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THE RISK OF BIOTERRORISM AND APPROPRIATE PUBLIC HEALTH PREPAREDNESS

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ABSTRACT

In this thesis project, the goal was to determine whether or not bioterrorism constitutes a real risk for the public and thus, if valuable resources should be committed to counterterrorism instead of other public health sectors such as annual influenza outbreaks. Extensive literature substantiating two schools of thought, one supporting the affirmative of the research question and one opposing it, was evaluated along with bioterrorism case studies on Aum Shinrikyo's attempted anthrax release in 1993, Al Qaeda's effort to develop their own bioweapons, and the 2001 U.S. postal anthrax incident. The methodology of the analysis portion of this paper was a meta-analysis of scholarly research on the risk of a bioterrorism attack occurring and the harm it could cause, the effectiveness of preparedness, resulting effect on the general health infrastructure, and the comparative state of seasonal influenza. Conclusively, it was determined that evidence does not support that bioterrorism is a substantial enough threat to warrant the billions being solely allocated towards preparing for a biological attack. By funding counter-bioterrorism through the public health infrastructure, not only would bioweapon preparedness be improved, but influenza preparedness would also be benefitted and limited funding would be lost to bioterrorism attacks that never transpire.

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Chapter 1

Introduction

As time progresses, terrorists grow more creative, and biotechnology is globalized, the threat of biological warfare becomes more of a reality. Bioterrorism, as defined by the Centers for Disease Control, is, "the deliberate release of viruses, bacteria, or other germs (agents) used to cause illness or death in people, animals, or plants. These agents are typically found in nature, but it is possible that they could be changed to increase their ability to cause disease, make them resistant to current medicines, or to increase their ability to be spread into the environment. Biological agents can be spread through the air, through water, or in food. Terrorists may use biological agents because they can be extremely difficult to detect and do not cause illness for several hours to several days. Some bioterrorism agents, like the smallpox virus, can be spread from person to person and some, like anthrax, cannot" (CDC, 2011). The earliest forms of bioterrorism can be traced back to 600 B.C. when armies utilized cadavers, animal carcasses, and contaminated instruments to weaken their enemy. Common tactics included catapulting infected, dead bodies onto the opposition's stations and polluting their water and food sources (Riedel, 2004).

In modern day, the arena for bioterrorism has expanded from conventional warfare to terrorism. The U.S. Department of Defense defines terrorism as, "the calculated use of unlawful violence of threat of unlawful violence to inculcate fear; intended to coerce or to intimidate governments or societies in the pursuit of goals that

are generally political, religious, or ideological." Moreover, today the destructiveness of bioweapons is potentially equivalent to that of nuclear weaponry. The Congressional Office of Technology Assessment and World Health Organization concur that 1 to 3 million casualties could result from 100 kilograms of anthrax being released upwind of Washington, D.C. in aerosol form, equal to the expected death toll from a one megaton hydrogen bomb dropped on a populated city (O'Toole [2004] 2007). In addition to casualties, the economic and social disruption caused by such a bioterrorist attack would be devastating.

To execute an attack, the bioweapon must first reach its target. There are three methods to deliver a biological agent—with living, mobile vectors, placing it in ingestible food or water, and releasing it into the air in aerosol form— of which the most effective is aerosolization (Espejo 2013). Aerosolization would allow for pulmonary access as well as the possibility of a completely odorless, tasteless, invisible, and silent attack. The attack could go unrealized until victims began showing up in doctors' offices and emergency rooms with unusual, but dire symptoms.

According to the North Atlantic Treaty Organization handbook on biological warfare, of the total 31 naturally occurring infectious microbes that could be employed, only 11 are conceivable (Henderson 1999). These useable biological agents possess the ability to be successfully grown and then distributed to their targets where they can fulfill their role of causing harm. The potential of altering natural microbe strains to include these useful abilities also exists. The infectious agents smallpox and anthrax are the most likely and most dangerous choice of bioterrorist groups due to their high fatality rates surpassing 80%, durability for storage and dispersal, extended time lapse before

detection, limited availability of vaccinations, and historical fear inclined to cause to public panic after attack (Kortepeter [1999] 2005).

At least five of the seven countries—Iraq, Iran, Libya, Syria, North Korea, Cuba, and Sudan—identified by the U.S. Department of State as supporting international terrorism, are also suspected of illegally harboring bioweapon development programs. However, no evidence exists that any have supplied to any sort of terrorist activity (Kortepeter [1999] 2005).

With the growing attention on bioterrorism, the United States has made substantial actions and pledges to protect their people from the threat of an attack. Since 2002, the government has spent a minimum of $33 billion on counter-bioterrorism through public health organizations such as the U.S. Department of Health and Human Services, Centers for Disease Control, and state departments of public health (Leitenberg [2006] 2009). But as more and more money is invested in the efforts, more and more people and affiliated organizations question wonder if it is worthwhile.

Another health issue that burdens the United States is influenza. Seasonal influenza viruses circulate through the population each year causing annual epidemics during the winter months. According to the CDC, roughly 5-20% of Americans are infected each year, sending 200,000 to the hospital and causing 36,000 deaths (2011). Seasonal influenza costs the United States over $80 million in direct medical costs and indirect economic losses each year (Office of the President, 2005).

The goal of this thesis project is to determine whether or not bioterrorism constitutes a real risk for the public and thus, if valuable money and resources should be

spent on solely on counterterrorism when it could be utilized in other health sectors such as seasonal influenza.

The paper is organized as follows: a literature review exploring extensive literature substantiating two schools of thought, one supporting the affirmative of the research question and one opposing it, and evaluation of bioterrorism case studies on Aum Shinrikyo's attempted anthrax release in 1993, Al Qaeda's effort to develop their own bioweapons, and the 2001 U.S. postal anthrax incident. The methodology of the analysis portion of this paper is a meta-analysis of scholarly research progressing through the risk of a bioterrorism attack occurring within the United States, the harm a potential attack could cause, and effectiveness of past preparedness measures. The status of seasonal influenza preparedness within the public health infrastructure is also analyzed along with the potential of bioterrorism preparedness through the general infrastructure. Lastly, all analysis is reviewed and an answer to the research question concluded.

Chapter 2

Literature Review

There is a great deal of existing literature regarding the threat of bioterrorism and level to which the United States should prepare for an attack. Through widespread research on the topic, it was found that many different details, statistics, catalysts, and fundamentals made significant contributions to the literatures' perspective. Overall, the literature can be divided into two subgroups or schools of thought. The first category is those supporting the notion that biological warfare is an immensely alarming issue that continuously threatens the welfare of the American people and, thus, all of the current counter-bioterrorism funding and methods need to not only be maintained, but substantially increased and streamlined.

The second school of thought is of those who conclude that the current funding and methods being used for counter-bioterrorism are wasteful and could be better utilized in other sectors because biological warfare is not as imminent as portrayed for a multitude of reasons. While there seems to be more literature supporting the first affirmative subgroup, it appears as though the second negative subgroup possesses a wider, differing range of support.

Beginning with the group emphasizing the need for increased counter-bioterrorism, in this year's report, the Graham-Talent Weapons of Mass Destruction Commission, a commission established after 9/11 to address and prevent weapons of mass destruction development and terrorism, released their judgment that a bioterrorism

attack is highly likely to transpire within the next four years and will drastically alter democratic fundamentals as we know them. They urge that in order to prevent or alleviate any attack, expansions must be made in vaccine development and antibiotics, prophylaxis, and other defenses against possible biological pathogens (Espejo 2013). These areas of recommended advancements are very specific to counter-bioterrorism.

Another, but broader judgment supportive of the first school of thought comes from the Bipartisan Weapon of Mass Destruction Research Center who cites nature, technological advancement, and intent in their reasoning for accepting bioterrorism as a serious threat. The Center points out that while skeptics doubt where terrorists could acquire the biological agents necessary, they exist all around in nature and are not only easy to locate, but plentiful. The aerosolization of harmful microbes was first accomplished by powerful nation-states such as the U.S. and Soviet Union, however the bipartisan group states that with today's rapidly advancing biotechnology and mass use and distribution of pulmonary pharmaceuticals, almost anyone is capable (Espejo [2010] 2013).

Tara O'Toole, Director and Chief Executive Officer of the Center for Biosecurity of the University of Pittsburgh Medical Center, goes as far as saying that there are, "no significant technological barriers to terrorists seeking to conduct large-scale bioattacks" ([2004] 2007). O'Toole is very committed to increasing the means and support behind counter-bioterrorism, justifying with the difficulty of detecting a biological attack and inadequate healthcare response. Bioweapon development requires the same materials as legitimate healthcare practices, making surveillance of suspicious activity complicated. Resultantly, the literature calls for augmented funding to counteract this and advises that

the current $4 billion allotment per year is barely comparable to the Department of Defense's national security budget. Such has resulted in an unreliable healthcare system incapable of managing a devastating attack (O'Toole [2004] 2007).

Existing literature also uses several studied trends to back their stance. Advocates contend that technological, political, and objective trends all predict a greater possibility of a bioterrorist attack and needs to be gravely evaluated (Epstein [2006] 2009).

Overall, there are many supporters of the first thought category with several critical factors substantiating their claims. Still, others disagree with the threat level of biological warfare. The second school of thought recognizes that bioterrorism is a concern, but not to the extent that all funding and attention should be solely directed towards it. Many of their ideas directly conflict, accidentally or purposefully, with those of the first group.

Concerning the ability of terrorist groups, the Scientists Working Group on Biological and Chemical Weapons asserts that, "Although many fictional 'tabletop scenarios and exercises have predicted bioterrorism catastrophes, these scenarios often have used unrealistic values for critical disease parameters and have routinely ignored the organizational and technical difficulties that terrorists would have in organizing, and successfully carrying out, a bioweapons attack" (Espejo [2010] 2013). The group notes that technological advancement on its own does not constitute the imminent threat of biowarfare. Other literature is also consistent with this notion, but expands saying that even to this day, only industrialized nation-states have the capacity to conduct a sizable attack, but international legal repercussions discourage such. Smaller assaults may be

within realm, but terrorists are more likely to harm themselves than others (Sidel, Hillel, and Gould [2002] 2005).

Literature also opposes the idea that proliferating research on defense against potential pathogens is purely beneficial. Skeptics argue that expanding Level IV facilities that store deadly agents will elevate the risk of an accident or unwanted exposure occurring, reduce external security, and grant more people access, therefore increasing the chance wrong things fall into the wrong hands (Sidel, Hillel, and Gould [2002] 2005). Further, these articles address the fact that currently existing counter-bioterrorism programs already deal with issues of limited-shelf life times and potentially wasting enormous resources if the actual attack deviates from what was predicted and prepared for (Espejo [2010] 2013). If more funding and expansion were to take place, all of these concerns would become even more of a concern

The U.S. Department of Health and Human Services does not necessarily profess that bioterrorism is not a serious threat, but is instead confident in the measures that they have already taken to address it. The Department attests that all fifty states have strong bioterrorism response plans established, sufficient emergency funding, and an adequate supply of anthrax prophylaxis and smallpox vaccinations (Langwith [2006] 2008).

Milton Leitenberg, a leading expert on biological weapons and arms control, also subscribes to the thinking of the second group. He compares the threat of a biological attack to the current statuses of global climate change, global urbanization, energy fallouts, poverty, and present-day warfare, sending a firm message that counter-bioterrorism is not as imperative in our world as others are creating it to be. The article cites the “Top Ten Future National Security Threats to the United States,” though 2020 as

determined by the Strategic Assessments Group of Central Intelligence Agency and RAND Corporation as well as the Millennium Project list of "The 15 Global Challenges We Face at the Millennium," neither of which mention biological weapons, bioterrorism, or biological agents at all (Leitenberg 2008). Our country's major analytical organizations do not view bioterrorism as being one of the top ten or even top fifteen issues of concern. This lack of priority sends a telling message and is critical support to the second school of thinking who believe that counter-bioterrorism should not be as highly prioritized as it currently is.

Much literature also draws light to the fact that the traditional biothreat seems to be lessening. The number of nation-state supported biological weapon programs has decreased from thirteen to nine in the last fifteen years alone and according to Leitenberg, "There is no publicly available evidence that even the most hostile of the nine remaining countries, Syria and Iran, are ramping up their programs" (Leitenberg [2006] 2008). That means the remaining programmed countries are considered to be stable.

Lastly, the second school of thought looks to trends just as the first. The literature evaluates history and objectives and uncovers that of all the recognizably recent terrorist attacks—the 1993 World Trade Center underground explosion, the bombing of the Federal Building in Oklahoma City, the attacks of U.S. Embassies in Africa, attacks on the USS Cole in Yemen, and September 11, 2001 attacks— explosives were the sole destructive device of choice (Sidel, Hillel, and Gould [2002] 2005). Once again, bioweapons played no part. Out of many opportunities, several very recent when the U.S. was unguarded and biotechnology largely available, there was no biological terrorist activity.

Looking at the literature comprehensively, both schools of thought had compelling arguments in their support. All of the articles and opinions will serve useful in determining the answer to the overarching research question of this project, whether or not bioterrorism constitutes a real risk for the public and thus, should valuable money and resources be spent on the counterterrorism when it could be utilized elsewhere.

Chapter 3

Bioterrorism Case Studies

To conclusively answer the research question, several cases concerning bioterrorism were consulted and analyzed. Aum Shinrikyo's attempted anthrax release in 1993, Al Qaeda's effort to develop their own bioweapons, and the 2001 U.S. postal anthrax incident are the selected case studies.

These specific case studies were selected because they each brought different, yet equally significant qualities to the overall analysis. Aum Shinrikyo and Al Qaeda are both very large, endowed, heavily manned, and financially supported terrorist organizations with vast capabilities and almost endless global networks. They also had the reputation of being very determined, tenacious, and devout groups. Essentially, if any terrorist organization could execute a successful biowarfare attack, it would be comparable to, if not, one of these two organizations. By including the terrorist groups with the best chance of an attack, we are ensuring that if there is a high biothreat, this analysis has a reliable chance of detecting it.

The 2001 anthrax case was selected because it was the most recent, successful, and widely publicized attack. It also occurred on American soil, allowing the analysis to be related to the home front, and was the most fatal. The attack was also specific, sent to a particular set of people. This gives a different viewpoint that the open release approach of Aum Shinrikyo. By properly utilizing this methodology, enough different and favoring

situations will be evaluated to properly resolve whether bioterrorism is an imminent threat that needs to be prepared for.

In July of 1993, residents in Kameido, Tokyo, Japan reported a strange odor to authorities. Such was the result of Aum Shinrikyo aerosolizing Bacillus anthracis, commonly known as anthrax, off of the eighth floor roof of their headquarters building. At the time, local physicians received complaints of appetite loss, nausea, and vomiting, none of which are typical symptoms of B. anthracis. Years later, a retrospective case study confirmed that no physicians in the high-risk areas saw patients with symptoms of systemic anthrax infection such as abrupt respiratory problems or hemorrhagic meningitis (Takahaski, Keim, et al 2004). After molecular analysis, it was determined that the strain released into the air that day was a version nonpathogenic to humans and often commercially utilized for animal vaccination against anthrax. In 1995 when Aum Shinrikyo members were on trial for the sarin gas attacks in the Tokyo subway, they admitted to what studies had already discovered, that they in fact, attempted to spread Bacillus anthracis by aerosolization with the goal of launching an anthrax inhalation epidemic (Takahaski, Keim, et al 2004).

Even after working for over six years, Aum Shinrikyo failed at many points in their attempted bioterrorist attack. First, they failed to obtain the correct strain and instead used one without the capsule needed to establish the pathogen's virulence. Secondly, the liquid suspension contained a much less than optimal concentration of anthrax spores, but was also too viscous. This caused the sprayer system on the roof to clog, malfunction, and ultimately, not distribute the biological agent as widely as intended. Third, many scientists capable of detecting these problems were working for the organization,

however it is likely that they were under such heavy pressure that they were forced to skip over necessary diagnostic testing or were too frightened to admit to failure (Yaddof 2006).

Al Qaeda has pledged to cause mass harm and chaos to the United States and in several ways they have done so. As far as we know, however, bioterrorism is not one of those ways. Al Qaeda attempted bioweapon development from 1997 up until late 2001, when the U.S. Invaded Afghanistan (Leitenberg [2006] 2009). In a publicly released report by the Commission on Intelligence Capabilities, it was stated that the terrorist organization never obtained their desired pathogens and therefore, could complete no further work on them (Leitenberg 2008). This can be considered quite surprising to many who supposed Al Qaeda would have no difficulties, with all of their resources and accessible biotechnological information, making rapid biological progress. So either the development is not as easy as certain officials predicted or Al Qaeda simply does not have enough interest in bioweapons to invest serious effort into developing them.

Information was also gathered on Ayman Zawahiri, Osama Bin Laden's partner and current leader of Al Qaeda, and his recorded statement, "we only became aware of (bioweapons) when the enemy drew our attention to them by repeatedly expressing concerns that they can be produced simply with easily available materials," was uncovered (Leitenberg [2006] 2009). Zawahiri's statement gives the impression that the idea of bioterrorism was plainly handed to them instead of them actively and aggressively pursuing biological weapons as their next big focus. Further, FDA Administrator Dr. Peggy Hamburg attests that if Al Qaeda would have spread a small quantity of powdered anthrax into the World Trade Center's ventilation unit instead of the airplane attacks on

September 11, 2001, the fatalities could have been much higher (Espejo 2013). Once again, either Al Qaeda did not possess the ability to execute a biological attack or are simply unconcerned with one.

From October through November 2001, just after the 9/11 attacks, an anthrax outbreak occurred. Two series of envelopes postmarked three weeks apart and containing Bacillus anthracis were mailed from Trenton, NJ to major news media companies and federal government officials with notes referencing 9/11, threatening death, and disclosing that anthrax was enclosed. In seven states along the east coast, investigators confirmed 22 cases of anthrax—11 inhalational and 11 cutaneous. Five eventually became fatal (Jernigan, Raghunathan et al. 2002). Indirect infection was also seen in postal workers and mailroom employees. The utilized stain of B. anthracis was sensitive to all tested, standard antibiotics including penicillin, showing that no genetic modifications had been made to the pathogen. The notes informing of anthrax presence allowed response teams to act very quickly to provide prophylaxis to the infected and are credited with saving many lives (Jernigan, Raghunathan et al. 2002). Despite endless speculation, the source, organization, or person behind the attack was never identified.

The federal government officially deemed this incident a bioterrorist attack, making it the first time anthrax was effectively employed as a biological agent in the United States. Although never publicly confirmed, Federal Bureau of Investigation believes that a U.S. Army civilian employee at Ft. Detrick, Maryland was the weaponizer (Espejo 2013). This heavily supported theory indicates that it was not a large, international terrorist organization gaining technological and biological abilities and now

capable of biowarfare. Further, the lone wolf aspect evidences that there is less chance of a repeat attack and there is no looming, inevitable threat of bioterrorism.

In summary, these case studies exhibit that regardless of size or reputation of a terrorist organization, the threat of bioterrorism does not seem to be an impending, irremediable issue desperate for full attention and prioritized monetary commitment. Aum Shinrikyo and Al Qaeda were both unsuccessful in their efforts whether due to lack of intelligence, planning and execution failures, or just disinterest. The 2001 U.S. anthrax incident is considered baseline successful, however the suspected attacker was not an enabled, major terrorist organization probable of repeat attacks or further biological advancement. The pathogenic strain was also unmodified, putting to rest much apprehension.

Since the anthrax outbreak, the U.S. Government has spent almost $60 billion dollars on very specific counter-bioterrorism methods including, but not limited to detection systems, biological agent research, and stockpiling of supplies (Aum Shinrikyo [2010] 2013). These very expensive measures will only benefit the division of counter-terrorism, no other government sectors or public health endeavors, and only if an attack is ever to occur.

Every twenty to thirty years, an influenza pandemic is expected to spread throughout the world. If has been over forty years since the last one and the World Health Organization has been recently forewarning and recommending increased preparations (Leitenberg 2008). Past flu pandemics have had fatalities ranging from one to fifty million people. The recent postal anthrax episode, and only fatal bioterrorist attack, killed five. Yet, “the annual budget for combating bioterror is more than $7 billion while

Congress passed a $3.8 billion emergency package to prepare for a flu outbreak" (Leitenberg [2006] 2009). When it comes to the state level, these counter-bioterrorism efforts could cost an additional $80 million of their budget. In states like California, where the economy is already struggling, taxes, social services, education, and the public's health may take the hit (Sidel, Hillel, and Gould [2002] 2005).

Chapter 4

Risk of a Bioterrorism Attack Occurring

While billions of dollars is being invested annually into preparing for a bioterrorism attack, chance still exists that an attack may never occur. So what is the risk, likeliness, or probability that a bioweapon attack is ever actually mounted to make use of the massive preparedness efforts and funding? Calculating the risk of a future bioterrorism attack occurring is extremely difficult and relatively untouched even in the statistically based fields. Each attack is independent, with very little purposeful correlation to other attacks deemed as bioterrorism. This individualistic component makes risk assessment difficult, first, because the few number of recognized bioterrorism cases hinders the development of a reliable prediction methodology and secondly, if a methodology were to be developed, the low number of cases in the foreseeable future would prevent testing and confirming the prediction methods (Zilinskas, Hope, & North, 2004). Lastly, little is known on the technological capabilities or motivations of terrorist groups, which are key factors in prediction methodologies (Zilinskas, Hope, & North, 2004).

Without a reliable source of calculated risk, the status of bioterrorism threats is determined by situational analysis and experts' educated opinions. According to Steven M. Block, a professor of biological sciences and applied physics at Stanford University, "opinions do count here, because quantitative risk assessment is a practical impossibility… successful bioweapons attacks are characteristically 'low probability,

high consequence' events. The expectation value of the risk is the product of a very small and a very large number, and such numbers carry great uncertainty" (Block, 2001).

In order for a terrorist party to execute a biological attack, several separate, yet interdependent steps must be reached as seen in Figure 1. Unless dispersed agents are virulent and virulent agents can be dispersed, biological attacks are not going to have the widespread lethality desired by terrorists. The lack of one or more of these integral precursors is responsible for the suboptimal results seen in the bioterrorism attempts by both Al Qaeda and Aum Shinrikyo in the previously described cases.

According to Falkenrath, these barriers in developing an effective bioweapon are penetrable, even for a terrorist group that is not state-supported (May, 2005). Expenses to produce biological weapons are relatively low and only intermediate microbiology skills are necessary to do so. Accessing and obtaining the biological agents is considered to be the greatest challenge for terrorist groups (Kaufmann, Meltzer, & Schmid, 1997). Anthrax, however, can be found in nature. Further, advocates of bioterrorism preparedness assert that these challenges are lessening overtime and in turn, the likeliness of an attack is escalating (Block, 2001).

The Homeland Security Presidential Directive 10 (HSPD-10) states, "the proliferation of biological materials, technologies, and expertise increases the potential for adversaries to design a pathogen to evade our existing medical and non-medical countermeasures." It also affirms, "Biological weapons in the possession of hostile states of terrorist pose unique and grave threats to the safety and security of the United States...The stakes could not be higher for our Nation" (Biodefense for the 21st Century, 2004).

Senator William Frist (R-TN) who authored the 2002 *Public Health Security and Bioterrorism Preparedness Response Act* along with Ted Kennedy (D-MA) and Judd Gregg (R-NH) said in 2005, "The greatest existential threat we have in the world today is biological... an inevitable bioterror attack [would come] at some time in the next 10 years" (Leitenberg, 2009). The legislation provided funding for bioterrorism training and countermeasures.

In 2008, under the direction of Chairman Senator Bob Graham (D-FL) and in accordance with the 9/11 Commission Act of 2007, *The Report of the Commission on the Prevention of WMD Proliferation and Terrorism* was released. From the compilation of hundreds of interviews with government officials and nongovernmental experts over six months, the report concluded that bioterrorism remains a grave, realistic threat. It continues to say that without immediate, vast acts of preparedness, "it is more likely than not that a weapon of mass destruction will be used in a terrorist attack somewhere in the world by the end of 2013," and that terrorists are more prone to use a biological weapon over a nuclear weapon (Graham et al., 2008). The Commission recognizes that much has already been committed to countermeasures, but points out that, "risks that confront us today are evolving faster than our multilayered responses...terrorists have been active, too—and in our judgment America's margin of safety is shrinking, not growing" (Graham et al., 2008).

From the Department of Homeland Security, assistant secretary Jeffrey Runge, another vanguard in protecting against bioterrorism, testified to the U.S. House of Representatives, "The risk of a large-scale biological attack on the Nation is significant. We know that our terrorist enemies have sought to use biological agents as instruments of

their warfare, and we believe that capability is within their reach" (Emerging biological threats and public health preparedness: Getting beyond getting ready, 2008).

In the November 2012 hearing on *Weapons of Mass Destruction Terrorism: Assessing the Continued Homeland Threat,* Patrick Meehan, Pennsylvania Congressman and Chairman for the Subcommittee on Counterterrorism and Intelligence, testified on his stance that bioterrorism remains a dire threat to the United States homeland and should remain at the forefront of concern, preparedness, and funding. He cites the recent proclamation and encouragement for the use of biological weapons by Anwar Al-Awlaki, an American, Islamic militant for al Qaeda, just before his death as well as the unease for politically unstable, or rogue nations in the Middle East and Asia, specifically Iran, Pakistan, North Korea, and Syria that are known to have active weapons of mass destruction (WMD) programs. Mr. Meehan speaks to the ability of any country equipped with a pharmaceutical industry to easily produce bioweapons of military grade and the fact that, "al Qaeda would love nothing more that to severely hamper the American economy with a bioterror attack" (WMD terrorism: Assessing the continued homeland threat, 2012).

Included in the hearing was reference to The Aspen Institute Homeland Security Group's *An Update on the Recommendations of the Commission on the Prevention of Weapons of Mass Destruction Proliferation and Terrorism,* a report requested by Homeland Security Secretary Janet Napolitano on the current status of the threat of bioterrorism. The report produced that the threat remains strong and although biodefense funding has continued, actual preparedness is deteriorating (Cole & Larsen, 2012). Such could be detrimental because the report finds that pathogens likely to be used as

weaponized agents are widely available and the technology to develop bioweapons is accessible, some even already present in commercial equipment. It refers to al Qaeda's failed anthrax attempt, but asserts there is still no evidence proving that the organization gave up on bioterrorism, especially considering Ayman as Zawahiri, a medical doctor that led the biological program, succeeded Bin Laden (Cole & Larsen, 2012).

While little exists on the calculated risk of bioterrorism, many experts express their educated opinion that it is a severe threat. Expert critics, however, say that although the possibility exists, the threat is not validated. They say that harvesting a virulent biological agent, preserving the agent during dissemination, developing and maintaining necessary production equipment, and strategizing an effective attack methodology is beyond the capability or more so, the will of terrorist groups to mount a biological attack. In the mid-nineteenth century, even major world powers such as the United States, Great Britain, and Canada seriously struggled with these steps and some never managed to complete them (Smithson & Levy, 2000).

In fact, after failed attempts with biological anthrax, Aum Shinrikyo switched to employing chemical weapons instead. Even as a sophisticated, well-funded program, the group was unable to successfully develop a biological weapon, hence exhibiting the insurmountable challenges for a terrorist group (Avery, 2004).

In the comprehensive research report conducted by The Stimson Center for Global Security, it was concluded that, "conventional terrorism was far more prevalent, far more harmful, and far more deadly than chemical or biological terrorism. Therefore, if the past is any predictor of the future, terrorist incidents involving chemical and biological

substances will continue to be small in scale and far less harmful than conventional terrorist" (Smithson & Levy, 2000).

In the 2008 *Report of the Commission on the Prevention of WMD Proliferation and Terrorism,* although the overall conclusion was that bioterrorism remains a severe threat, the Commission acknowledges that these bioweapon failures of Aum Shinrikyo and al Qaeda demonstrate that the difficulties in developing a successful biological attack should not be diminished and resultantly, the threat of bioterrorism hyperbolized (Graham et al., 2008). Also in the report was the assertion that there would likely be a WMD terrorist attack, probably biological, by the end of 2013. The year 2013 has officially passed and no biological attack was seen anywhere in the world, contradicting the firm predictions.

Past Director of the Defense Intelligence Agency (DIA) Lt Gen Michael Maples presented to the Senate Select Committee on Intelligence Committee in 2007 on global terrorism and proliferation of WMDs in regards to defense of the homeland. Maples addressed the issue of terrorist organizations acquiring the ability to produce WMDs, saying that the DIA does not believe that Al Qaeda had yet to develop bioweapon capabilities (Current and projected national security threats to the United States, 2007). The assessment also states that, "Syria's biotechnical infrastructure is capable of supporting limited biological agent development. DIA assesses Syria has a program to develop select biological agents" (Current and projected national security threats to the United States, 2007). Of two of the most threatening terrorist powers, one state and one non-state, neither is surmised to have the capacity to mount a considerable bioterrorism attack.

In the 2012 DIA Annual Threat Assessment, past Director James R. Clapper again addressed the threat of global terrorism to the United States. Clapper states that the assessment determined that no terrorist organizations are receiving help with WMDs from any nation states and likewise, none of the politically unstable nation states are being targeted by terrorist organizations for their vulnerable WMDs. The report goes as far as stating that within the next year, a biological attack is improbable (Unclassified statement for the record on the worldwide threat assessment of the U.S. intelligence community, 2012).

The current Director of the DIA, Lt Gen Michael T. Flynn, presented the Annual Threat Assessment in February 2014 to the Senate Armed Services Committee, to update them once again on the threats our nation faces. As noted in the 2007 assessment, Syria is still believed to only have the ability to produce minimal biological agents, however the DIA does not suspect that they have accomplished producing bioweapons from these agents (Worldwide threat assessment of the U.S. intelligence community, 2014). As evidenced by the annual DIA threat assessments, the threat of bioterrorism remains, but little progressed. The possibility of a biological attack still exists, yet the threat is very speculative with little validation.

The 2001 U.S. postal anthrax attack is the incident that set off the mass defense efforts and sense of urgency surrounding bioterrorism that has since cost the United States tens of billions of dollars. While not initially known, the attacker was a homegrown, American scientist that had worked at the U.S. Army Medical Research Institute himself. While substantial government efforts utilizing billions of dollars prepares for foreign biological attacks, the greatest repercussions ensued from a

perpetrator employed by the government itself, from the inside. Risk may exist, but the actual threat is unpredictable.

The Braun School of Public Health and Center for Clinical Quality and Safety examined how media coverage can affect public perception, healthcare decisions, and public policy. Evaluation of radio, television, and newspaper reports on health issues in 2003 found that there was a strong inverse correlation between the amount of media coverage and number of casualties for each of the health hazards (Bomlitz & Brezis, 2008). Bioterrorism was covered in over 50,000 news stories within the year, but accounted for fewer than 10 deaths in its entire modern history. Smoking and physical activity, on the other hand, were featured in the fewest number of media stories, yet are responsible for almost 800,000 lives lost. This is contrary to what most would expect. Authors attribute the findings to the prospect theory, saying that new health risks are perceived with disproportionately greater sensitivity and acted upon with greater concern than chronic, more severe, yet known risks simply because they are new (Bomlitz & Brezis, 2008). Public perception of bioterrorism directly influences how the government responds to the risk of an attack. The federal government responds the greatest to public fear; if the public is outwardly fearful of biological attacks, the government will enact policies and contribute money to placate that. As seen in this study, the public is way more distressed over bioterrorism than its relative mortality rate suggests they should be, hence the government may be overreacting in response.

Chapter 5

Harm Posed by a Bioterrorism Attack

If a bioterrorism attack were to ever occur, the affect on human capital and the economy could be devastating. Resulting damages depend on many factors including location of attack, agent of choice, mode of dissemination, etc.

The Proliferation of Weapons of Mass Destruction Risk Assessment performed by the 1993 Congressional Office of Technology found that releasing aerosolized anthrax spores upwind of an urban center, such as Washington D.C., in the amount of one hundred kilograms could result in anywhere from hundreds of thousands to millions of civilian deaths, depending on the weather conditions as seen in Figure 2 (U.S. Congress, 1993). The absence of wind would cause spores to remain in the highly populated area longer and hence, infect more bystanders and result in higher casualties.

Former National Coordinator for Security, Infrastructure Protection, and Counter-terrorism for the U.S., Richard A. Clarke, references a report by the U.S. Enforcement Assistance Administration that predicts that 70,000-80,000 stadium fans could be infected within an hour if an ounce of anthrax was sent through the air-conditioning unit. In another scenario, an estimated 600,000 casualties would occur if anthrax spores were aerosolized on New York City, according to the Advanced Corporation of Santa Barbara, California's 1972 study (Purver, 1995).

Biological weapons can bring more harm than chemical weapons and can be more crippling to humans than war—their outbreaks can go unnoticed, agents are contagious

and reproductive, and the transmission is self-spread. In ideal circumstances, bioweapons can be more destructive than nuclear attacks, a previous device of war utilized by the United States conclusively in World War II. Figure 3 displays the potential affect anthrax can have on a population. Only 10kg of viable anthrax can result in comparable casualties to a 10kiloton nuclear bomb (Siegrist, 1999). The 1993 Congressional Office of Technology assessed that pound for pound of chemical versus biological weapon under optimal conditions, bioweapons unfailingly result in more casualties; prevention efforts, however can be more effective against biological weapons than nuclear (U.S. Congress, 1993).

Among organizations that are believed to have bioweapon ambitions, non-state terrorist groups are of the highest concern. Former Department of Homeland Security assistant secretary, Jeffrey Runge, included his great unease on the consequences of Al Qaeda's biological goals his testimony to the Committee on Homeland Security.

> We have determined that al-Qaeda seeks to develop and use a biological weapon to cause mass casualties in an attack on the homeland. Our analysis indicates that anthrax is a likely choice; and a successful single-city attack on an unprepared population could kill hundreds of thousands of citizens. A coordinated attack on multiple targets would come much closer in magnitude to our enemy's goal. Because of this, we see the threat of an aerosolized anthrax attack as our number one bioterrorism concern, and it is that threat which we vigorously plan, invest and intend to defeat. Our efforts are not optional or discretionary. The ramifications of such an attack include tremendous loss of life, economic costs, damage to critical infrastructure, and unprecedented environmental

contamination. (Emerging biological threats and public health preparedness: Getting beyond getting ready, 2008)

The 2001 inhalational anthrax attack demonstrated these costly ramifications. Despite intensive medical care such as postattack antibiotic therapy and vaccination, the inhalational mortality rate was still 45% (Schmitt et al., 2007). Additionally, in a cross-sectional, collaborative study between the Centers for Disease Control and the New Jersey Department of Health and Senior Services, researchers found that all of the inhalational survivors experienced lessened health-related quality of life (HRQOL) indices and more psychological stress than the comparable general population. Of the sixteen survivors of both inhalational and cutaneous anthrax, eight were unable to return to work since their 2001 infection (Reissman et al., 2004). Even the survivors endured severe damages that impaired their entire lives. By the end of 2001, $1.4 billion of the federal budget was committed to counter-bioterrorism measures (Avery, 2004). Even with over a billion dollars invested in preparedness and top experts leading the efforts, the harm to the exposed was not prevented nor stopped.

Chapter 6

Effectiveness of Past Preparedness

Although there was a high final mortality rate, without prophylaxis, that statistic could have reached much higher. After the 2001 dissemination of anthrax spores through the postal system, public health officials recommended antimicrobial prophylaxis (AP) with antibiotics to groups with potential exposure risk to the virulent agent. Groups included employees at the sites of confirmed anthrax infection cases: a media-publishing company in Florida and postal facilities in Washington D.C. and New Jersey (Brookmeyer & Blades, 2002). In a study executed by the Department of Biostatistics at John Hopkins Bloomberg School of Public Health, it was calculated that the disease rate of inhalational anthrax could have been double the size if antibiotic prophylaxis was not administered to at risk groups. Utilizing incubation period, disease onset dates, numbers of cases, and exposure risk, the likelihood function calculated that 17 cases of disease should have transpired, as seen in Figure 4 (Brookmeyer & Blades, 2002). While 8 cases did occur in the exposed groups, 9 cases were likely inhibited by the regimen of antimicrobial prophylaxis.

But question exists on whether antibiotic prophylaxis reached the necessary persons as quickly as the government claims or if the distribution would have suffered if the biological attack was any larger in size. Federal agencies claim that within 12 to 24 hours, federal disaster response teams would arrive and be executing response plans. Local officials with experience on disaster teams, however, doubt those predictions and

contend that federal assistance would not reach the disaster site for anywhere from 24 to 72 hours (Heinrich, Are We Ready?).

Federal response was delayed in the 2001 anthrax attacks and unexpected weaknesses were seen in the response system. Marc Siegel, a physician contributing to Senate Finance Committee's evaluation of bioterrorism, speaks to the numerous detrimental errors made by the federal government in their response. Siegel says that essentially, the Centers for Disease Control, the federal agency responsible for the health of the American public, was excluded from the entire investigation. Not only was the CDC never allowed to see or analyze the mailed anthrax letters, but all of the nation's top experts on anthrax, bioweapons, and public health were prohibited from contributing their valuable knowledge (Siegel, 2002). Postal facilities that should've been closed remained open, wrong information was conveyed to the public, and inadequate antibiotics were prescribed. Siegel attests that many, if not all, of these errors could have been avoided if the federal health agency would've had more authority in the dire health matter (Siegel, 2002).

Dr. John F. Eisoid, the physician of the United States Capitol during the attack, said, "the message was clearly a medical message, and you have got to have medical people talking about medical facts and not nonmedical people prescribing antibiotics," and Dr. Larry M. Bush, the chief of staff at the J.F.K. Memorial Medical Center and infectious disease expert who examined the first victim of the anthrax attack, said he immediately knew what was wrong (Altman & Kolata, 2002).

The current Secretary of Health and Human Services, Tommy G. Thompson, however, publicly broadcast that the anthrax victim became infected naturally and that

there was no connection to terrorism (Altman & Kolata, 2002). While Secretary Thompson was blatantly incorrect in this situation, bioweapons are, in fact, naturally occurring biological organisms that cause infectious outbreaks. It can be difficult to differentiate between natural and planned outbreaks. As cited earlier, Aum Shinrikyo's attempted anthrax attacks were only unveiled during the investigation of their chemical weapon attack years later. The botched anthrax triggered symptoms in victims common among gastrointestinal illnesses and hence, was overlooked as a bioterrorism attack.

In 1984, the Baghwan Sri Rajneesh cult contaminated salad bars in Oregon restaurants with salmonella bacteria in efforts to stop people from voting, therefore influencing a local election's results. Being that food poisoning is not uncommon, the bioterror intentions were not discovered until over a year later when members of the cult admitted to them (Block, 2001). Biological attacks can be concealed by natural diseases which allow them to evade the first line disaster responders prepared to handle explosive, chemical, and biological emergencies (Noji, 2001). Bioterrorism is a public health emergency until proof surfaces that it is something more. This places the responsibility and strain on the established public health infrastructure; in these cases the surveillance was not strong enough to recognize them.

Chapter 7

Seasonal Influenza and the Public Health Infrastructure

Seasonal influenza outbreaks plague the United States' public health infrastructure each year. Influenza is a highly contagious viral infection of the respiratory tract. The infectious disease causes symptoms similar to the common cold, but much more severe including fever, body aches, chills, lethargy, and dizziness. It can eventually lead to death, consistently being one of the leading causes of illness in the United States and among the Centers for Disease Control's top priorities. Seasonal influenza viruses circulate through the population causing annual epidemics during the winter months. According to the National Strategy for Pandemic Influenza by the Homeland Security Council, an average of 200,000 hospitalizations and 36,000 deaths are caused each year by the seasonal influenza virus. Influenza directly costs the United States over $10 billion annually in medical costs (Office of the President, 2005). Anywhere 5-20% of the American population is infected with influenza virus yearly, with death tolls reaching 49,000 lives (CDC, 2011). It is consistently ranked in the top ten overall leading causes of death in the United States.

Seasonal influenza is considered to be a preventable and curable infectious disease. The Centers for Disease Control recommends an annual influenza vaccine as the best way to prevent the illness. Additionally, antiviral medications are available as an effective treatment for those already infected and as a second line of defense for high-risk populations (CDC, 2011). The Advisory Committee on Immunization Practices

recommends that every person over the age of six months be vaccinated each year against seasonal influenza (Estimated Influenza Illnesses and Hospitalizations Averted by Influenza Vaccination--United States, 2012-13 Influenza Season, 2013).

In the flu vaccine effectiveness study, the CDC determined that the 2013 influenza vaccine prevented about 62% of influenza cases, similarly to other seasons; Getting vaccinated against the flu reduced the probability of needing medical care by 62% across all ages (Influenza: perspective on current season and update on preparedness, 2013). Despite the success of the vaccine and government recommendations, roughly only 41% of adults had been vaccinated by the end of the 2013 flu season, with less than 35% between the ages of 18 and 64. The vaccine coverage rate remains fairly constant from year to year, as can be seen in Figure 5, yet the CDC declares that number is too low and improvements need to be made. The more people that go unvaccinated, the more the virus can circulate through the population, and the more social and economic disruption influenza can cause within the U.S. (Roos, 2014). Among children, approximately 90% of the flu-associated deaths in 2013 occurred in those who were not vaccinated against seasonal influenza (CDC, 2013).

The public health infrastructure is faced with 24.7 million cases of seasonal influenza each year. This generates approximately 31.4 million outpatient visits and 3.1 million days of hospitalization, producing a $10.4 billion burden from direct medical costs from annual influenza endemics, claims the Immunization Service Division and Division of Viral Diseases in the National Center for Immunization and Respiratory Diseases at the CDC. Additionally, $16.3 billion in earnings is lost annually due to decreases in productivity and loss of life within the estimated 610,656 life years lost. In

total, seasonal influenza amounts to $87.1 billion in direct and indirect costs (Molinari et al., 2007). This economic burden translates to less than 1% of the national GDP, yet being that it is an annual incurrence, it continues to stifle economic growth in the United States. The Immunization Service Division and Division of Viral Diseases stated that increased influenza prophylaxis and prevention could reduce this preventable burden (Noji, 2001).

In the Morbidity and Mortality Weekly Report, the CDC reported that the influenza vaccine prevented about 6.6 million cases of influenza and 79,000 (17%) influenza-associated hospitalizations during the 2012-2013 season. Less than half of the vaccine-eligible population, however, was actually vaccinated against influenza (Estimated Influenza Illnesses and Hospitalizations Averted by Influenza Vaccination--United States, 2012-13 Influenza Season, 2013).

Healthy People 2020, an initiative of health promotion and disease prevention goals established by the U.S. Department of Health and Human Services, has set a target vaccination rate of 70%. If achieved, an additional 4.4 million influenza cases and 30,000 hospitalizations can be prevented. While vaccination efforts are effective, there is still need to expand and improve vaccine coverage rates (Estimated Influenza Illnesses and Hospitalizations Averted by Influenza Vaccination--United States, 2012-13 Influenza Season, 2013). Increased efforts would translate to a decrease in the burden of influenza.

"Since 2000, the United States has experienced an unprecedented series of shortages of vaccines recommended for widespread use," such as seasonal influenza (Leitenberg, 2009). After the severe influenza vaccine shortages between 2004-2005, the United States Government Accountability Office completed a study on the status of

seasonal influenza preparation. The final report recognized that the vaccine shortage of 4.7 million doses, approximately half of the necessary supply, uncovered the need for better preparation for seasonal endemics. Many state departments and agencies, however, lacked even a general response plan to get them through the public health crisis (Shortages in 2004-2005 Season Underscore Need for Better Preparation, 2005).

Immediate treatment with antiviral medication is vital once a person becomes infected with influenza, however CDC Director Tom Frieden, MD, MPH says, "unfortunately, we're seeing that only a small proportion of people who are severely ill and have flu are treated for flu promptly" (Roos, 2014). The problem may be limited access to treatment within a weakening health infrastructure. Funding at over 30% of hospitals in the United States, where vaccine stockpiles and response plans are stationed, is being reduced and nearly 550,000 ill Americans were turned away from their neighborhood emergency department last year because of capacity issues (Osterholm, 2007).

The 2012 *Ready or Not? Protecting the Public from Diseases, Disasters, and Bioterrorism* report by the Trust for America's Health non-profit organization disclosed that between 2005 and 2012, federal funding for state and local health preparedness was reduced by 38%. Furthermore, twenty-nine states decreased their public health funding between 2010 and 2012, twenty-three of which cut funding in two consecutive years, and fourteen which cut funding three times consecutively (Trust for America's Health, 2012). All states were also evaluated on their levels of public health preparedness, as can be seen in Figure 6. Thirty-five states, including the District of Columbia, scored a six or lower out of a possible ten. Of the fifty state public health laboratories, thirteen even lack the

capacity to respond to an influenza outbreak for six to eight weeks (Trust for America's Health, 2012).

The World Health Organization recently released new guidelines in 2012 for surveying influenza cases, entitled *WHO Global Epidemiologic Surveillance Standards for Influenza*. According to the Center for Infectious Disease Research and Study, the updated system is a result of the lack of useful data during the 2009 influenza outbreak that developed into a pandemic. The standards aim to enhance surveillance with a greater emphasis on seasonal influenza epidemiology (Roos, 2002). The WHO recognized the deficit in influenza surveillance and is making efforts to improve because of the importance of effective influenza monitoring.

In the Commonwealth Fund's *State Preparedness for Bioterrorism and Public Health Emergencies* evaluation, public health shortcomings for both infectious disease and bioterrorism response were identified in hospital resources, surveillance, and laboratory readiness. Serious recommendations were made to rebuild such areas to better response systems across the board (Garfield, 2005).

Over the past year, all of the government funding worldwide towards influenza preparedness has totaled under $1.25 billion combined. Michael T. Osterholm, the Director of the Center for Infectious Disease Research and Policy and Medical Professor at the University of Minnesota, argues that is unsatisfactory for the amount of disruption caused by influenza and the increasing threat it poses (Osterholm, 2007). The United States alone has $1.2 billion invested in research to develop vaccines and pharmaceuticals against anthrax (Rempfer, 2009).

In a survey conducted by the Harvard School of Public Health on "Biological Security and the Public," only 10% of Americans believe that, within the next year, they or a family member are likely to become infected with anthrax and only 8% with smallpox. On the other hand, 69% believe in the likeliness of becoming infected with seasonal influenza (Blendon, Benson, DesRoches, & Herrmann, 2002). David Koplow, a former legal counsel in the Department of Defense, published, "the most pressing public health threat to our national well being might be the annual surge of ordinary influenza, but it has not benefitted from the same sort of political anguish, emergency funding, and public attention that the national security entrepreneurs have discovered in the ever looming fear of international bioterrorism" (Leitenberg, 2009).

Chapter 8

Bioterrorism Preparedness Through the General Public Health Infrastructure

Edward P. Rogers, former Executive Director of the Center for Public Health Law at the University of Missouri Kansas City Law School, said that, "the best way to manage the risk of bioterrorism is not to extend precious resources and political credibility on low frequency events, such as bioterrorism, but focus on day to day public health functions" (Richards, O'Brien, & Rathburn, 2002).

Surveying for diseases, detecting outbreaks, investigating transmission, and implementing prevention and control programs are the core functions of public health system, writes Joseph E. McDade of the Centers for Disease Control, regardless of whether their source is organic or planned. The requirements for preventing natural disease are analogous to preventing bioterrorism. McDade explains how a reliable, integrated national surveillance system would detect for all health issues, not just the naturally occurring ones (McDade, 1999). The appearance of an intentional disease would probably be first recognized through general public health surveillance at the state and local level, not federal security systems (Bryan & Fox, 1999). McDade also explains how distribution structures used in distributing antiviral medications and vaccines in large annual influenza outbreaks could be utilized to distribute prophylactic antibiotics and vaccinations if ever necessary after a bioterrorist attack (McDade, 1999).

By only preparing for attacks through programs designated purely for bioterrorism and focused on usual bioweapons such as anthrax, smallpox, and plague,

potential attack agents may be excluded. Salmonella, the bacterial agent of choice for the Sri Rajneesh cult in Oregon, is not a listed bioweapon and yet it caused one of the only bioterrorism attacks in United States history (Bryan & Fox, 1999). In addition to weakening the capacity of the general public health infrastructure, supporting only surveillance and laboratory capabilities for routinely defined bioterrorism could result in failure to detect the bioterror itself.

Many in the public health arena agree that the probability of a bioterrorism attack is so minimal that devoting extensive resources to specific biological agents is less effective than general preparation and surveillance (Avery, 2004). A major downfall of bioterrorism preparedness, as discussed earlier, is that there are too few attacks to evaluate whether the preparedness system is effective. If the reporting system being used, however, is for all diseases then the many reports on naturally occurring diseases will evaluate the effectiveness of the system. Then if a bioterrorism attack ever does occur, the system will be as tested and effective as possible (Richards, O'Brien, & Rathburn, 2002). Just a month before the 2001 anthrax attacks at Fairfax Hospital, where anthrax victims would later be treated, a mock bioterrorist attack was executed to test the hospital's preparedness to respond. The exercise went well, but when the actual attack occurred weeks later, no part of the drill was relevant, said Dr. Thom Mayer, the hospital's chairman of the emergency department (Altman & Kolata, 2002). What the hospital thought had prepared them for a biological attack actually produced no benefit at all because of their narrow expectation of what an attack would be. If general improvements would be made all around instead of just within predefined circumstances, then health systems would be prepared no matter what the details of an actual attack.

The Association of State and Territorial Health Officers, the representative institution for all public health agencies in the United States, asserts that improvements need to be made to the general public health infrastructure in order for bioterrorism responses to ever be successful (Bryan & Fox, 1999). While some argue that specific counter-bioterrorism programs also strengthen general public health infrastructure, others say that it is not effective and only diverting resources from other public health sectors that need it, such as influenza (Avery, 2004). In the height of bioterrorism funding, however, less that 1% of allocated bioterrorism funding was allotted for infrastructure development (Avery, 2004). Additionally, despite the annual increase in bioterrorism funding, funds for upgrading surveillance have remained low and constant (Bryan & Fox, 1999). The federal government granted Colorado Larimer County's health department with $100,000 for counter-bioterrorism programs, yet the state cut $700,000 from their health appropriations. Resultantly, child immunization programs had to be forcibly reduced (Center for Effective Government, 2003). The city of Los Angeles closed 16 health centers, shortened communicable disease clinic hours, reduced chronic disease control staff, and shut public hospitals as a result of their $800 million deficit. Nevertheless, federal government provided them with $28 million designated solely to bioterrorism preparedness. Not only would general public health infrastructure improvements better detect for bioterrorism incidents, but the funding could be dually utilized for the betterment of all public health sectors.

Chapter 9

Conclusion

In this thesis project, bioterrorist organizations, the possibility and harm of a biological attack, governmental approach, and public health conditions were evaluated using literature reviews, case studies, and a meta-analysis of scholarly research. The objective was to determine how serious of a threat bioterrorism is to our country and hence, to what extent preparedness measures should be taken over other public health concerns such as seasonal influenza.

While billions of dollars are being invested annually into preparing for a bioterrorism attack, chance still exists that an attack may never occur. Risk of a biological attack in the United States does exist, that's why this topic is pertinent, but it may not be as large as people presume. The biological efforts mounted by Aum Shinrikyo, Al Qaeda, and the 2001 postal anthrax dissemination were all failures in regards to what the groups were trying to achieve. Bioterrorism is not a typical event with calculated risk-and-reward statistics. Individualistic characteristics, limited number of cases, and little surrounding knowledge on the technological capabilities and motivations of terrorist groups make calculations unreliable, if not impossible. Without reliable risk calculations, the status of bioterrorism threats is determined by situational analysis and experts' educated opinions. Although many believe that bioterrorism is a severe threat, and while a chance always exists, there is no proof that the threat is even probable. Experts declare that obstacles to creating and properly disseminating a biological agent are too large to be

overcome and that terrorist groups have made little progress in past years. Further, more effective, attractive types of terrorism exist. History shows that terrorist organizations flock towards those other options, typically nuclear or chemical. A homegrown, American military scientist manufactured the only bioterrorism attack on U.S. soil to cause casualties. Altered public perception of attack probabilities and possible scenarios not only instill fear in the public, but encourages the government's over-prioritization of counter-bioterrorism programs. Bioterrorism is a possibility, but there is not enough evidence to support it being considered a definite threat.

If an attack were to be mounted on the United States, the population and economy could be devastated, but it could also not be. The outcome depends on many factors—location of attack, agent of choice, mode of dissemination, effectiveness of attack—hence, casualty estimates range from a handful to tens of thousands to millions. Despite the mass response efforts in the 2001 anthrax attack, the mortality rate still reached almost 50%. Additionally, surviving victims suffered from large losses in health-related quality of life (HRQL) and high levels of psychological stress throughout their lives. A bioterrorism attack could be crippling to our country, but the realm of possibility for one to occur in is too extensive for concrete predictions to be made. The anthrax attacks have been the basis for all preparedness measures and predictions since 2001 and yet, less than ten casualties occurred.

Studies show, however, that death rates could have been much higher without antibiotic treatment. Agency officials with experience in disaster response are still gravely concerned that response efforts may suffer during a larger attack and that federal assistance will not arrive to an attack site nearly as fast as the government claims.

Federal response was delayed and many other problems arose during response to the 2001 anthrax outbreak. Communication between security and health agencies was almost non-existent, cutting the Centers for Disease control and all of its experts out of the investigation and treatment of the attacks. Scientific analysis was mishandled, wrong information was publicized, additional persons were put at risk, and errors in medical treatment were made. Biological attacks are predominantly a health issue and hence, health professionals need to be the ones leading the response efforts.

Both the outbreaks of anthrax and salmonella were not initially recognized as bioterrorism, but instead first managed by the public health infrastructure as ordinary health ailments. Although the onset phase of an intentional biological outbreak cannot be differentiated from a natural one, the surveillance system should have revealed the terrorist intentions in these situations faster than it did.

Past response plans have experienced several significant difficulties. This along with the concern of local officials and lagging surveillance system demonstrates the need for improvements in current preparedness measures. Putting health agencies in charge of all plans and stronger surveillance should be apart of these improvements.

Seasonal influenza is an annual burden on the United States, infecting between 5-20% of the population and costing over $87 billion (CDC, 2011). The influenza vaccine is highly preventative, yet annual vaccine coverage rates are below half of the population. Infected patients can be cured with immediate antiviral treatment, yet hospitals are losing funding to do so. Influenza surveillance is lacking and vaccine shortages expose preparedness inadequacies. The CDC affirms that increased preparedness efforts are needed to reduce the damages of influenza, yet the United States has almost as much

money invested in anthrax research as all of the world's governments have in annual influenza developments.

The federal government continues to grant states with bioterrorism funding as states are cutting their own public health funding, only aggravating their already deficient health infrastructures. Seasonal influenza poses a significant threat and incessantly afflicts the human population. It continues to stifle the U.S. economy year after year. Influenza is a preventable and treatable disease and hence, much more can and should be done to reduce its burden.

The best way to prepare against bioterrorism is not to waste precious resources solely on a low frequency event, but focus on public health efforts relevant day-to-day. Whether a natural or intentional outbreak, the agent needs to be controlled by the same core public health functions—disease surveillance, detection of outbreak, monitoring transmission, and implementing preparedness. Bioterrorism attacks first lapse to the general health surveillance system, so the best way to detect bioterror is to have strong general surveillance. Similar response systems can be used in bioterrorism and natural disease, such as the same distribution system for vaccinations and antibiotics in both anthrax and influenza outbreaks. Emergency room staff can be trained for biological threats at the same as seasonal influenza and other typical diseases.

Bioterrorism should not be prepared for through funding and programs exclusively for bioterrorism. Not only does this divert money from other needful sectors, but it may disadvantage counter-bioterrorism as well. Risks addressed specifically by bioterrorism programs are narrower than the threats posed by potential biological agents. Only preparing for agents deemed as bioweapons leaves the risk than an unsuspected

agent is used in an attack and the U.S. is struck unprepared. Additionally by employing bioterrorism-specific response systems, the low number of bioterrorism attacks prevents these systems from being evaluated for effectiveness. If bioterrorism outbreaks were detected in the general health system, however, the naturally occurring incidents could assess the system's effectiveness; if a terror attack ever does occur, the system has been evaluated and confirmed effective. Biological attacks are a health issue and therefore should be prepared for within the general public health infrastructure.

After in-depth evaluation of this meta-analysis, the research question can be conclusively answered. Evidence shows that bioterrorism is not best prepared for solely through counterterrorism specific programs and funding, but through the health expertise established systems, and general surveillance offered in the public health infrastructure. Currently, however, roughly only 1% of bioterrorism funding contributes to developing the general infrastructure (Avery, 2004). Seasonal influenza is an annual burden on the United States and more effort towards preparedness could produce immensely beneficial comprehensive health improvements.

There is not sufficient evidence to support that bioterrorism is a substantial enough threat to warrant the billions being solely allocated towards preparing for a biological attack. Evidence supports that bioterrorism preparedness would be stronger if executed through the general public health infrastructure. Although the notion of bioterrorism is alarming and prompts the desire to defend, there are many other public health misfortunes also plaguing our country in a much more tangible way. Seasonal influenza burdens both human and economic capital within the United States annually. By strengthening the public health infrastructure for bioterrorism attacks, influenza

preparedness would also be benefitted and limited funding would be lost to bioterrorism attacks that never transpire. With the current state of biowarfare and inadequate public health conditions, taking a comprehensive approach towards preparing for bioterrorism is best for all.

Appendix

Figures

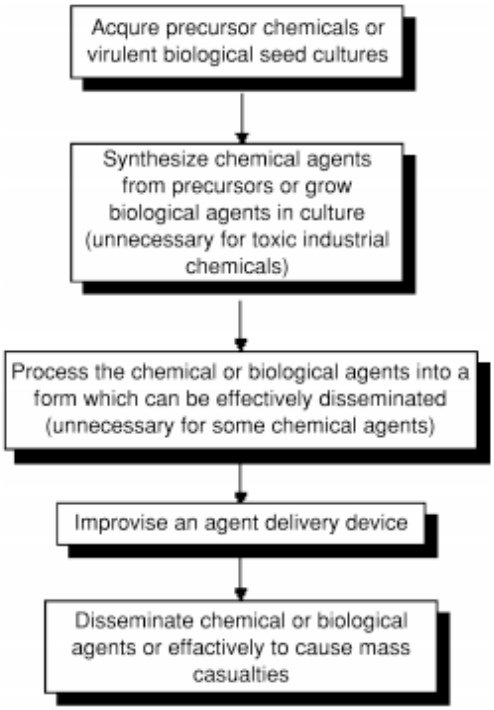


Fig. 1. Necessary precursors to a successful terrorist event.[14]

Figure 1
(Haas, 2002)

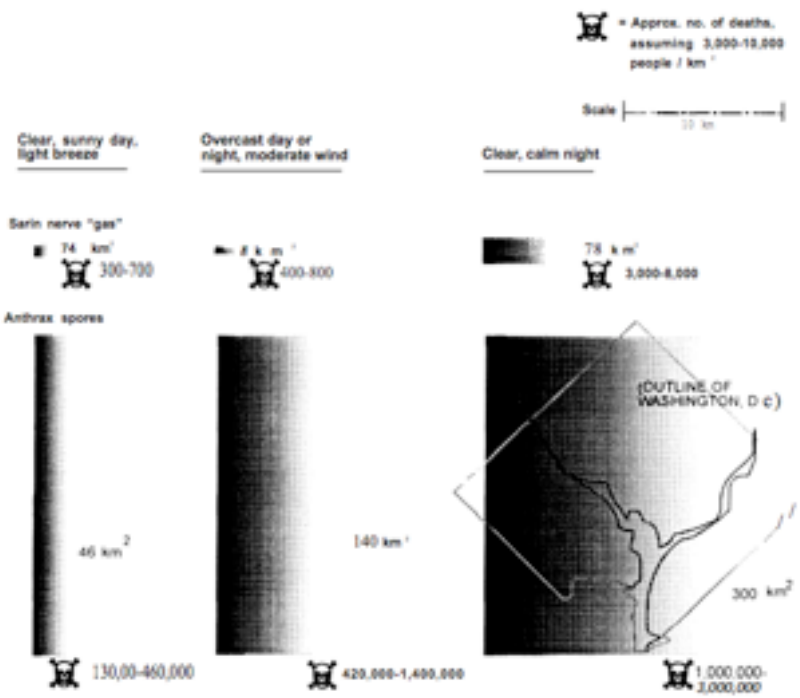


Figure 2
(U.S. Congress, 1993)

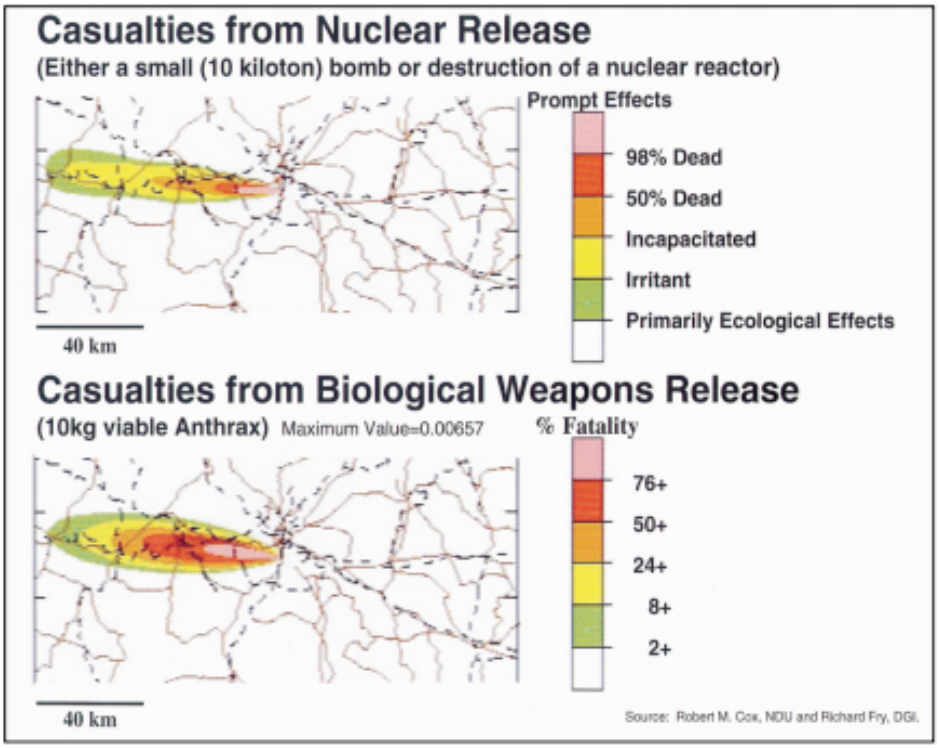
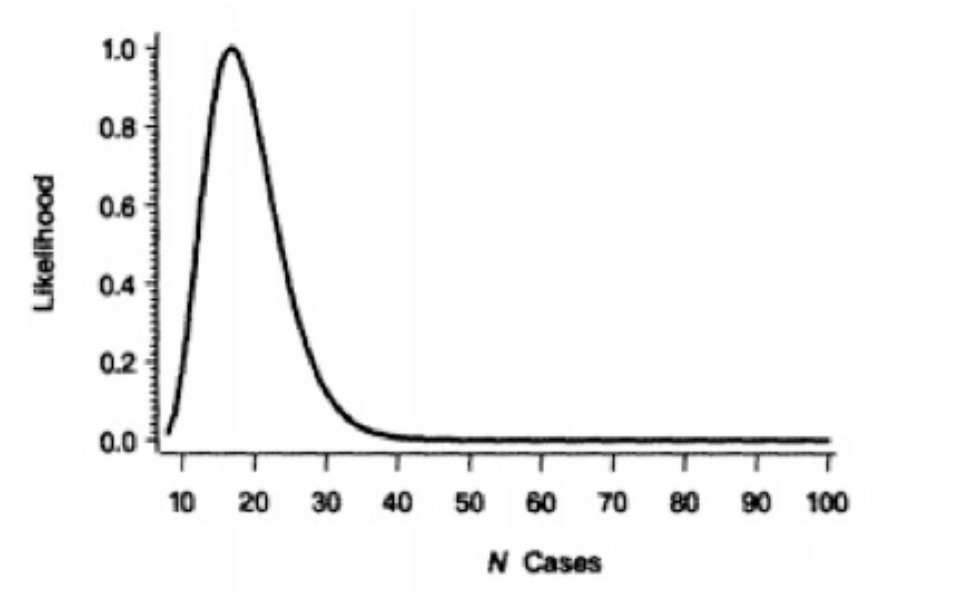


Figure. Effects of a nuclear and a biological weapons release.

Figure 3
(Siegrist, 1999)



likelihood for the number of cases of inhalational anthrax, *N*, that would have occurred if there had not been AP among the Florida media-publishing company employees, New Jersey postal workers, and Washington, D.C. postal workers (normalized to 1 at maximum).

Figure 4
(Brookmeyer & Blades, 2002)

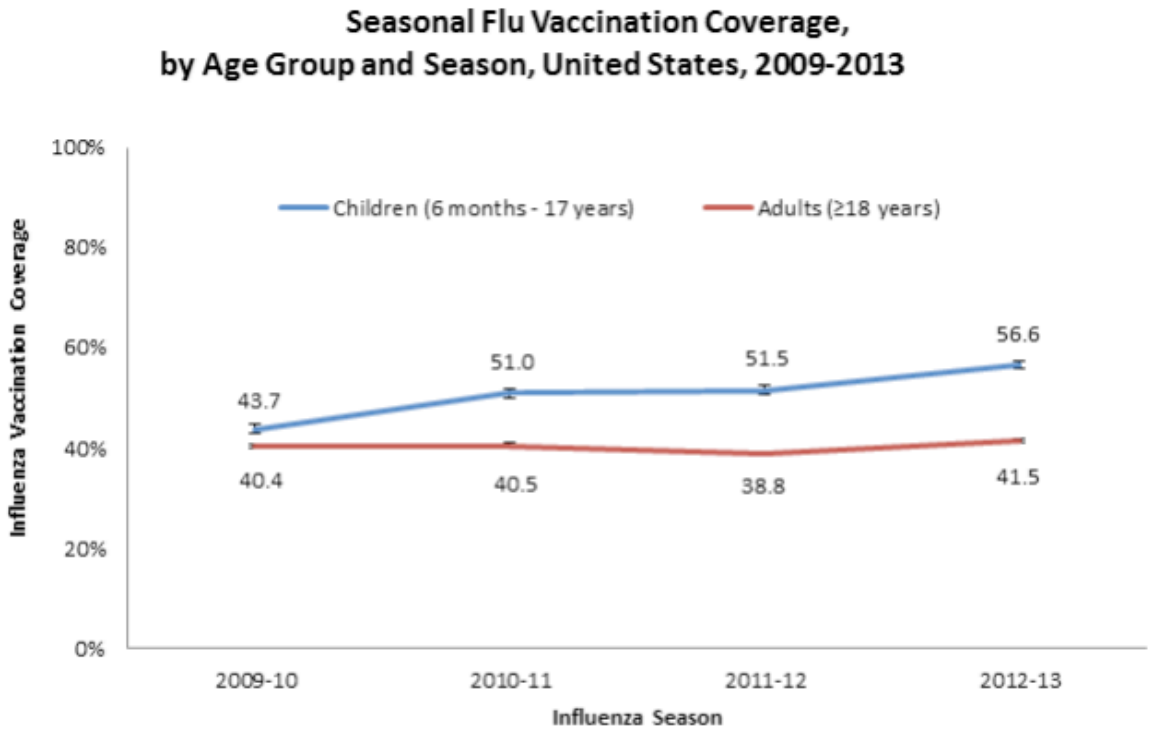


Figure 5
(CDC, 2011)

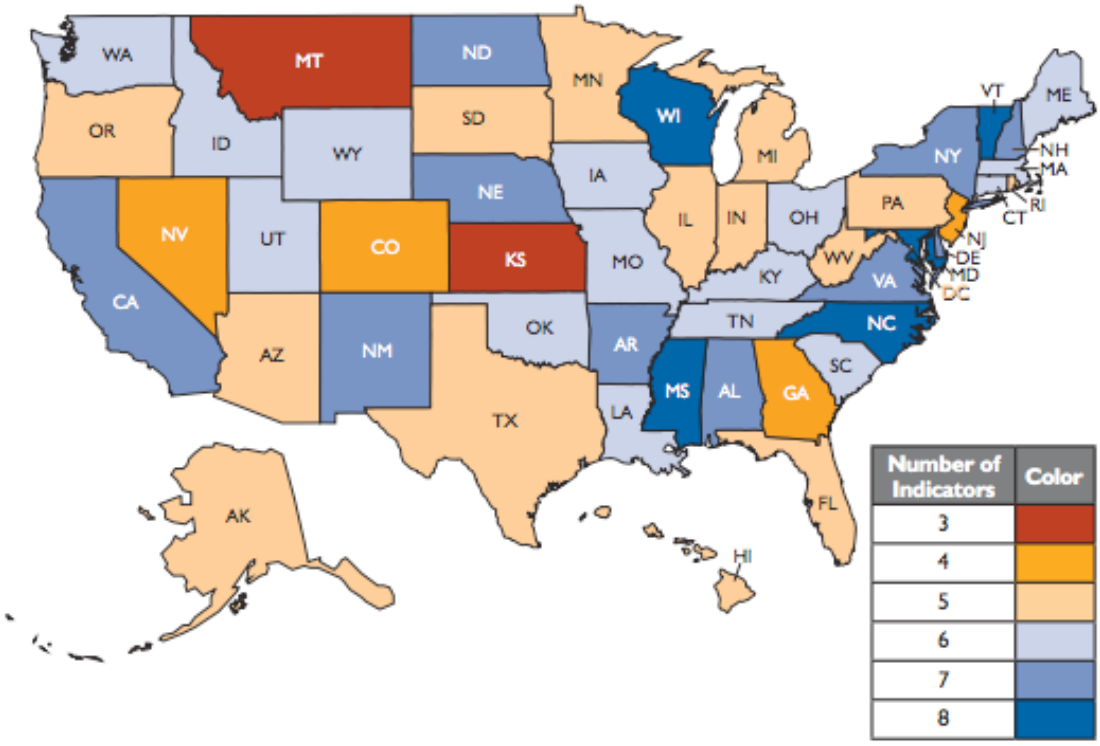


Figure 6
(Trust for America's Health, 2012)

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ACADEMIC VITA

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EDUCATION:

The Pennsylvania State University, **Schreyer Honors College** August 2010-May 2014
Bachelor of Science in Immunology and Infectious Diseases
Honors in Security and Risk Analysis
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PROFESSIONAL EXPERIENCE:

Centers for Disease Control and Prevention, Atlanta, GA June 2013-August 2013
Intern, Laboratory Reference and Research Branch in the Division of STD Prevention
- Assist Senior Research Microbiologists in development of innovative STD/HIV point of care testing
- Prepare serum samples and perform diagnostic testing such as RPR, VDRL, EIA, and TPPA
- Partake in division meetings, research presentations, and grant requests

Muhimbili University of Health and Allied Sciences, Dar es Salaam, Tanzania May 2013-June 2013
Global Fieldworker, Community Health Placement
- Reside in village field-site to gain cultural and health insight
- Assist and observe typical medical care and respective difficulties at community's health center
- Conduct interviews with locals and compile survey data to identify the most damaging health problems
- Assess epidemiological data to recommend best remedying course of action

Penn State Center for Neural Engineering, University Park, PA May 2012-May 2013
Undergraduate Research Assistant, Director Steven J. Schiff MD, PhD
- Assist faculty researchers in studying cerebral malaria as a cause of epilepsy in murine models
- Examine histological evidence using techniques such as confocal microscopy and small animal surgery
- Manage supply chain logistics within campus lab and international research facilities

Penn State Hershey Medical Center, Hershey, PA March 2012 –November 2012
Undergraduate Team Member, Pediatric Heart Surgery Three-Week Mission to Ecuador
- Served physicians performing life-saving, open-heart surgeries on children with congenital defects
- Assisted nurses in Intensive Care Unit with patient monitoring and care
- Performed supervised patient rounds
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RELEVANT TECHNICAL SKILLS:

Aseptic Technique	Differential Centrifugation	Microscopy	Serology
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LEADERSHIP & SERVICE:

Lion Ambassadors, Penn State Student Alumni Corps
Committee Director & Executive Board Member March 2013-April 2014
Lion Ambassador January 2012-May 2014

The Presidential Leadership Academy
Selected Student March 2011- May 2014

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Morale Committee Member October 2010-March 2014

University Park Undergraduate Association
Chief of Staff Intern October 2010-May 2011

HONORS AND AWARDS

Dean's List
Phi Kappa Phi Honor Society
Penn State College of Agricultural Sciences Scholarships