A historical review of Bioterrorism and Biological Warfare

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ABSTRACT

The increased threat of terrorism has led to the development and use of biological weapons. This article explains the concepts of biological warfare and its states of development, its utilization, and attempts to control its proliferation. Waste produced in healthcare institutions is covered, as well as environmental biotechnologies such as bioreactor systems, microbial treatment, and composting. Case studies from different parts of the world show how environmental biotechnologies have been successfully applied to the disposal of medical waste. More research and development are needed to boost theeffectiveness, efficiency, and sustainabilityof medical waste management.

Keywords: Bioterrorism, Biologicalwarfare

INTRODUCTION

Biological warfare (BW) and bioterrorism (BT) have been used for centuries, with evidence of their use dating back to ancient times. However, the deliberate use of biological agents as weapons became a significant concern in the 20th century, especially during World War I and World War II. During World War I, both sides used chemical weapons, including poisonous gas and biological agents. The German army allegedly used anthrax and glanders against Russian troops, but the evidence for this is limited. The Japanese also used biological weapons during their invasion of China in the 1930s and 1940s, causing widespread disease and death. In the years after World War II, several countries began developing biological weapons programs. The United States and the Soviet Union were the two most significant players in this area, with both countries stockpiling large quantities of biological agents for potential use. However, the signing of the Biological Weapons Convention (BWC) in 1972 marked a turning point in the fight against biological weapons, as countries agreed to prohibit developing, producing, and stockpiling these weapons. Despite this treaty, several countries continued to pursue biological weapons programs secretly. Iraq is one notable example, as it used biological weapons against Iran during the Iran-Iraq War and against its own Kurdish population in the late 1980s. The Aum Shinrikyo cult in Japan also attempted to use biological agents in several terrorist attacks during the 1990s, including a botched attempt to release anthrax in the Tokyo subway system in 1995. In the early 2000s, the United States experienced anthrax attacks, killing five people and infecting 17 others. The attacks were attributed to a domestic perpetrator, Dr. Bruce Ivins, who was a scientist working for the US government. The incident highlighted the vulnerability of modern societies to bioterrorism and the need for effective measures to prevent and respond to such attacks.

EMPIRICAL USE OF BIOLOGICAL WAR

There is evidence to suggest that biological warfare has been used since ancient times. The ancient Greeks recognized the impact of infectious diseases on their armies as early as 600 BC. The Greek physician Hippocrates wrote about the spread of disease in his works, and the historian. Thucydides documented the devastating effects of a plague that swept through Athens in 430 BC. Throughout history, infectious diseases have played a significant role in shaping human society, affecting everything from the outcome of wars to the development of medicine and public health measures [1]. The crude use of filth, cadavers, animal carcasses, and contagion as weapons of war has been documented throughout history, and it is true that these tactics have had devastating effects on enemy forces. For example, during the siege of Caffa in 1346, the Mongol army catapulted the bodies of plague victims over the walls of the city, causing a massive outbreak of disease among the defenders. Similarly, during the French and Indian War in North America in the 18th century, British forces intentionally distributed smallpox-infected blankets to Native American populations as a form of biological warfare. These tactics, while effective in weakening the enemy, have been widely condemned as unethical and inhumane. It's worth noting that the intentional use of contagious diseases as weapons is considered a war crime under international law, and the use of such tactics is prohibited by the Geneva Conventions. The development and use of biological weapons are considered serious threats to

global security and public health, and efforts are underway to prevent the proliferation of these weapons and to promote the safe and secure management of biological agents [2]. For example, in 1346, the Tartar army allegedly catapulted plague-infected corpses into the city of Kaffa (modern-day Feodosia in Ukraine), which resulted in an outbreak of the disease among the defending soldiers [3]. The cadavers of plague victims during the battle between Russian troops and Swedish forces in Reval (now Tallinn, Estonia) in 1710. This incident is considered one of the earliest recorded uses of biological warfare in modern history. Black Death, which was a bubonic plague pandemic that swept through Europe, North Africa, and Asia in the mid-14th century, is considered one of the deadliest pandemics in recorded history. The origins of the Black Death remain a topic of debate among historians and scientists, but it is believed to have originated in the region of Central Asia and spread westward along trade routes. The disease is caused by the bacterium Yersinia pestis and is transmitted to humans through the bites of infected fleas that live on rodents such as rats. The pandemic is estimated to have killed between 75 and
200 million people, with mortality rates ranging from 30 to 90 percent in some areas. The Black Death had a profound impact on the social, economic, and cultural landscape of the affected regions, leading to significant population declines, labor shortages, and shifts in power and influence. Efforts to prevent and control the spread of infectious diseases have since become a major focus of public health efforts, and the lessons learned from the Black Death and other pandemics have helped shape the development of modern medicine and public health policies [4,5].

The account of the Caffa incident, in which the Mongol army allegedly used plague- infected corpses as a form of biological warfare against the city's defenders, was first described by the Italian chronicler Gabriel de Mussis. Mussis was a notary and chronicler from Piacenza, in northern Italy, who wrote a history of the city of Piacenza and its surrounding regions. In his account, Mussis describes how the Mongol army besieging the city of Caffa in Crimea in 1346 was decimated by an outbreak of plague, which they attributed to divine punishment for their attacks on the city. As the Mongol army retreated, they allegedly catapulted the bodies of plague victims over the walls of the city in an attempt to spread the disease among its inhabitants. Mussis's account is one of the earliest recorded instances of biological warfare, and although the accuracy of his description has been debated, the incident has become a well-known example of the use of infectious disease as a weapon of war [6].

Sir Jeffrey Amherst, the commander of British forces in North America during the French and Indian War, is known to have suggested the use of smallpox as a biological weapon against Native American populations who were hostile to the British. In a letter to Colonel Henry Bouquet in 1763, Amherst discussed the idea of giving blankets infected with smallpox to Native American tribes who were allied with the French, as a way of reducing their numbers and weakening their resistance. The plan was subsequently carried out by British troops at Fort Pitt, where blankets and handkerchiefs contaminated with smallpox were distributed to Native American groups during a peace negotiation. The use of smallpox as a biological weapon against Native Americans has been widely condemned as a form of genocide and a violation of human rights. The intentional use of infectious diseases as weapons of war is considered a war crime under international law, and the incident at Fort Pitt has become a well-known example of the unethical use of biological warfare [7,8]. Captain Ecuyer, a subordinate officer under Sir Jeffrey Amherst, provided Native Americans with smallpox-laden blankets from the smallpox hospital on June 24, 1763. In his journal, he recorded the following statement: "I hope it will have the desired effect"[9]. This action was part of Amherst's broader plan to use smallpox as a biological weapon against Native American populations who were hostile to the British. The blankets were deliberately contaminated with the smallpox virus, which is highly contagious and can be deadly. The use of smallpox as a weapon of war was a controversial and unethical practice, and the intentional spread of the disease through contaminated blankets has been widely condemned as a form of genocide. The impact of this specific incident on the Native American populations in question is not clear, but it is believed to have contributed to the spread of smallpox and the deaths of many individuals who were not immune to the disease. The incident at Fort Pitt serves as a reminder of the

devastating consequences that can result from the unethical use of infectious diseases as weapons of war. It is now widely recognized that the use of biological weapons is a violation of international law and a threat to global health and security. During World War I, there were reports of attempts by German agents to ship horses and cattle inoculated with disease-producing bacteria, such as Bacillus anthracis (anthrax) and Pseudomonas pseudomallei (glanders), to the United States and other countries. These efforts were part of a larger strategy by German military officials to use biological warfare to gain an advantage over their enemies. In addition to shipping contaminated animals, there were also reports of German agents attempting to spread diseases like typhus and cholera through contaminated food and water supplies. The use of biological warfare during World War I was a violation of international law and ethical principles, and it posed a significant threat to public health and global security. Fortunately, many of these attempts were unsuccessful, and the use of biological weapons was eventually banned by the Geneva Protocol of 1925[10,11].

The horrors of chemical warfare during World War I led to increased international efforts to limit the use and proliferation of weapons of mass destruction, including biological and chemical weapons. In 1925, the Geneva Protocol was signed by many nations, which banned the use of chemical and biological weapons in warfare. This was followed by the Biological Weapons Convention in 1972 and the Chemical Weapons Convention in 1993, which aimed to eliminate the production, stockpiling, and use of such weapons altogether. While the use of these weapons has decreased, there are still ongoing concerns about their potential use by rogue states or terrorist groups [12,13]. During the French and Indian War (1754-1763), British forces allegedly distributed smallpox-infected blankets to Native American tribes as a way of weakening their resistance. However, there is some debate over the accuracy of this account. In the 19th century, there were several documented instances of biological warfare. During the siege of Fort Pitt in 1763, British forces gave blankets contaminated with smallpox to Native American tribes who were allied with the French. In the late 1800s, during the Spanish-American War, yellow fever- infected mosquitoes were reportedly released by Cuban insurgents in an attempt to spread the disease to American troops. In World War I, both the Allied and Central Powers used chemical weapons, but there is limited evidence of the deliberate use of biological agents. However, during the Russian Civil War (1917-1922), the Bolsheviks allegedly used cholera and typhus as weapons against their enemies. The most well-known use of biological weapons during wartime occurred during World War II. The Japanese army conducted experiments on prisoners of war and civilians in China and Southeast Asia, using various biological agents, including anthrax, bubonic plague, and botulinum toxin. These experiments resulted in the deaths of thousands of people. Overall, while there is evidence of the use of biological warfare throughout history, it was not until the 20th century that the use of biological agents as weapons became a significant concern.

BIOLOGICAL WARFARE IN THE 19TH AND 20TH CENTURIES

In the 19th century, there were several documented instances of biological warfare. During the First Carlist War (1833- 1840) in Spain, both sides allegedly contaminated wells with faces in an attempt to spread disease among the enemy forces. During the American Civil War (1861-1865), Confederate forces reportedly tried to infect Union troops with yellow fever by releasing infected mosquitoes into their camps. In the early 20th century, the German army allegedly used biological agents, including anthrax and glanders, against Russian troops during World War I. However, the evidence for this is limited. During the interwar period, several countries began developing biological weapons programs. In the 1930s and 1940s, the Japanese army conducted experiments on prisoners of war and civilians in China and Southeast Asia, using various biological agents, including anthrax, bubonic plague, and botulinum toxin. These experiments resulted in the deaths of thousands of people. In the years after World War II, several countries, including the United States and the Soviet Union, began stockpiling biological agents for potential use in warfare. However, the signing of the Biological Weapons Convention (BWC) in 1972 marked a turning point in the fight against biological weapons, as countries agreed to prohibit developing, producing, and stockpiling these weapons. Despite the treaty, several countries continued to pursue biological weapons programs secretly. Iraq is one notable

example, as it used biological weapons against Iran during the Iran-Iraq War and against its own Kurdish population in the late 1980s.In the early 2000s, the United States experienced anthrax attacks, killing five people and infecting 17 others. The attacks were attributed to a domestic perpetrator, Dr. Bruce Ivins, who was a scientist working for the US government. Overall, the 19th and 20th centuries saw several instances of the use of biological agents in warfare, as well as the development and stockpiling of biological weapons by several countries. The "anthrax letters" in the wake of the September 11, 2001, World Trade Centre attack demonstrated how even a small number of infections can have a significant psychological impact by making everyone feel scared and uncertain of what will happen next While the Biological Weapons Convention has been effective in curbing the spread of these weapons, the threat of bioterrorism and the deliberate use of biological agents in warfare remains a concern.

Japanese biowarfare program

Unit 731 was the center of the Japanese biological warfare program during World War II. It was a secret military research unit established in 1935 in the city of Harbin, Manchuria, which was then a puppet state of Japan. The unit was led by Lieutenant General Shiro Ishii, a medical doctor, and microbiologist, and was responsible for conducting experiments on prisoners of war and civilian subjects, including men, women, and children. The experiments conducted by Unit 731 included infecting subjects with various diseases, including anthrax, bubonic plague, and cholera, and then studying the effects of the diseases on the human body. The subjects were often subjected to horrific conditions, including being subjected to extreme temperatures, being deprived of food and water, and being subjected to live dissections. Unit 731's research aimed to develop biological weapons that could be used against enemy troops and civilians. The unit conducted field tests of biological weapons in China, resulting in the deaths of thousands of Chinese civilians and soldiers. After the war, the United States granted immunity to Ishii and other members of Unit 731 in exchange for access to their research. This decision was made in order to prevent the research from falling into the hands of the Soviet Union. As a result, many of the crimes committed by Unit 731 were never prosecuted, and Ishii and other members of the unit were never brought to justice. The Japanese biological warfare program was a large and complex operation, with multiple facilities and thousands of staff members. In addition to Unit 731 in Harbin, there were several other research units and facilities located throughout China and Southeast Asia. One of the largest of these facilities was located in the town of Pingfan, near the city of Harbin. The facility, known as the "Epidemic Prevention and Water Purification Department of the Kwantung Army," covered an area of more than six square kilometers and consisted of more than 150 buildings, including research laboratories, production facilities, and living quarters for the staff. In addition to Pingfan, the Japanese military also established several satellite camps throughout China and Southeast Asia, where they conducted experiments on prisoners of war and civilian subjects. These camps were often located in remote areas and were designed to be self- sufficient, with their own sources of food, water, and electricity. Overall, the Japanese biological warfare program was a vast and sophisticated operation, with a large and well-trained staff of scientists, researchers, and support personnel. The program was responsible for the deaths of thousands of people, both through the use of biological weapons and brutal experiments conducted on human subjects.

The Japanese biological warfare program was focused on developing and testing a wide range of biological agents, including bacteria, viruses, and toxins. Some of the organisms and diseases that were of particular interest to the program included:

Bacillus anthracis: the bacterium that causes anthrax, which was investigated for use as a biological weapon. Unit 731 conducted experiments on prisoners to study the effects of anthrax infection and todevelop effective methods of dissemination.

Neisseria meningitides: a bacterium that can cause meningitis and other serious infections. The Japanese programinvestigated the use of this bacterium as a potential biological weapon.

Vibrio cholerae: the bacterium that causes cholera, which was also investigated for use as a biological weapon. Unit 731 conducted experiments on prisoners to study the effects of cholera infection and to develop effective methods of dissemination.

Shigella spp.: a group of bacteria that can cause severe gastrointestinal illness. The Japanese

program investigated the use of these bacteria as potential biological weapons.

Yersinia pestis: the bacterium that causes bubonic and pneumonic plague, which was investigated for use as a biological weapon. Unit 731 conducted experiments on prisoners to study the effects of plague infection and to develop effective methods of dissemination Japanese biological warfare program was focused on developing a wide range of biological weapons that could be used against enemy troops and civilian populations [14].

Biological Weapons Convention

The Biological Weapons Convention (BWC) is an international treaty that was signed in 1972. The treaty prohibits the development, production, and stockpiling of biological weapons and requires that all signatories destroy any existing stocks of such weapons. The BWC is considered to be one of the most important international agreements aimed at preventing the use of biological weapons. The treaty was signed by over 170 countries, including the United States, Russia, China, and other major powers. The BWC established a framework for international cooperation to prevent the development and use of biological weapons and includes provisions for monitoring and verification to ensure compliance. Under the BWC, signatories are required to destroy any existing stocks of biological weapons and to implement measures to prevent the development and production of such weapons. The treaty also requires that countries establish measures to detect and respond to outbreaks of infectious diseases that could potentially be used as biological weapons. The BWC has been strengthened over the years through a series of review conferences and other measures, including the establishment of a monitoring and verification regime. Despite these efforts, concerns remain about the potential use of biological weapons, and there have been several instances where countries have been accused of violating the treaty. The Biological Weapons Convention is an important international agreement aimed at preventing the development and use of biological weapons. While there have been challenges to implementing the treaty and ensuring compliance, the BWC remains an important tool for promoting international cooperation and preventing the use of biological weapons [15].

Convention on the Prohibition of the Development, Production, and Stockpiling of Bacteriological (Biological)and Toxin Weapons and on Their Destruction

The Convention on the Prohibition of the Development, Production, and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on Their Destruction, commonly known as the Biological and Toxin Weapons Convention (BTWC), is an international treaty that was signed in 1972. The BTWC is aimed at prohibiting the development, production, and stockpiling of biological and toxin weapons. The BTWC currently has 183 state parties, making it one of the most widely supported arms control agreements in the world. The treaty prohibits the development, production, acquisition, transfer, stockpiling, and use of biological and toxin weapons. It also requires state parties to destroy any existing stockpiles of such weapons, as well as any facilities used to produce or store them. The BTWC includes a verification mechanism, which allows states parties to request that other states parties provide information about their activities related to biological and toxin weapons. The treaty also requires state parties to provide annual declarations on their activities related to biological and toxin weapons, as well as to submit to periodic on-site inspections by other state parties. Despite the BTWC's provisions, concerns remain about the potential use of biological and toxin weapons [16]. In recent years, advances in biotechnology and synthetic biology have raised concerns about the potential for non-state actors to develop and use such weapons. In response to these concerns, the BTWC has been strengthened through a series of review conferences and other measures. These efforts have focused on improving the implementation of the treaty, enhancing transparency and confidence-building measures, and addressing emerging challenges related to advances in science and technology. The Biological and Toxin Weapons Convention is an important international agreement aimed at preventing the development, production, and use of biological and toxin weapons. While challenges remain, the treaty serves as a critical tool for promoting international security and preventing the use of these weapons of mass destruction. Unlike the Chemical Weapons Convention, which has a strong verification regime with on- site inspections and an international organization dedicated to its implementation, the BWC relies primarily on voluntary declarations and confidence- building measures among its member states. As a result, the effectiveness of the

BWC is limited by the lack of a robust verification mechanism, which makes it difficult to detect and deter non- compliance. Efforts to strengthen the verification regime of the BWC have been ongoing, and some progress has been made in recent years with the establishment of an Implementation Support Unit and the development of voluntary reporting templates. However, there is still a long way to go to ensure effective monitoring and enforcement of the BWC's provisions.

Challenges of the BWC

One of the challenges of the Biological Weapons Convention (BWC) is that it does not provide a clear definition of what constitutes defensive research or the quantities of pathogens that are necessary for benevolent research. This ambiguity can make it difficult to distinguish between legitimate researchfor defensive purposes and illicit activities for offensive purposes.

In addition, there have been alleged violations of the BWC in the past, which have highlighted the need for more effective mechanisms for reporting and investigating such violations. According to the Convention, alleged violations should be reported to the UN Security Council, which may then initiate inspections of accused parties and determine the modalities of correction. However, the effectiveness of this process has been limited by the lack of a robust verification regime, as mentioned earlier, and the political complexities of the UN Security Council. Furthermore, some countries have been hesitant to report suspected violations for fear of retaliation or political repercussions. The Biological Weapons Convention represents an important step in limiting the proliferation and use of biological weapons, but there are still many challenges to ensuring its full implementation and effectiveness [17,18]

A PERIOD AFTER THE BWC

In recent years, there have been efforts to strengthen the BWC and address some of its shortcomings. For example, the establishment of an Implementation Support Unit (ISU) in 2006 has provided technical support and assistance to member states in implementing the provisions of the Convention. The ISU has also helped to develop a voluntary reporting template for member states to report on their implementation of the BWC. There have also been proposals for additional measures to strengthen the BWC, such as the establishment of a legally binding protocol for verification and compliance, which would include on-site inspections and other measures to ensure compliance with the Convention's provisions. However, negotiations on such a protocol have been challenging, and progress has been slow. In addition to efforts to strengthen the BWC, there have been other initiatives to address the threat of biological weapons. For example, the Global Health Security Agenda, launched in 2014, aims to strengthen global preparedness and response to infectious disease outbreaks, including those caused by the deliberate or accidental release of biological agents.

In 1978, the Bulgarian dissident Georgi Markov was assassinated in London, England, in what became known as the "umbrella killing." Markov was attacked with a small device that was disguised as an umbrella, which fired a tiny pellet containing ricin poison into his leg. He died a few days later from complications related to the poisoning. The assassination was widely believed to be the work of the Bulgarian secret police, and the incident raised concerns about the potential use of biological and chemical weapons by state actors for covert assassinations. The case also highlighted the limitations of the Biological Weapons Convention (BWC) and other international treaties in preventing the use of such weapons for covert operations. While the BWC prohibits the development, production, and stockpiling of biological weapons, it does not specifically address their use for covert operations, nor does it provide a mechanism for investigating suspected violations of the Convention. As a result, it can be difficult to detect and deter the use of biological weapons for covert purposes. The "umbrella killing" remains an infamous example of the use of a biological agent for covert assassination, and it has spurred efforts to strengthen international norms and treaties against the use of such weaponsin any context [19].

In April 1979, an outbreak of anthrax occurred in the city of Sverdlovsk (now Ekaterinburg) in the former Soviet Union. The outbreak was initially attributed tocontaminated meat, but it later became clear that the outbreak was the result of a release of anthrax spores from a nearby military microbiology facility known as Compound

19. The facility was part of the Soviet Union's biological weapons program and was involved in research and development related to biological weapons. The release of anthrax spores is believed to have been caused by a malfunction in the facility's air filtration system, which allowed the spores to escape into the surrounding area. The outbreak had significant health and economic impacts, with at least 66 people dying from anthrax and many others becoming ill. In addition, many livestock died from anthrax in the same area, with the outbreak spreading up to 50 km from the site of the release. The Sverdlovsk anthrax outbreak raised concerns about the safety and security of biological research facilities and the potential risks associated with the development and use of biological weapons. The incident also highlighted the need for improved transparency and confidence-building measures to prevent similar incidents from occurring in the future [20].

The report in Bild Zeitung about an anthrax cloud resulting from an accident in a Soviet military settlement in Sverdlovsk is likely a reference to the same incident that occurred in April 1979. The incident involved the release of anthrax spores from a military microbiology facility known as Compound 19, which was part of the Soviet Union's biological weapons program. The incident was initially covered up by Soviet authorities, who claimed that the outbreak was the result of contaminated meat. It wasn't until several years later that the true cause of the outbreak was revealed, and the incident raised significant concerns about the safety and security of biological research facilities and the potential risks associated with the development and use of biological weapons. It's possible that the Bild Zeitung report was based on leaked information or rumors about the incident, which were circulating at the time. However, without further information, it's difficult to determine the accuracy of the report or the sources on which it was based [21]. During Operation Desert Shield, the build-up phase of the Persian Gulf War (Operation Desert Storm), there were concerns that Iraq might use biological and chemical weapons against the coalition forces. Iraq had a history of using chemical weapons, including against Iranian troops during the Iran- Iraq War in the 1980s, and there were indications that Iraq had continued to develop its chemical weapons capabilities in the years leading up to the Gulf War. As a result, the United States and its coalition partners took significant steps to prepare for the possibility of a biological or chemical attack, including developing specialized protective gear, training personnel in detection and response, and establishing procedures for decontamination and medical treatment. Fortunately, Iraq did not use biological or chemical weapons during the Gulf War, although it did launch several missile attacks against coalition forces, including missiles believed to be armed with chemical warheads. The successful defense against these attacks, as well as the overall success of the coalition's military campaign, helped to reinforce the importance of preparedness and deterrence in the face of the threat of biological and chemical weapons[22].In 1995,representatives of the Iraqi government admitted to UN Special Commission Team 7 that Iraq hadconducted research into the offensiveuse of severalbiological agents, including. Bacillus anthracis (thebacterium that causes anthrax), botulinum toxins,and Clostridium perfringens. The admission was part of Iraq's effort to comply with UNSecurity Council Resolution 687, which required Iraq to disclose and eliminate its weapons of mass destruction programs in the aftermath of the Gulf War. The admission of biological weapons research was a significant development, as it contradicted previous statements by Iraqi officials denying the existence of such programs. The revelation of Iraq's biological weapons research raised concerns among the international community about the proliferation of biological weapons and the need for greater efforts to prevent their development and use. The UN Special Commission, along with other international organizations and countries, worked to investigate and verify Iraq's compliance with the resolution, which ultimately led to the discovery and destruction of significant portions of Iraq's biological and chemical weapons programs.

The National Biodefense Strategy(NBS)2018

In recent years, there have been concerns about the potential use of biological weapons by state and non-state actors. In 2018, there were several significant developments related to biological weapons research and preparedness: The National Biodefense Strategy (NBS) of 2018 is a comprehensive plan developed by the U.S. government to address the growing threat of biological incidents, whether naturally occurring or deliberate. The strategy outlines a collaborative approach involving federal, state, and local agencies, as well as private sector partners and

international stakeholders, to prevent, detect, and respond to biological threats. The NBS also identifies several priority areas for action, including improving risk awareness and assessments, enhancing public health preparedness and response, advancing medical countermeasures, strengthening bio surveillance and detection capabilities, and promoting global health security. The overall goal of the NBS is to ensure that the United States is prepared to quickly and effectively respond to any biological incident, whether it is a natural outbreak or a deliberate act of bioterrorism's highlighting the potential threat posed by natural outbreaks of diseases such as SARS, Ebola, and Zika viruses, as well as the risk of deliberate biological attacks by state and non-state actors. While natural outbreaks of disease are not considered deliberate threats, they can serve as a warning and a reminder of the potential impact of biological threats. Moreover, there are concerns that terrorist groups and rogue states could seek to acquire biological weapons or develop clandestine bioweapons programs and that they could use natural outbreaks as a cover for their activities. The United States government released a new National Biodefense Strategy in 2018, which outlined the country's approach to preparing for and responding to biological threats. The strategy emphasized the importance of international cooperation and collaboration, as well as investments in research, surveillance, and response capabilities. In March 2018, the United States accused Russia of developing and using nerve agents in an assassination attempt on a former Russian spy in the United Kingdom. The incident raised concerns about the use of chemical and biological weapons by state actors and led to the expulsion of Russian diplomats from several countries [23].

In April 2018, a research team at the University of Alberta in Canada announced that they had successfully synthesized horsebox, a close relative of the smallpox virus, using synthetic DNA. The announcement raised concerns about the potential misuse of synthetic biology techniques to create new biologicalweapons. In May 2018, the World Health Organization (WHO) announced the creation of a new global initiative to prevent the spread of deadly diseases from animals to humans. The initiative, known as the Global Preparedness Monitoring Board, aims to improve surveillance and response capabilities for emerging infectious diseases. These developments highlight the ongoing need for vigilance and preparedness in the face of potential biological threats, as well as the importance of international cooperation and collaboration in addressing these challenges.

COVID-19's impact has increased ourvulnerability to biological warfare.

The COVID-19 pandemic has exposed vulnerabilities in our ability to respond to biological threats, including those posed by biological warfare. The pandemic has demonstrated the devastating impact that a highly contagious and deadly pathogen can have on global health, economies, and societies.

The COVID-19 pandemic has highlighted several areas of vulnerability, including:

Lack of preparedness: Many countries were caught off-guard by the COVID-19 pandemic and were not adequately prepared to respond to the outbreak. This has raised concerns about our ability to respond to a deliberate biological attack.

Disruptions to supply chains: The pandemic has disrupted global supply chains, including those for medical supplies and equipment. This has highlighted the importance of ensuring that critical suppliesare available during a biological attack.

Dependence on technology: The pandemic has forced many activities to shift to online platforms, highlighting our dependence on technology. A biological attack could potentially disrupt these platforms and cause significant disruption to society.

Misinformation and disinformation: The pandemic has also highlighted the role of misinformation and disinformation in exacerbating the spread of disease. In the case of a biological attack, deliberate misinformation could be used to sow fear and confusion, making it more difficult to respond effectively.

Global interconnectedness: The COVID-19 pandemic has demonstrated the interconnectedness of the global community, and how quickly diseases can spread across borders. This highlights the importance of international cooperation in responding to biological threats. The COVID-19 pandemic has exposed vulnerabilities in our ability to respond to biological threats, including those posed by biological

warfare. Addressing these vulnerabilities will require international cooperation, investment in research and development, and improved preparedness and response capabilities [24].

Conclusion

A biowarfare attack would seek to induce fear, panic, and paralyzing uncertainty in addition to sickening and killing a lot of people. Its objectives include impeding military responses, upsetting social and economic order, and shattering governmental authority. The "anthrax letters" in the wake of September 11, 2001, World Trade Centre attack demonstrated how even a small number of infections can have a significant psychological impact by making everyone feel scared and uncertain of what will happen next.

Future projects may be impacted by the connection between biodefense strategies and the COVID-19 pandemic response. Maintaining the National Biodefense System (NBS) and preventing biological warfare assaults require military medicine. The military health system mustbe flexible and rapid during the epidemic to avoid a bioterrorism attack.

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