-awareness, (accessed February 20, 2019).

biological threats."[292] Detection and Diagnostics focus on "developing tools to rapidly detect and diagnose high-priority and emerging biological and chemical threat agents both in the field and medical practitioners office as well as highly characterized microbe repositories for use in validation studies."[293] Response and Recover focus on "returning things to normal following a biological attack."[294] The Department of Homeland Security indicates that the United States is making progress in all four of these areas, but leading research organizations around the country including the WMD Terrorism Research Center and the Blue-Ribbon Biodefense Panel continue to indicate that the United States remains vulnerable to attack.

For example, in an attempt to better gauge the United States' readiness to respond to a biological attack, the Bipartisan WMD Terrorism Research Center in 2011, led by former Senators Bob Graham and Jim Talent, Colonel Randy Larsen, and Lynne Kidder, released its "Bio-Response Report Card."[295] The authors describe the report card's purpose as to "provide a strategic, end-to-end assessment of America's bio-response capabilities."[296] The report card analyzes the United States' abilities in eight separate areas of biodefense including Detection and

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292. "CBD Focus Areas Biosurveillance," *Department of Homeland Security,* https://www.dhs.gov/science-and-technology/biosurveillance, (accessed February 20, 2019).

293. "CBD Focus Areas Detection and Diagnostics," *Department of Homeland Security,* https://www.dhs.gov/science-and-technology/detection-and-diagnostics, (accessed February 20, 2019).

294. "CBD Focus Areas Response and Recovery," *Department of Homeland Security,* https://www.dhs.gov/science-and-technology/response-and-recovery-0, (accessed February 20, 2019).

295. Martin Matishak, "U.S. Receives Poor Marks in Latest Biodefense Report Card," *NTI,* October 13, 2011, https://www.nti.org/gsn/article/us-receives-poor-marks-in-latest-biodefense-report-card/, 7.

296. Matishak, "U.S. Receives Poor Marks," 7.

Diagnosis, Attribution, Communication, Medical Countermeasure Availability, Medical Countermeasure Development, and Approval Process, Medical Management, Environmental Cleanup. For each area, the research center assigned a grade using a common school grading scale:

A – Meets Most Expectations

B – Meets Many Expectations

C – Meets Minimal Expectations

D – Meets Few Expectations

F – Fails to Meet Expectations

Aside from assigning grades to each area, the center also indicates whether the trend for that area is stagnant or improving.

Figure 1 below is the full Bio-Response Report Card:

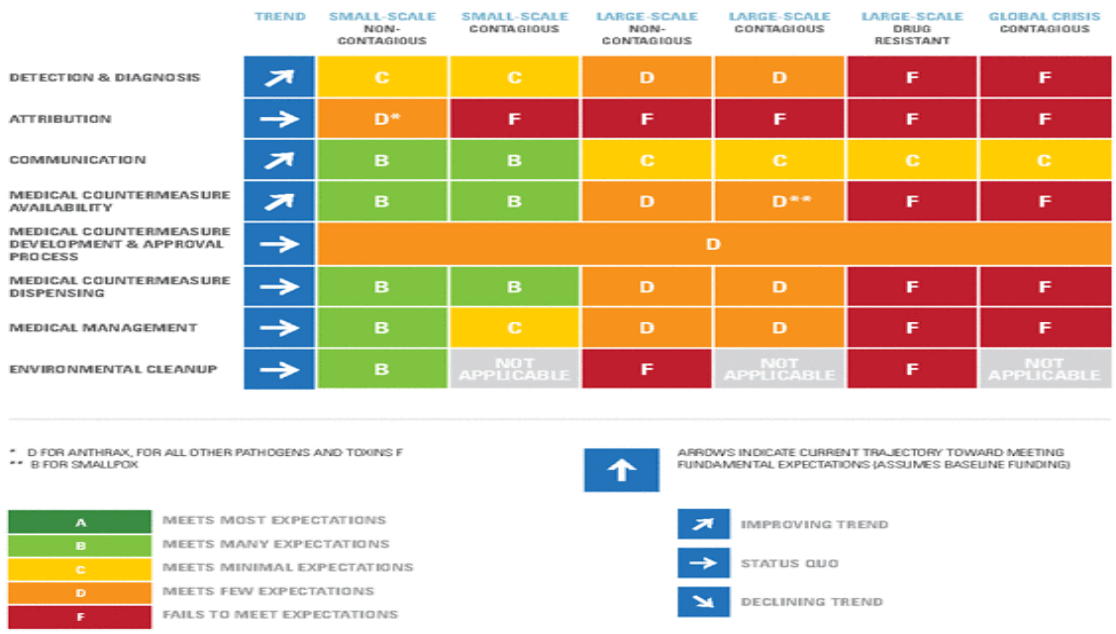

Figure 1. Bio-Response Report Card that measures the United States readiness for different areas of preparedness by assigning grades and then designating the current trend for predicted improvement in that area. [297]

297. Matishak, "U.S. Receives Poor Marks," 7.

The results were disheartening. While the United States received good ratings for its response to small-scale biological attacks, its ability to respond to large-scale attacks and global crises failed to meet expectations in most areas. The trends in this report card show that while there have been some improvements, most areas remain stagnant.

Over the past ten years, biodefense spending has varied, but in the past few years, the funding has trended downward. Table 1 below shows the breakdown of funding for specific areas of biodefense from Fiscal Year (FY) 2012 to FY2019.

Table 1. Total Federal Civilian Biodefense Funding Over Eight Years (In Millions) [298]

	FY2012	FY2013	FY2014	FY2015	FY2016	FY2017 (Actual)	FY2018 (Estimated)	FY2019 (Budget)
DoD Total	891.1	825.7	1,035.6	889.8	750.2	633.9	707.8	600.0
DHS Total	654.8	642.6	614.9	1,016.4	693.5	720.4	651.0	731.9
HHS Total	244.5	246.3	271.8	266.8	266.8	266.8	266.8	266.8
USDA Total	0.0	26.0	27.0	31.0	32.0	38.0	38.0	15.0
NSF Total	15.0	15.0	16.7	15.0	15.0	0.0	0.0	0.0
Funding Total	1,805.4	1,755.6	1,966.0	2,219.0	1,757.5	1,659.1	1,663.6	1,613.7

The above table specifies that the spending in the budget for the DoD Civilian Biosecurity Program has decreased by almost $100 million from FY 2018. More specifically,

298. Watson et al, "Federal Funding for Health Security," 284.

both the Medical Biological Defense area and the Biologically Based Material and Devices lost nearly half their funding. The total Federal Civilian Biosecurity Program fared better, losing only $30 million of funding overall. Other notable programs facing cuts are the U.S. Department of Agriculture's biodefense program which lost an estimated 66% of its funding. These programs are just a few of the many programs facing cuts. Within the USDA, the program losing most of the funding is the Agriculture Quarantine Inspection program that is instrumental to diagnosing and containing disease outbreaks in crops across the United States. The program within DARPA that researches infectious diseases and containment methods also lost a significant amount of funding decreasing the United States' understanding of infectious diseases and how they spread.

While the Trump administration is confident that these budget restrictions will lead to more efficiency among offices, Republican Senator Lindsey Graham called them "radical and reckless and made without a plan."[299]

The current protections offered to the United States are not as complete or as integrated as they could be or have been. This chapter is meant to provide some suggestions on how the United States can increase its biological defenses or biodefense. These recommendations range from more funding and; following previous panel suggestions, to mandated vaccines and international cooperation. While this is not a comprehensive list of steps the United States could take for more protection, it addresses a wide array of United States' biodefense vulnerabilities.

Suggestions in the Blue-Ribbon Panel on Biodefense

In October 2015, the Blue-Ribbon Study Panel on Biodefense put forth a report titled "A National Blueprint for Biodefense: Leadership and Major Reform Needed to Optimize Efforts."

299. Kirby, "The Trump Administration," 385.

The Blue-Ribbon Panel on Biodefense is a privately funded organization that provides a comprehensive assessment of the state of the United States' biodefense efforts. The organization also produces reports that offer recommendations to foster change in the area of biodefense. The current panel includes Senior Counsel Joseph Liberman, Chairman Thomas Ridge of Ridge Global, Senator Tom Daschle, Representative Jim Greenwood, the CEO of the Biotechnology Industry Organization, the Honorable Kenneth Wainstein, and the Honorable Lisa Monaco.[300] The purpose of this report was to inform the government about different options for reforming the leadership aspect of biodefense, including restructuring the current biodefense infrastructure.[301] However, this was not the only report to be published by this Blue-Ribbon Panel. Since 2015, the panel has also put forth reports with suggestions about the defense of animal agriculture, increasing funding, and even reinforcements.

As a first recommendation, the United States could enact some of the suggestions present in the multiple reports provided by the biodefense blue-ribbon panel to streamline overall biodefense. Overall, the committee offers over 20 different recommendations dealing with all aspects of United States biodefense. However, for this section, the focus will remain on restructuring White House leadership for biodefense. The panel suggests reorganizing the current biodefense structure to allow for a more coordinated response against biological threats.[302] One possible answer would be to let the Vice President have administrative power over the

300. "Blue Ribbon Study Panel on Biodefense," *Biodefense Study,* February 13, 2019, https://www.biodefensestudy.org/index.htm.

301. "A National Blueprint for Biodefense: Leadership and Major Reform Needed to Optimize Efforts," *Bipartisan Report of the Blue Ribbon Study Panel on Biodefense,* October 2015, https://www.biodefensestudy.org/a-national-blueprint-for-biodefense.

302. "Holding the Line on Biodefense: State, Local, Tribal, and Territorial Reinforcements Needed," *Bipartisan Report of the Blue Ribbon Study Panel on Biodefense,* October 2018, https://www.biodefensestudy.org/news, 34.

biodefense budget and coordinated efforts.[303] Under this recommendation, there are two action items: 1) Empower the Vice President with jurisdiction and authority and 2) Empower the Vice President with budget authority.[304] The idea behind this change in policy is to restructure the biodefense response architecture by creating a more top-down system. So instead of state legislatures relying on individual reports of a situation, possibly leading to bad decisions in the case of a biological attack, state and local leaders can instead look to the Vice President to dictate important decisions like quarantines and emergency responses needed. By creating a clear chain of command that could then direct response efforts, the United States stands a better chance of containing and responding to a biological attack.

Another vital recommendation mentioned in this blue-ribbon panel deals with better integrating federal resources and information with that of State, Local, Tribal, and Territorial (SLTT) governments. Due to the country's current biodefense infrastructure, SLTT governments must work to contain possible bio- and agroterrorist attacks by themselves until the federal government can get assets on the ground to help contain an attack. However, the blue-ribbon panel instead suggests "empowering non-federal entities to become equal Biosurveillance partners by creating an interagency Biosurveillance planning committee"[305] increasing cooperation and communication between the two entities to improve response time during a biological attack. This empowerment gives the SLTT governments a voice in how each

303. "Holding the Line on Biodefense," 34.

304. "Holding the Line on Biodefense," 34.

305. "Holding the Line on Biodefense," 28

municipality responds to biological attacks allowing a more effective overall response than if the SLTT governments had to handle it on their own.

Switching gears to a more agroterrorism focused defense, the blue-ribbon panel on 'Defense of Animal Agriculture' suggests increased collaboration between the United States Department of Agriculture (USDA) and the Federal Bureau of Investigation (FBI). The panel suggests that law enforcement and health officials should conduct investigations into agricultural disease outbreaks together to get a more well-rounded report on the contamination causes and impacts.[306] Currently, investigations regarding animal health are handled by the USDA, while the FBI acts as law enforcement in the case of an intentional attack. Since the FBI deems all domestic incidents of foreign animal diseases suspicious, it keeps communication lines open with the USDA.[307] However, as of now, both agencies conduct separate investigations; to prevent or respond to a coordinated agroterrorism attack or even a biological attack against humans; communication and collaboration are critical to ensuring all entities involved in the containment and response are on the same page and working towards the same goal. Increasing cooperation between the USDA and the FBI is just one way of improving overall collaboration during a possible biological attack.

Increased Funding

306. "Defense of Animal Agriculture," *Bipartisan Report of the Blue Ribbon Study Panel on Biodefense,* October 2017, https://www.biodefensestudy.org/defense-of-animal-agriculture.

307. "Defense of Animal Agriculture," 3.

One suggestion that may seem too obvious is also an essential suggestion in this section, increasing funding. As mentioned before, the DHS's Chemical and Biological Defense Division faced a 28% budget decrease in 2018.[308] Researchers at the John Hopkins Center for Health Security estimate that the 2019 proposed budget would cut funding for health-security programs by an additional 4% or nearly $636 million.[309] These cuts would affect five critical categories of health security including biodefense, radiological and nuclear defense, chemical defense, natural outbreak and emerging infectious disease defense, and general preparedness, likely increasing the United States' vulnerability to biological attacks.

However, it is not just civilian agencies that are affected by these budget cuts to biodefense. Also facing new budget constrains is DoD military programs focused on developing chemical and biological countermeasures. James Dillman, the Director of Research at US Army Medical Research Institute of Chemical Defense, states "[current] budget constraints have caused the organization to narrow our focus in research opportunities."[310] Crystal Watson, a senior scholar at the Center for Health Security and lead author on the *Health Security* report for the proposed FY2019 federal budget cuts, broke down the programs most highly affected by the proposed cuts. Biosecurity programs are focusing on prevention, preparedness, and response to intentional attacks on civilians, accidental releases of diseases, and natural outbreaks. Programs dealing with Radiological, Nuclear, and Chemical security were also facing cuts between 2% and

308. Machi, "Homeland Security Struggling."

309. Nick Alexopulos, "Proposed FY2019 Federal Budget Cuts Health Security Funding by 4%," *John Hopkins Bloomberg School Center for Health Security,* October 30, 2018, http://www.centerforhealthsecurity.org/about-the-center/pressroom/press_releases/2018-10-30_federal-funding-health-security-fy2019.html

310. Alexopulos, "Proposed FY2019 Federal Budget."

6%. Programs focused on general preparedness and increased health infrastructure to increase the United States capacity to respond to large-scale attacks are being cut by seven percent.[311] Budget reductions on programs that have proven an effective defense against bioterrorism are damaging to the United States' ability to protect its population at home and abroad, including its deployed military personnel. But it is not just specific programs that are suffering.

The blue-ribbon panel on budget reforms explains how the domestic public health emergency funding is also in a sad state. "In 1983, Congress appropriated $30 million for the fund, an amount insufficient to address a public health catastrophe. Congress has not explicitly appropriated any money for the public health emergency fund since 1993. [As of February 2018], only about $57,000 remained," the report reads.[312] The same reports suggest that not only does the United States need a substantial infusion of funds into the Public Health Emergency Fund, but that it also requires a rapid response fund that can be used in advance to preempt a suspected significant problem, like increasing infrastructure required to handle an attack. The report estimates that $2 billion would be a good baseline for the initial fund.[313] The money could then be used by multiple entities to prepare the United States for an attack.

In terms of increasing funding, the United States should first begin with the recommended two-billion-dollar infusion into the Civilian Biodefense Fund. First, a portion of this money, approximately $76 million, should be used to rebuild the Public Health Emergency Fund. This infusion would bring the fund back up to the level it was in 1983 when it was first

311. Alexopulos, "Proposed FY2019 Federal Budget."

312. "Budget Reform for Biodefense," *Bipartisan Report of the Blue Ribbon Study Panel on Biodefense,* February 2018, https://www.biodefensestudy.org/Budget-Reform-for-Biodefense-Feb-2018.htm, 19.

313. "Budget Reform for Biodefense," 19.

created, while also accounting for the inflation rate from then until now. Seventy-six million dollars would provide the United States the same purchasing power today as $30 million would have provided the United States nearly 40 years ago. The rest of the money should be used to fund a Rapid Response Fund that would provide the United States with new health infrastructure, like the construction of more biosafety level 4 hospitals and better detection systems in public areas.

Increased funding for biodefense remains the single most important recommendation for increased biodefense. By increasing funding, you are providing the lead parties in biodefense the ability to decide what vulnerabilities need to be addressed first. Increased funding could serve as the difference between the United States reacting to a biological attack and proactively preventing one.

Vaccinations (Stockpiled and Mandates)

A third suggestion would be stockpiling and mandating vaccines. Smallpox was eliminated worldwide because of mandated vaccines and, up until recently, measles and polio were nearly unheard of in the United States due to vaccinations. However, one erroneous report about a connection between vaccines and autism could serve to reverse all the progress made by increased inoculations. Just this past week, the State of Washington declared a State of Emergency because of a continued measles outbreak in the southwest.[314] Already 30 cases have been reported among unvaccinated children. State data shows that "only about 77 percent of Clark County kindergarteners had completed their vaccinations for the 2017-2018 school year,

314. Gaby Galvin, "Measles Outbreak Prompts State of Emergency in Washington," *U.S. News,* January 28, 2019, https://www.usnews.com/news/healthiest-communities/articles/2019-01-28/state-of-emergency-after-measles-outbreak-in-washington.

down from 91.4 percent in 2004-2005. Experts say roughly 95 percent of people should be vaccinated to create "herd immunity" against a contagious disease like measles."[315] Peter Hotez, a professor at the Baylor College of Medicine in Houston, called the event "awful and really tragic and totally preventable."[316] One way to prevent situations like these would be returning to the smallpox era where vaccines were mandatory. Mandating vaccines, except in cases where the vaccine might cause irreparable harm due to a possible allergy, could be the solution needed to decrease the effectiveness of a biological attack in the United States. A vaccinated population could also serve as a deterrent for potential biological terrorist groups.

As well, the United States also has options to protect our troops in the Middle East against biological attacks. As noted before, those serving in the Middle East are likely at a higher risk because of their proximity to many of these terrorist organizations. The United States has many different options it could implement to make the Middle East safer for its soldiers. The first would be to make vaccinations for smallpox and anthrax mandatory for all soldiers stationed abroad. Currently, the United States mandates certain vaccines for soldiers, like yellow fever and typhoid, but it does not mandate the smallpox vaccine or the anthrax one. Instead, those two vaccines are put under special circumstances and used only if the United States suspects a valid high-level biological warfare threat in the area.

The Department of Defense immunization Program for Biological Warfare Defense specifies that "personnel assigned or scheduled for deployment to a high-threat area should be

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315. "School Immunization Data Tables," *Washington State Department of Health,* April 2018, https://www.doh.wa.gov/DataandStatisticalReports/HealthBehaviors/Immunization/SchoolReports/DataTables.

316. Galvin, "Measles Outbreak."

immunized against validated biological warfare threat agents for which suitable vaccines are available."[317] This means that for soldiers to be preemptively vaccinated, there must be a proven, validated threat. However, it is nearly impossible for the United States to prove the existence of an offensive biological weapons program in any area because, as mentioned before, biological warfare infrastructure and commercial biotechnology infrastructure look identical. In this way, it would be nearly impossible to prove the existence of a valid, imminent threat to justify vaccinating soldiers. So, the United States should instead inoculate all soldiers before they are deployed abroad to protect them from potential threats beforehand instead of trying to cure them after the fact.

Increasing Infectious Disease Research

Epidemiology or infectious disease remains an ever-changing field of study. When the United States thinks it is prepared to defend against known diseases worldwide, new diseases like Ebola or the Zika virus appear, reminding the world that when the weapon can mutate at will, the research never ends. To combat these ever-changing diseases, it is essential that the United States dedicates more resources to researching how and in what situations diseases mutate to better prepare the United States for handling biological attacks. Research into mutating disease can also show the United States how its adversaries might attempt to mutate pathogens to make them vaccine resistant, meaning that the United States has a chance to reverse engineer a new and more effective vaccine against the virus.

317. LM Joellenbeck, JS Durch, and LZ Benet, "Giving Full Countermeasures: Addressing Problems in the DoD Program to Develop Medical Countermeasures Against Biological Warfare Agents," *Institute of Medicine National Academies Press: (2004),* https://www.ncbi.nlm.nih.gov/books/NBK215966/.

Currently, the United States only spends $478 million on antimicrobial resistance research as opposed to the $525 million spent in past years.[318] Antimicrobial Resistance refers to "the ability of a microorganism like bacteria, viruses, or parasites to stop an antimicrobial like antibiotics, antivirals, and antimalarials from working against it."[319] The research into antimicrobial resistance is essential to the United States' ability to combat diseases that its adversaries may have mutated to be more effective against countermeasures like vaccines. While monetary funding is decreasing, resistant diseases are increasing. Dr. Viera Scheibner, a scientist and author from Blackheath New South Wales (NSW) Australia, studies how diseases adapt and mutate to new vaccines. She says that diseases like B. pertussis, measles, and Haemophilus influenzae have all shown the ability to adapt, evade, and combat vaccines.[320] While Dr. Scheibner is referring to mostly natural adaptations, diseases can also be intentionally mutated by scientists in adversarial nations. For this reason, the United States should increase funding for antimicrobial resistance from its current $478 million to the previous level of $525 million. The extra funding can be used specifically for creating vaccines better suited for combating drug-resistant forms of highly infectious diseases.

But increased research is not limited to diseases that affect humans. Research is also useful for defense against agroterrorism, like creating plants that are less susceptible to pathogens that could devastate the United States economy. For example, the producers StarkBros

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318. "Estimates of Funding for Various Research, Condition, and Disease Categories," *U.S. Department of Health & Human Services,* May 18, 2018, https://report.nih.gov/categorical_spending.aspx.

319. "Antimicrobial," *World Health Organization,* November 2017, https://www.who.int/antimicrobial-resistance/en/.

320. Viera Scheibner, "Speeding New Antibiotics to Market: A Fake Fix," *The BMJ* 350, no. 1: (2015), https://www.bmj.com/content/350/bmj.h1453/rr-12.

have created disease-resistant apple trees that are less likely to be infected by citrus targeted diseases.[321] Along the same lines, the South Dakota Agricultural Experiment Station has experimentally bred a new type of winter wheat that not only provides higher yields, but it is also more disease resistant compared to other kinds of grain.[322] The more research that done to understand this topic, the better the likelihood the United States has of preventing or responding to an attack.

However, a lack of funding and international oversight can limit the good that international development labs can do to help protect against biological attacks. In some cases, scientific developments can make the risk of bioterrorism higher. For example, this past summer a Canadian research lab revived horsepox. They intended to use this revived virus to treat cancer or develop a smallpox vaccine; however, Dr. Tom Inglesby worries that the direction and publication of this research will lower the barriers to synthesize smallpox, one of the world's only eradicated diseases creating many international biosecurity and biosafety risks.[323] While this research could lead to vaccines for diseases, it also opens the world to possible bioterrorist threats using these diseases. The possibility of a bioterrorist threat seems to be increasing.

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321. "About Stark Bro's," Stark Bros, accessed January 26, 2019, https://www.starkbros.com/tags/disease-resistant-apple-trees.

322. Vincent Jelani, "Research Finds High Yield and Disease Resistant Wheat," *Harvard University,* 2016, https://scholar.harvard.edu/vincentjelani/publications/research-finds-high-yield-and-disease-resistant-wheat.

323. Kim Riley, "Bioterrorism Threats Require Common Global Experimentation Oversight, Expert Says," *Homeland Preparedness News,* August 10, 2017, https://homelandprepnews.com/featured/23673-bioterrorism-threats-require-common-global-experimentation-oversight-expert-says/.

Increased Detection Technologies

But increased research does not just come in the form of vaccines and disease-resistant agriculture; it also comes in the form of more efficient detection methods. Since 9/11, the United States has upgraded entry protocols in and out of military bases and airports, meaning that our soldiers in the Middle East are more protected than they were ten years ago because they are more aware. However, the soldiers checking for possible biological agent breaches have often not been adequately trained on what a bioagent would look like and what to do if the found evidence of a possible bioagent from someone entering United States' property.[324] Security may have increased, but because of insufficient technology, it is not capable of protecting against a biological attack.[325] But the United States detection layer doesn't just rely on humans looking for signs of a possible attack; it also relies on the technology used in high traffic areas that can pick out air contaminants.

Unfortunately, detection also remains in stasis. In 2014, the DHS terminated a contract with NVS Technologies out of 'convenience' for the federal government. NVS Technologies had been six months away from delivering a prototype of an inexpensive, portable device that could quickly and accurately analyze air samples from current nationwide sensors to determine if they contained pathogens.[326] The original hope was that this cheap, handheld device could improve

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324. George Alakpa, "Current Department of Defense Entry Control Point Search Procedures and the Possible Breach of a Combat ECP with a Bioagent," *Austin Emergency Medicine* 2, no. 4 (2016): 2.

325. Alakpa, "Current Department of Defense," 4.

326. David Willman, "Did Homeland Security Ignore a Breakthrough Tool to Block Bioterrorism? A Trial Will Decide," *Los Angeles Times,* September 8, 2017, https://www.dhs.gov/topic/biological-security.

and eventually replace the current bioterrorism attack detection system, BioWatch. Since 2001, BioWatch has cost the US government over $1 billion in funding, takes up to 36 hours to analyze potential pathogens, and has falsely warned of dozens of biological attacks.[327] As of 2017, BioWatch continues to be the nation's only line of detection against bioterrorism.

Due to the relative failure of BioWatch, it is highly recommended that the United States invests in better detection technologies. To accomplish this, it would be beneficial for the United States to look towards private companies for new and unique detection devices. New investments could include but are not limited to looking into re-establishing the DHS contract with NVS Technologies for small and portable detection devices to replace the current system. Spurring private and commercial development for biological detection devices is a great way to increase competition and ensure that the United States has the best options for protecting its citizens.

Early detection of the presence of infectious disease could be vital to getting the medical countermeasures needed on site promptly. It also allows the United States to quarantine the area and remove personnel to contain the spread of the disease. Technology allows for a more sophisticated approach to fighting infectious disease spread. The same technology that enables terrorists to weaponize and engineer new diseases can be used to contain and respond to biological attacks.

Creating an International Oversight Committee

In general, the United States could also increase international cooperation on disease research. While current efforts are working on this, lack of international oversight of these efforts

327. Willman, "Did Homeland Security Ignore a Breakthrough Tool?"

increases biosecurity risks. The United States has a unique opportunity to head an international oversight committee to regulate how infectious diseases are used in research and further protect the United States from biological attacks. Utilizing scientists from across the world, the United States could create an international organization that would lead to research on infectious diseases and possibly leads to finding a cure. The organization could be a subset of WHO or an entirely separate organization, but its focus could be to study infectious diseases and discover ways to stop their spread and cure them.

Creating this international oversight committee also prevents countries from entering an internationally sponsored organization for researching infectious disease for weaponization. The United States severely limits itself by relying only on itself for research breakthroughs and prevention methods. The United States has a chance to access an entire worldwide network of scientists that could prove to be the best in their respective fields, searching for cures and better vaccines a worldwide one. Not only would an organization like this give the United States a chance to control the situation at an international level, but it would also allow the United States access to the best and the brightest of the infectious disease world. International cooperation is a much-needed addition to the United States' current policy.

As well, the United States could work with the Middle East Consortium for Infectious Disease Surveillance (MECIDS) to detect and control disease outbreaks in the Middle East where many of its troops are currently stationed. MECIDS is a regional collaboration created to improve detection and control of infectious disease outbreaks among Middle Eastern nations and the neighboring countries of Jordan, Palestine, and Israel. It began as a foodborne disease surveillance program but has grown to include avian flu detection as well as other highly

infectious diseases.[328] This organization gives the United States a ready-made network of detection devices that it may be able to use for its protection, however, because of its relative newness the United States has yet to begin cooperation efforts with the group. It has a perfect example of how the United States does not have to do everything themselves, but instead, it can access networks that are already set up for the same reasons. Not only is this an excellent alliance maintenance tactic, but it also provides better biosecurity to soldiers in the area.

Increasing Overall Health Infrastructure

Lastly, the United States could expand current health infrastructure to ensure that a biological attack will not too quickly overwhelm hospitals, forcing them to send patients elsewhere or off base. The United States military hospitals need to be biohazard level five ready to adequately be prepared to protect soldiers in the time of a crisis. If the United States had trouble containing a small EVD outbreak with advanced notice, it would likely struggle even more with an unexpected intentional attack.

Containing a biological attack requires specific resources to house and treat infected persons. Currently, there are only four United States' Biocontainment Hospitals that are built specifically to handle infectious disease:

1. National Institutes of Health in Bethesda, Maryland
2. Emory University Hospital in Atlanta, Georgia
3. University of Nebraska Medical Center in Omaha, Nebraska, and

328. Alex Leventhal et al, "Enhanced Surveillance for Detection and Management of Infectious Diseases: Regional Collaboration in the Middle East," *Emerging Health Threats Journal* 6, no. 1 (2013): p. 10, https://www.tandfonline.com/doi/full/10.3402/ehtj.v6i0.19955.

4. Saint Patrick Hospital in Missoula, Montana.[329]

During the 2014 Ebola outbreak, these four hospitals acted as the first line of defense against the Ebola virus. The purpose of these specialized containment units is to contain patients that could cause a devastating pandemic, however, even with all four facilities working at full capacity there are only 22 rooms to hold highly infectious patients (25 if the rooms at Saint Patrick Hospital are doubled up), they have no hope in containing a widespread highly contagious disease.[330] As the only biocontainment facilities in the United States, outbreaks in parts of the country where these hospitals aren't operating remain unprotected without facilities to rely on in the case of an epidemic. Michael Osterholm, director of the Center for Infectious Disease Research and Policy at the University of Minnesota, says, "They serve as the very foundation in the U.S. for fighting highly infectious diseases. They have the best equipment, the right protocols, and the properly trained personnel to confront diseases for which most other hospitals would be unprepared."[331] This indicates that a high majority of hospitals in the United States are woefully unprepared to handle the influx of patients a biological attack could cause.

The current breakdown of biocontainment ready hospitals leaves the southwest region of the United States without a facility to handle an attack. For these reasons, it is crucial that the United States government builds up its health infrastructure to better handle possible future biological attacks. This should start by providing funding and incentives to hospitals that put the

329. Katherine Courage, "Inside the 4 U.S. Biocontainment Hospitals That Are Stopping Ebola," *Scientific American,* October 24, 2014, https://www.scientificamerican.com/article/inside-the-4-u-s-biocontainment-hospitals-that-are-stopping-ebola-video/.

330. Courage, "Inside the 4 U.S. Biocontainment Hospitals."

331. Courage, "Inside the 4 U.S. Biocontainment Hospitals."

effort in to build new biocontainment units and attend infectious disease training to prepare those hospitals better. To begin, the United States should specifically fund a biocontainment hospital in Texas, so that there is at least one biocontainment hospital per region of the United States. It costs approximately $15 million to construct a level 4 biocontainment unit, a relatively small cost compared to the overall amount of money spent on biodefense each year.[332] After the construction of a biocontainment unit hospital in Texas, the United States should work towards adding at least one additional biocontainment hospital in each region to handle better any future attack that the United States might face. A rate of one new hospital every two years is recommended as each unit takes about 18 months to complete.[333] As well, increasing health infrastructure would also mean that the government needs to be able to provide these biocontainment units with the materials that are necessary to fight outbreaks, like vaccines, anti-viral medicine, and antibiotics. The United States has a population of over 300 million; it is high time the United States has the health infrastructure to match.

Summary

The United States is at a turning point in its biodefense. The world is watching as the United States shifts its focus from terrorism back to an era of Great Power Competition, allowing efforts against terrorism to become a secondary priority. But while the United States may view terrorism as a secondary priority, it should not be considered a less critical threat. Today, the United States is woefully unprepared for a bio- or agroterrorism attack, but by implementing the

332. Kelly Marie Holt, "Bio-Containment Units in the U.S.: How Many We Have and Plans for Building More," *Disaster Accountability Project,* October 31, 2014, http://www.disasteraccountability.org/blog2/bio-containment-units-u-s-many-plans-building/.

333. Holt, "Bio-Containment Units in the U.S."

above solutions, it is possible to reverse current vulnerabilities and set the United States on a better and safer future path.

CHAPTER VIII: CONCLUSION

The goal of this thesis is not to destroy hope or provide a bleak and spooky outlook on the world of biological terrorism; instead, this thesis is meant to educate the public on what biological terrorism looks like and what the United States can do to limit and contain the potential effects of a biological attack. To this end, this conclusion serves dual purposes; to wrap up the overall goal of this thesis and offer a place to discuss its limitations.

First, in Chapter II, this thesis explored potential biological agents state and non-state actors might use as biological weapons against the United States, but the list provided is in no way comprehensive. The pathogens chosen in this Chapter were selected based on their potential for destruction and based on the Category A, B, and C pathogens located on the CDC website.

Moreover, in Chapter III, it should be known that the six countries I chose to analyze and use as possible state-sponsors of biological terrorism are not the only countries in the world with alleged biological weapons programs. They are not even the only countries accused of supporting terrorist organizations worldwide. These six nations were chosen because of the amount of information available to support allegations of their biological weapons programs and due to their mutual dislike of the United States as this dislike makes the possibility of them supporting biological attacks against the United States more realistic.

As for Chapter IV, the history provided in this chapter is but a small selection of biological attacks that have happened over the years. Due to page restraints, this chapter was not in any way meant to provide a comprehensive history of the use of biological weapons, but instead, it showcases that there is a precedent of using biological weapons in battles dating all the way up to the 2000s. It was meant to show that biological weapons are still a wartime possibility, unlike obsolete weapons, e.g., bayonets.

Chapter V, which provides definitions of common terms and the advantages and disadvantages of biological weapons is meant to be mostly explanatory and factual, but terrorist organizations are historically unpredictable and because of this fact it is impossible to honestly know what advantages and disadvantages might deter them from carrying out a biological attack. Along the same lines, the list of pros and cons is not comprehensive but serve as the most compelling advantages and disadvantages for this thesis.

In Chapter VI, this thesis explores the impact and threat of a biological attack using imaginative scenarios. It should be noted once more how this thesis calculates the risk of an attack, by analyzing the capability and intent of entities to conclude the likelihood of a biological attack. In most cases, this calculous provides that a biological attack is a low risk but high impact scenario. The same applies to most instances of the use of WMD. The imaginative scenarios are based in fact that takes how diseases spread, future outbreaks of disease, and areas of attack into account to extrapolate what a future *intentional* outbreak could look like but are still imaginative scenarios and that diseases remain an unpredictable and uncontrollable weapon, which could lead to a very different type of impact than the one indicated.

Lastly, Chapter VII provides multiple possibilities for policy changes that would better prepare the United States but like in other chapters this list is in no way comprehensive. There are hundreds of things that could be done by the United States to help prevent a biological attack, but this chapter explores the policy recommendations that had the potential to be the most impactful for thwarting an attack and those that were also part of the Blue-Ribbon panel on biodefense that was explicitly put together to provide these suggestions.

These limitations are not meant to invalidate this thesis, but rather provide more context on the limitations of this thesis and even indicate that a longer book could be written to expand on some of these limitations.

At this point let us return to the scenario presented on page one.

It has now been one year since the biological attack that changed the course of the United States' policy. No longer were people afraid to walk outside or turn on the news. No longer did a cough make you a pariah, nor did the appearance of a boil indicate a death sentence. And yet, there was still a sort of unease that lingered. The United States population was still more aware than ever that they were vulnerable. The government had changed its course. The government restored biodefense funding and incentivized technological advances for detection devices. Children everywhere were being vaccinated for diseases once thought eradicated in the United States, and hospitals stockpiled vaccines at an unprecedented rate. The United States would never again make the mistake of believing it was invulnerable to pathogens. It is possible that no amount of preparation could have prepared them for the 2019 Bubonic Plague attacks, but the United States was learning from their mistakes and never again would it be caught unprepared. Biological warfare might still get the best of the United States, but it should never be said that the United States is going down without a fight.

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