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The Threat of Bioterrorism

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Abstract

The increasing threat of the number and various types of weapons of mass destruction (WMD) has increased exponentially with the start of the 21st century. Combined with the invasion of Ukraine by Russia and the invasion of Israel by Hamas the proliferation of nuclear weapons by developed and rogue nations increases the chances of either a nuclear strike as an escalation of an existing war or a mishap which escalates into a nuclear retaliation and all-out war. Aside from nuclear threats other types of WMDs exist, including Bioterrorism. The use of Biological weapons goes back over two thousand years. Toxins, Bacteria, and Viruses are among the likely choices of Bioterrorists now and in the future. Unless the global community acts quickly and decisively, the chance of a Biological WMD being used effectively by a terrorist organization is very real.

Keywords: Bioterrorism, Biological Warfare, COVID Pandemic, Microorganisms, Toxins, Bacteria, Viruses, Vaccines, Anthrax, Smallpox

Modern technology and existing advances within the fields of microbiology and genetics have made possible the modification or combination of biological weapons to create new ways to kill with increasing efficiency (Johnson & Nolan, 2016). The COVID-19 global pandemic is still being felt within the United States by communities, cities and states as people continue to search for answers to rebuilding affected infrastructures and strengthening defenses against current and future biological threats. For many people the pandemic was a crude awakening to the impacts that a biological threat can have on a country. Although the argument that COVID was a weapon created in a lab is controversial and as yet undecided at this point, it is a relevant example because of the scale of impact caused as a result. The use of infectious agents and poisons against enemies has been utilized as a weapon for generations. Bioterrorism is the intentional use of microorganisms and toxins, generally of microbial, plant or animal origin, to cause disease and/or death in humans, livestock and crops (Sultan, 2001).

Early Use of Biological Weapons

The earliest known history of the use of biological warfare dates back as early as 400 BC, as Scythian archers would infect their arrows with a combination of manure and bits of decomposing bodies for additional effects on their adversaries (Zygmunt, 2022). There continued to be advances in the use of biological weapons as bodies were used to contaminate wells and toxins were used in assassinations. One of the earliest and most significant examples of biological warfare was during the siege of Caffa or modern day Feodosia, Ukraine. In 1346, Jani Beg, commander of the Mongols during a siege of the city decided there was no point in he and his army sitting among the rotting, plague ridden corpses of his men, so he decided to catapult the dead, plague-ravaged carcasses over the walls of the city. Aside from being a horrifying example of employing terror and psychological warfare against an enemy, the tactic represents one of the first deliberate uses of biological weapons in warfare (Karem, 2020). “Some historians believe that ships from the besieged city returned to Italy with the plague, starting the Black Death pandemic that swept through Europe over the next four years and killed some 25 million people (about one-third of the population)” (Schneider, n.d.).

The earliest known use of biological weapons on what is now American soil took place in 1763 when British troops knowlingly gave blankets infected with smallpox deliberately to Native Americans in the French and Indian War in hopes of reducing the numbers of Native American tribes that were hostile to the British (Lederberg, 2001).

The Fight Against Disease

Throughout history, ignorance of the exact cause of diseases has increased the risk of illness and death. During the 1830s the cholera epidemic devastated Europe. It began in India in 1817 and spread to Moscow in 1826 and then into western Europe, killing millions. No one understood that a bacterium, the cholera vibrio, causes the disease, or that it is transmitted primarily through contact with feces-contaminated drinking water. In the nineteenth century, doctors had trouble distinguishing one epidemic disease from another. The symptoms, including rash, fever, loss of appetite, and aching joints were common to half a dozen likely causes. The only exception was smallpox,with its distinctive rash. A preventive inoculation was available, but not accepted universally. Folk doctors in India and China had used the scabs from infected victims to inoculate others against the disease for centuries. This information was transmitted through the trade route to Constantinople, where Lady Mary Wortley Montagu, wife of the British ambassador, took it to the English court in 1720. This caused a medical controversy, which continued in 1796 when the English doctor Edward Jenner, conducting experiments on inoculation, developed a serum from cows that could be injected into humans to prevent smallpox.

French doctor Louis Pasteur published his argument that specific germs cause disease in 1858, which he based on fermentation experiments. Pasteur also invented vaccines, which he named for the latin word for cow, *vacca*, in deference to Jenner's prior work. The doctor's anthrax vaccine, announced in 1881, helped end livestock outbreaks worldwide.

Toward the end of the nineteenth century, scientists discovered microorganisms and made great strides toward understanding that a specific germ can cause a specific disease, and that food, water and personal contact can communicate illness from one person to another. After these were understood and accepted, it became possible for humans to methodically control disease outbreaks. It became possible to protect populations from diseases such as smallpox, cholera, plague, diphtheria, malaria and influenza that had swept across nations during previous centuries and killed millions, hitting hardest in crowded urban areas, particularly among the poor. Science alone was not a magic wand. Wars, famines, forced migrations, poverty, and malnourishment remained the primary and political preconditions of epidemics that science alone could not address and control, any more than it can, now.

By the 1920s, Western societies were rarely subjected to sudden deadly disease outbreaks that might threaten social order. Public health agencies in most cities had advanced to the point that food and water sources were monitored and controlled by the state, and drugs and vaccines were being invented and distributed as further protection. As childhood diseases were controlled, people lived longer, and were dying of diseases generally attributed to older people in industrialized societies, such as heart disease, cancer, and stroke. In the rest of the world, science alone without public health services and freedom from poverty and wars destined people to continuing epidemics, the enduring dichotomy between developing versus developed nations (Guillemin, 2005).

Biological Warfare

As Western nations were advancing against the threat of epidemics, some of them invented biological weapons as a means of obtaining an advantage over others. The German army during World War I was the first to actually use weapons of mass destruction, including both chemical and biological, to attempt to kill packhorses and mules being shipped to the French and British from neutral nations (Frishknecht, 2003). Shipboard workers were paid to infect animals with either anthrax or glanders, and entire shiploads were killed.

In 1919 Auguste Trillat, director of the French Naval Chemical Research Laboratory, conducted an inspection of a German pharmaceutical plant, as part of the oversight granted by the terms of the Treaty of Versailles. While Trillat was inspecting the plant, the director of the German bacteriological laboratories confided to him that German research on biological weapons was continuing (Brown, 1968). Trillat was well aware of the prior biological German effort during the war, and France may have engaged in similar covert activities, with undercover agents using anthrax against German livestock (Posen, 1984). Trillat's report to French authorities raised alarm, and two years later the French War Ministry decided that their nation should begin a biological weapons program, headed by Trillat. Trillat was most likely the first government scientist to calculate the probable military value of using biological weapons and actually play a major role in implementing them.

He realized that biological cultures loaded into shells could theoretically be detonated to form "microbial clouds" with infective power (Weber, 1946). In addition, Trillat also convinced French authorities that the most efficient and effective way to implement the weapons would be biological bombs dropped from aircraft (Colwel and Zilinskas, 2000). Trillat, of course, was not the only person to realize the potential for using airplanes for chemical bombing. Among them was the French military leader Marshal Foch, who wrote in 1921, "The carrying power of the aeroplane is increasing. Improvements are made almost daily enabling greater and greater weights to be carried. These developments introduce an entirely new method for the large-scale use of poison gas. By the use of bombs, which are becoming increasingly efficient and of greater capacity, not only have armies become more vulnerable, but the centres of population seated in the rear, and whole regions inhabited by civilians will be threatened (Gusterson, 1996).

Trillat had little confidence in technology protecting either soldiers on the front lines or civilians behind enemy lines against germ weapons, using either gas masks or vaccines. However, he believed that biological weapons would do the most damage behind enemy lines, against either unprotected reserve troops or civilians in industries and citties, as well as against crops, livestock, and water supplies. In World War I, both sides used chemical weapons, including phosgene, chlorine, mustard gas, tear gases, and other toxic chemicals (Guillemin, 2005). The first large-scale use of gas, in 1915, occurred at Ypres, Belgium, when German troops released chlorine which was carried by wind across the battlefield. French colonial troops, taken by surprise and lacking any protective gear, were routed. The German troops, apparently not expecting success, failed to exploit the temporary advantage, and the Allies quickly learned to respond using similar tactics.

Treaty of Washington

One aspect of chemical weapons, particularly at that point in time, was that simple effective individual defenses against their use could be invented relatively quickly and easily. During the war, masks and clothing were developed and the military was taught how and when to use them. This protective equipment and training prevented the gas from providing any decisive role in the war, but it did inflict much suffering on the unprepared. After the first World War ended, chemical weapons were generally regarded as one of the great horrors of the conflict. One result of this was the 1922 Treaty of Washington, which banned the use in war of "asphyxiating, poisonous or other gases, and all analogous liquids, materials, or devices" (Guillemin, 2005). Although the U.S. Senate gave its consent to ratification, the 1922 Treaty was rejected by France because of its provisions on submarine warfare. However, the chemical restrictions of the Treaty became the template for the 1925 Geneva Protocol.

Geneva Protocol

The 1925 Geneva Protocol which was signed on June 17, 1925 and entered into force on February 8, 1928, was the first diplomatic attempt at deterring and banning biological and chemical weapons in international armed conflicts (Frinking, 2016). This was considered the first multilateral disarmament treaty banning the development, production, and stockpiling of an entire category of WMD (Frinking, 2016). Unfortunately, the treaty lacked clear guidelines in term of basic research, production, or possession of biological weapons (Lederberg, 2001). Japan, which, like America, did not ratify the 1925 Geneva Treaty, developed a biological weapons program in Mancuria from 1934 to 1945 and caused significant illness and deaths among Chinese civilians using plague-infested food and water.

Although the Geneva Treaty banned the first use of biological weapons, it did not specifically prohibit nations from reprisals in kind if an enemy attacked with biological or chemical weapons. Theoretically, it allowed limited or symmetrical use of a prohibited weapon, if used in retaliation to attempt to persuade an adversary to stop. One area of contention was civilian casualties. If a nation's civilian population were attacked, was it allowed to seek retribution against enemy civilians? The imaginary line between offensive and defensive preparations was vague, at best. And, since the enemy's capacity was relatively unknown, there existed incentives to maximize one's own capacity, just in case.

Biological Weapons Convention Treaty

Between 1935 and 1940, the French military was actively researching biological weapons, which was not the case in the United States, Great Britain, or any other Western power. Logistical problems were coming into focus, including choosing the right pathogen, which depended primarily on the target—humans, animals, or water?

In 1942, biologists from Columbia University's College of Physicians and Surgeons in London mapped the components of a biological weapons program (Mims, 1987). The United States in 1942 developed offensive biological programs in an effort to combat Germany and Japan in a hypothetical situation where bioweapons were used against allied or American soldiers (Zygmunt, 2022). During the Cold War there were accusations between the United States and Russia each claiming the other used illegal biological weapons. In 1972 the Biological Weapons Convention treaty was signed prohibiting signatory countries from developing, producing, and stockpiling biological weapons and included the requirement to destroy biological weapon stockpiles (Zygmunt, 2022). The United States and its allies complied with the terms of the treaty, but not the Soviet Union, which conducted an aggressive clandestine biological warfare program even though it had signed and ratified the treaty.The Soviet Union's biological warfare project Biopreparat was one of the largest programs in history (Frischknecht, 2003). The Geneva Protocol was expanded by the Biological and Toxins Weapons Convention of 1975.

Bioterrorism in the United States

Bioterrorists in the United States have inflicted harm to citizens in the United States on numerous occasions. In 1984, 751 people were infected with Salmonella typhimurium after an intentional contamination of restaurant salad bars in Oregon by followers of the Bhagwan Shree Rajneesh in an attempt to influence a local election (Zygmunt, 2022). "From September to November 2001, a total of 23 confirmed or suspected cases of bioterrorism-related anthrax (10 inhalation, 13 cutaneous) occurred in the United States. Most cases involved postal workers in New Jersey and Washington DC, and the rest occurred at media companies in New York and Florida, where letters contaminated with anthrax were handled or opened. As a result of these cases, approximately 32,000 persons with potential exposures underwent antibiotic prophylaxis to prevent anthrax infections" (Zygmunt, 2022).

Infectious Diseases and Biological Threats

Biological weapons are weapons used to disseminate and distribute disease causing organisms or toxins to cause exceptionally grave damage to or potentially kill humans, plants, and animals (United Nations, n.d.). Biological weapons, like chemical weapons, radiological weapons, and nuclear weapons, are commonly referred to as weapons of mass destruction. There are a number of microbes found in the environment that, if transformed into a weapon, can inflict severe damage to the targeted parties and have impacts on health and infrastructures. The U.S. National Institute of Allergy and Infectious Diseases (NIAID) categorizes biological weapons and agents into three categories based on threat and damage assessment (NIAID, 2016). The first category, category A, are high-priority agents and organisms that pose a potential risk to national security and public health because of ease of transmission and dissemination, mortality rate, public health preparedness and the chance of public panic and social disruption. Category B are agents that are moderately easy to transmit, present moderate risks of death (NIAID, 2016). Category C includes emerging biological threats that could be engineered for mass distribution in the future based upon availability, ease or production, and potential for high death rates and public health impact (NIAID, 2016).

In general, the creation of biological agents requires the following steps:

1.Acquire the pathogen
2.Access information about bioweapons
3. Obtain necessary equipment
4. Grow the agent to the required quantity
5. Weaponize the biological agent by enhancing its stability and shelf life and processing the agent into a concentrated slurry or dry powder
6. Select a method of delivery to disseminate (Washington Post, 2004)

The first four steps are related to acquiring the biological agents. These can be either produced synthetically or sourced from nature, and obtaining the infrastructure to develop them. Until this point in time, these steps would have been completed in large-scale laboratories. Subsequently, the agent must be weaponized, which poses more problems than the first step of either creating or obtaining the necessary biological agents. Sufficient volumes of the agent must be obtained and they must be processed to remain viable long enough for successful transmission. Viable pathogens must acquire properties to be heat-resistant and relatively stable in environmental conditions such as exposure to humidity, air, and ultraviolet light (Nicolson and Nicolson, 2005).

Bacteria as a Biological Threat

Various bacteria could be used for bioterrorism purposes, but there are ones which have properties that make them more likely candidates for weaponized use based on their lethality, stability, and level of contagion. "Bacteria are too small to be seen without a microscope, yet they comprise more of the total biomass of Earth than all plants and animals combined. Different species are adapted to different conditions, and bacteria can be found in virtually every environment on the planet" (Johnson & Nolan, 2016). These single-celled organisms cause diseases including cholera, anthrax, plague and brucellosis which have taken many lives in countries around the worl (Schneider, N.d.).. Anthrax, or Bacillus anthracis, its medical name, is classified by NIAID as a Category A biological agents (NIAID, 2016).

Toxins as a Biological Threat

Toxins are any substance produced in or by nature that can be or are poisonous to humans and when weaponized have been used for assassinations throughout recorded history (Johnson & Nolan, 2016). Toxins are unique because they have a wide variety of effects on humans from local inflammation to intense pain, paralysis, and death (Johnson & Nolan, 2016). While toxins are produced in nature by insects, spiders, snakes, marine organisms, plants, bacteria, or fungi, they are inanimate and are not capable of reproducing unlike bacteria (Johnson & Nolan, 2016). Some common toxins known to be weaponized during biological warfare or by bioterrorists are Ricin, Botulinum, and Staphylococcal Enterotoxin B (Schneider, N.d.).

Viruses as a Biological Threat

"Bacteria are living organisms, toxins are nonliving chemicals, and viruses fall somewhere in between. Every life form on the planet is susceptible to infection by some type of virus, and viruses, similar to bacteria, can be found in all ecosystems" (Johnson & Nolan, 2016). Viruses are unique because of their evolutionary nature illustrated recently by variants of the COVID disease. Many believe that viruses have the potential to be the most devastating of the different biological threats as they are able to spread via aerosol dissemination exposing many people in a relatively short period of time (Johnson & Nolan, 2016). In addition, an increasing immunity to antibiotics, and the fact that viruses can be very contagious spreading by close contact make them possibly the most deadly of all biological weapons (Johnson & Nolan, 2016).

Possible Delivery Mechanisms

In the past, biological weapon programs have constructed and utilized a variety of systems to deliver biological payloads while some have designed spray-tanks to be fitted to aircraft, cars, trucks, boats, and other vehicles for delivery (United Nations, N.d.). Aerosols and food and water contamination are the most common form of covert delivery mechanism (Zygmunt, 2022). Some delivery systems are much more effective than others, and some are only conducive to specific types of biological weapons since there are numerous variables that need to be considered. For example, the use of "an explosive device to deliver and disseminate biological agents is not particularly effective, since such agents tend to be inactivated by the heat of the blast. Contamination of municipal water supplies requires an unrealistically large amount of agent and introduction into the water after it passes through a regional treatment facility" (Zygmunt, 2022). For biological weapons to be successful, they must be delivered undetected since it is extremely hard to trace until symptoms are noticed at or by the target.

Defense Against Threats

The first line of defense of biological attacks is prevention aided by effective policies and procedures at both the state and federal levels to mitigate exposure and act in a way that isolates and removes the threat in the quickest and safest way possible without allowing further spread of the biological agent (Johnson & Nolan, 2016). With the COVID-19 pandemic, the United States infrastructure was not prepared for the type of threat. While many of the precautions taken were similar to other countries, many believe the United States was too reactive and not aggressive enough in implementing the necessary procedures.

Future use of Biological Weapons

The combination of a number of criteria make the use of biological weapons more suitable and powerful. These include: high morbidity and potential lethality, high infectiousness and toxicity, suitability for mass production and storage without loss of potency, suitablity for wide-area-delivery and its ability to linger in its environment well after delivery.

Gerstein (2009) asked the following questions: "Do terrorists have the desire to employ WMD, and in particular biological weapons? Under what conditions might biological weapons be an attractive choice for use by terrorists? Would they have the requisite knowledge, equipment, and organizational capacity to mount a biological warfare (BW) attack? Would they be successful in such an attack?" (Gerstein, 2009). There is sufficient evidence in the world to answer most of these questions in the affirmative. There are many avenues by which a bioterrorism attack can occur, and the United States and allies are not doing enough as a global community to deter the use of this type of WMD. The recent COVID pandemic proved this. How difficult would it be for a terrorist organization to contaminate a major metropolitan city's water supply with a biological agent?

Non-Proliferation of Nuclear Weapons Treaty

The Non-Proliferation of Nuclear Weapons Treaty (NPT), is a landmark international treaty entered into force in 1970, and extended indefinitely in May 1995. Its objective is to prevent the spread of nuclear weapons and the technology associated with such weapons, to promote cooperation in the peaceful uses of nuclear energy and to further the goal of achieving nuclear disarmament (Affairs, 2020). The likelihood of a terrorist organization launching a nuclear terrorist attack depends, for the most part, on the ability of a terrorist or terrorist groups to acquire, construct, and detonate a nuclear device. A well-organized terrorist group with access to enough weapons-grade nuclear material might well be able to make at least a crude nuclear bomb. The danger of such an event should not be exaggerated, but an attack by a non-state terrorist or terrorist group using an actual nuclear device would be extremely difficult to achieve, and therefore, not likely (Bunn, 2006).

The global security environment is witnessing the rise of hostile non-state actors whose motivations, status and messages continue to mobilize individuals to their cause. The strategic value of possessing bioweapons could conceivably be considered higher to non-state actors than it is to state actors. With the evident rise in terrorist attacks in recent years combined with the aforementioned trend of easier access to technologies, a bioterrorist attack is increasingly likely (Frinking, 2016). Bioterrorism is considered to be a viable risk, according to a government report release titled "World at Risk" by two former senators, Bob Graham and Jim Talent (Graham, 2008). The World Health Organization (WHO) classifies biological and toxin weapons as either microorganisms like virus, bacteria or fungi, or toxic substances produced by living organisms that are produced and released deliberately to cause disease and death in humans, animals or plants. The use of biological agents is of serious concern, and the risk of using such agents in a terrorist attack is thought to be increasing (Organization, 2023).

Millions of people died of infectious diseases during the past century. Many of these deaths were caused by the deliberate release of pathogens or toxins by the Japanese during attacks on China in WWII. The bioterrorism treaties failed to stop countries from conducting research and large-scale production of biological weapons. Consequently, as our knowledge of the biology of disease-causing agents – viruses, bacteria and toxins – increases, it is a justifiable fear that modified pathogens could constitute devastating agents for biological warfare (Frischknecht, 2003). During the 1990s, the number of countries thought to be involved in developing biological weapons increased substantially. According to the U.S., countries that were actively pursing such programs were Iran, Iraq, Syria, North Korea, Taiwan, Israel, Egypt, South Africa, China, Russia, India, and Libya (Sultan, 2001). Since this list was established the number of countries with programs has increased significantly, including some European countries, and most probably the U.S., in spite of the fact that the United States claimed to have abandoned biological weapons programs in the late 1960s.

Advances in biotechnology and the ever increasing number of targets potential terrorist and terrorist organizations have to choose from and the lack of adequate measures to defend against a biological attack makes the use of such weapons a very real possibility today. Regardless of the advances in biotechnology, biological weapons are still extremely susceptible to atmospheric and meteorological conditions, factors that significantly influence their effectiveness as weapons. A reliable delivery system could compensate for some shortfalls, however, an agent such as anthrax or similar agents require a delivery system that can deliver a fair portion of the agent in a short period of time in order for it to be effective. A number of delivery systems have been developed and some are preferred more than others. Standoff distance is important to the delivery of a biological agent and therefore low-flying projectiles, missile systems, aerial bombs, cluster bombs, and cruise missiles are some of the more common conventional means of delivery, and although common and conventional, they are not the only means of delivery.

Conclusion

Bioterrorism is a major foreign policy concern. Numerous articles and books have been published about terrorism, its impact, and its challenges for policy makers. Discussions about combatting bioterrorism have taken place with public health officials and law enforcement/national defense. While each has important contributions to offer to the discussions, the uniqueness of bioterrorism will require some very thoughtful foreign policy decisions (Ostfield, 2004). The conclusions policy makers come to concerning bioterroism must include consideration of the international community and must effectively and simultaneously provide for a global health system that protects against infectious diseases. The agents that are of particular concern to law makers and public health officials are viruses, bacteria, and toxins because they tend to cause widespread panic and usually result in significant loss of life.

The Covid-19 pandemic is one example that led to millions of deaths and cases of serious illness, destabilized economies, diminished U.S. international standing, and exposed the U.S. military to challenges never before experienced in over a century (Cullison, 2021). It is important that the United States Department of Defense (DOD), Congress, and the White House fully understand what assets DOD brings to the discussions when it comes to the issue of global health and security both here in the homeland and overseas. Protecting the homeland against bioterrorism before it reaches our shores requires the concerted efforts and experience of all government and civilian institutions.

We are not likely to witness this characterization of the use of a biological weapon today, but unless and until the global community acts quickly and decisively, the likelihood that some sort of biological weapon of mass destruction (WMD) will be used by a terrorist organization somewhere in the world is very real. The simple fact is that a biological WMD is much easier to develop and/or obtain than a nuclear weapon.

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