A Historical Overview on Biological Warfare and Bioterrorism During World Wars and After

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Abstract - **The risk presented by diverse microorganisms as bioweapons must be assessed, and the historical evolution and usage of biological agents needs to be better understood, due to the rising threat of terrorism. Potentially more powerful than traditional and chemical weapons are biological warfare agents. The advancements in technology and biochemistry over the past century have made it easier to build and produce such weapons. Additionally, genetic engineering may have the greatest threat. The ease of manufacture, widespread accessibility of biological agents, and technological know-how have all contributed to the proliferation of biological weapons and the rise in demand for them among emerging nations.**

This review explores the ideas of biological warfare, including its stages of development, applications, and historical attempts to curtail its spread. The threat of biological weapons is serious and real; it is not limited to our country or the domain of science fiction.

Keywords: Biological warfare, Bioterrorism, Threat, Viruses, SARS-CoV-2, COVID-19

I. INTRODUCTION

The intentional release of viruses, microbes, or other pathogens used to infect or kill humans, animals, or plants is referred to as a bioterrorism attack. These substances are normally present in nature; however, it is probable that they may be altered to make them more virulent, resistant to treatment, or more easily disseminated across the ecosystem.

Bioterrorism agents have been categorized as A, B and C (1)

Category A: Organisms that may readily spread or be passed from person to person, have high rates of mortality and the potential to have a significant impact on public health are examples of high-priority agents. They are also those that constitute a threat to national security. They may result in social unrest and widespread fear, necessitating significant preparation for public health. Agents and illnesses include tularemia, anthrax, botulism, smallpox, plague, and viral hemorrhagic fevers.

Category B: The second-highest priority agents are those that are somewhat simple to spread, have low fatality rates and moderate rates of morbidity, and call for specialized improvements in the CDC's diagnostic capabilities. These threats include *Salmonella* species, *Escherichia coli* O157:H7, *Shigella*, glanders Staphylococcal.

Category C: Emerging infections that have the potential to produce high rates of morbidity and death as well as significant harm to human health are the next highest priority agents and may one day be developed for widespread distribution. Agents include *Mycobacterium tuberculosis* and viral illnesses as the Hanta virus and Nipah virus.

II. USE OF BIOLOGICAL WEAPONS DURING WORLD WAR I AND II

In the 19th century, biological warfare techniques advanced significantly. The isolation and creation of stocks of certain diseases were made feasible by the advent of modern microbiology and Koch's postulates in the 19th century (2).

There is strong evidence that Germany engaged in an intensive biological warfare program during World War I. According to reports, this program included clandestine activities. Reports of German attempts to export animals infected with pathogens including anthrax and glanders to the USA and other nations circulated during World War I. (3,4). The sheep from Romania intended for shipment to Russia were

infected with the same agents. There were subsequent claims that Germany attempted to transfer the plague and cholera to St. Petersburg, Russia, and Italy, respectively (3,4). All of these accusations, including the claim that pathogenic bombs were thrown over British positions, were refuted by Germany.

Some of the nations started a relatively substantial biological weapons research program during World War II. The events that took place during and after World War II were muddled by numerous accusations and denials. From around 1932 to the conclusion of World War II, Japan engaged in biological weapons development (5, 6). The initiative was managed by Kitano Misaji (1932–1942) and Shiro Ishii (1942–1945). There were several military organizations dedicated to developing and researching biological weapons. Unit 731, the brainchild of the Japanese biowarfare program, was situated in Manchuria not far from the village of Pingfan (5).

Between 1932 and 1945, it is estimated that over 10,000 inmates perished because of an experimental infection under the Japanese program.1942 saw the beginning of an offensive biological warfare programme in the USA, which was run by the War Reserve Service, a civilian institution.(5)

The program comprised testing locations in Mississippi and Utah, a production plant in Terra Haute, Indiana, and a research and development centre at Camp Detrick, Maryland.

III BIOWARFARE PROGRAMS AFTER WORLD WAR II

Newspapers were flooded with stories about illness epidemics brought on by foreign agents using biological weapons in the years following World War II (7). The North Korea, Soviet Union and China charged the United States with employing biological warfare agents against North Korea during the Korean War (5, 7). Later, the USA admitted possessing the ability to produce such weapons, although it denied ever using them. The USA's reputation was nonetheless damaged by its refusal to ratify the Geneva Protocol of 1925, public admission of its own offensive biological warfare programme, and allegations of collaboration with former Unit 731 experts. (5,7).

In reality, the US programme was expanded during the Korean War (1950–1953) with the establishment of a new production facility in Pine Bluff, Arkansas. The creation of defences, such as immunisations, antisera, and chemotherapeutics, to protect troops from potential biological attacks was the exclusive focus of a defensive programme that was launched in 1953. By the late 1960s, the US military had developed a biological arsenal of poisons, fungal plant infections, and biological illnesses that could be deployed against crops to lead to crop damage and starvation.(5)

Several studies were carried out between 1951 and 1954 to show the susceptibility of US urban centers (8). Simulants were dispersed during clandestine tests in New York City and other locations, serving as covert labs to study aerosolization and diffusion processes. For these tests, *Serratia marcescens*, *Bacillus subtilis* var. *globigii*, and *Aspergillus fumigatus* were chosen (8). To investigate how climate change and solar radiation affect an organism's capacity to survive, organisms were dispersed over vast geographic regions.

IV THE 1972 BIOLOGICAL WEAPONS CONVENTION

In 1972 ***"****Convention on the Prohibition of the Development, Production, and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on Their Destruction"*, Also known as BWC was created. The invention, manufacture, and storage of infections or poisons in "quantities that have no justification for preventive, protective, or other peaceful purposes" is forbidden under this treaty (4). The BWC forbids the creation of delivery methods and the transmission of bioweapons knowledge or technology to other nations. Additionally, it mandated that within nine months after ratification, the signatories to the BWC destroy all stockpiles, delivery methods, and manufacturing machinery. The pact was approved in April 1972 and was reached by 103 cosigning countries. The BWC became operational in March 1975. (5).

The BWC does not, however, offer definite instructions for inspections and supervision of disarmament and conformity to the agreement, similar to the 1925 Geneva Protocol. Additionally, there are no rules for enforcement or sanctions for infractions. In addition, disagreements remain on the definition of "defensive research" and the number of pathogens required for beneficial research (9).

V THE TIME AFTER BWC

Despite the 1972 accord, a number of the BWC signatory countries engaged in activities that

were forbidden by the treaty (5). These incidents unequivocally show that the convention cannot be relied upon to eradicate biological weapons and stop their future spread. Information on the number and identities of nations that have conducted offensive bioweapons research is still mainly secret. However, it is true to say that over the past 30 years, there have been a major growth in the number of state-sponsored initiatives of this kind. There have also been a number of reported assassination plots and attacks, along with terrorist actions that were not state sponsored.

Biological weapons were employed for clandestine assassinations in the 1970s. Georgi Markov, a Bulgarian expatriate, was slain in an assault in 1978 in London, England. Due to the employment of a device that looked like an umbrella as the weapon, this assassination later came to be known as the "umbrella killing" (10). While Markov was waiting at a bus stop in London, this weapon shot a small pellet into subcutaneous fat of his leg. He developed serious illness the next day, and three days after the assault he passed away. Upon autopsy, the cross-drilled pellet that appeared to be intended to hold another substance was found. It was later discovered, and the Soviet Union provided the Bulgarians with the equipment to do it (10) After learning of Markov's passing two weeks later, Medical experts from France analysed Kostov. They pulled out a similar pellet, which had the ricin toxin and was made of an uncommon platinum-iridium alloy.There have been claims that people in Laos and Sri Lanka may have suffered attacks by aircraft and helicopters spraying aerosols with different colours in the 1970s (5, 11).

Those who were exposed got unwell and confused. Yellow rain was a typical term used to characterise these attacks. It was hotly debated whether these clouds actually included biological warfare agents. It was thought that some of these clouds contained trichothecene poisons (e.g., T-2 mycotoxin). According to some experts, the yellow showers were likely made up of the excrement that wild honeybees released on their "cleaning flights." Unresolved is the debate surrounding the instances involving the yellow rain.

Sverdlovsk, Russia, experienced an anthrax pandemic in April 1979. People who resided and worked close to the Compound 19 military microbiology facility in Sverdlovsk were affected by the disease. Additionally, a 50 km radius around the same location saw several cattle deaths from anthrax (12).

The laboratory was believed by US and European intelligence to be engaged in biological weapons research, and the pandemic was attributed to an unintentional anthrax spore discharge. In early February 1980, a tale about an incident that led to an anthrax cloud in a Russian military outpost in Sverdlovsk was published in the highly read German daily Bild Zeitung (13). In 1986, outside scientists were invited to Sverdlovsk to conduct an investigation after Matthew Meselson (Department of Molecular and Cellular Biology, Harvard University, Cambridge, Massachusetts) made repeated failed requests to Soviet officials (5,13).Eventually, four Soviet doctors who had been to Sverdlovsk to cope with the outbreak responded to this request by inviting them to travel to Moscow to talk about the tragedy. Following these discussions, it appeared that a solid case had been presented and that additional research into the epidemiology and pathoanatomical evidence was required. The former Soviet Union continued that eating tainted meat that was bought on the underground market was what started the anthrax outbreak (13).

The Russian president at the time, Boris Yeltsin, however, ordered his advisor for ecology and health to identify the cause of the pandemic in Sverdlovsk after the Soviet Union dissolved. Yeltsin acknowledged the facility's involvement in a programme to develop offensive biological weapons in May 1992. He also acknowledged that an unintentional anthrax spore release was what started the pandemic. According to a quotation from him, "The KGB acknowledged that our military accomplishments were the cause." To assist with these additional investigations, Meselson and his associates went back to Russia (13).A medical pathologist's notes of 42 autopsies that led to the anthrax diagnosis were among the material examined (14). Data on demographics, the environment, and the atmosphere were also examined. The pattern of these 42 fatal cases of anthrax bacteremia and toxaemia was determined to be consistent to inhalational anthrax as found in nonhuman primates that were experimentally infected. In conclusion, the outbreak was caused by an aerosol that began at Compound 19 based on the small area of animal and human anthrax cases that extended downwind from there (14).

According to a 1995 assessment, the Russian programme persisted after the incident in 1979 and briefly expanded in the 1980s. The programme continued to run in 1995 and employed between 25,000 and 30,000 persons (5). Several senior figures from the old Soviet military and Biopreparat had also defected to Western nations at the same time. These

former workers' information added to our understanding of the Soviet Union's biological weapons programme. Following the Sverdlovsk anthrax outbreak, an even more deadly strain of anthrax was created in a distant army facility in the secluded city of Stepnogorsk, Kazakhstan (5,13). The former Soviet Union increased the scope of its bioweapons research in 1980 and eventually succeeded in turning smallpox into a weapon. There is very little information known about the scope, results, and locations of this research, which was carried out at isolated sites in Siberia (5).

The United States and the coalition of ally nations faced the prospect of biological and chemical warfare during Operation Desert Shield, the build-up stage of the Persian Gulf War (Operation Desert Storm), after Iraq had invaded and captured Kuwait in the autumn and winter of 1990 (15). The knowledge of biological and chemical weapons accessible to the Western intelligence community was bolstered by observations made during the start of the Persian Gulf War in the late 1980s. In actuality, Iraq frequently employed chemical warfare on its own citizens in the 1980s (5). The Iraqi regime was believed to have backed an extremely sophisticated biological and chemical warfare programme, according to intelligence assessments from the period. In 1990–1991 coalition forces trained in protective masks and gear, practised decontamination procedures, received in-depth instruction on potential detection techniques, and immunised troops against possible biological warfare threats as part of their preparation for possible biological and chemical warfare. A new botulinum toxoid vaccination was given to 8000 US troops, and around 150,000 United States troops received anthrax toxoids that were approved by the Food and Drug Administration (11). The 500,000 US troops who were participating in the operation received a 1-month course of chemoprophylaxis with 30 million 500-mg doses taken by mouth of ciprofloxacin as additional defence against anthrax spores.

The first UN examination of Iraq's biological weaponry capabilities took place in August 1991, following the conclusion of the Persian Gulf War. Iraqi government representatives informed members of the UN Special Commissions Team 7 that their country has investigated the use of botulinum toxins,B. anthracis, and Clostridium perfringens for offensive purposes (15). Only a small portion of Iraq's enormous and redundant research facilities, which were located at Salman Pak, Al Hakam, and other locations, suffered damage during the war (5,15).

Despite the UN's extensive efforts, the BWC's enforcement was a problem far into the new millennium and into the late 1990s. The creation of biological and chemical weapons poses a serious threat, as the recent events in Iraq have demonstrated, and efforts to stop their spread are hampered by logistical and political issues. The BWC will continue to be a toothless tool in the possession of the UN Security Council as long as there are no specific procedures for enforcement. Private and non-governmental organisations have also tried to create, disseminate, and employ biological and chemical weapons as well as to these state-sponsored and military-related biowarfare programmes. One incidence was the Rajneeshee cult deliberately contaminating salad bars in cafes in Oregon in late September 1984 (7,13). There were 751 cases of severe enteritis recorded overall, and Salmonella typhimurium was found to be the etiological agent. During this outbreak, 45 individuals were hospitalised. Even though the Rajneeshees were considered suspects the Oregon Health Department and the Centres for Disease Control's intensive research and investigation were unable to definitively pinpoint the epidemic's starting point. But in 1985, a cult member acknowledged the attack and recognised the pandemic as a planned biological strike (13).Unfortunately, there have been a number of intentional uses of biological weapons recently. In the latter part of the 1990s, large amounts of the neurotoxic botox were found in a lab inside a Red Army Faction secure facility in Paris, France.

Evidently, the poison was never employed (13). In 1995, the Tokyo subway system was attacked with sarin gas, the bioterrorism danger reappeared. Following this occurrence, investigators turned up proof of a crude biological weapons program. The cult allegedly tried three unsuccessful biological assaults in Japan before March 1995 using botulinum toxin and anthrax. In 1992, members of a cult also tried to get the Disease in Zaire (11, 13)

It is also speculated that the recent episode of Corona induced pandemic can also be possibly an event of biological warfare. SARS-CoV-2, also known as COVID-19, is a brand-new coronavirus strain that hasn't been previously identified in humans. A sizable family of viruses known as coronaviruses can be found in both humans and animals. Some are known to cause illnesses in people, from the common cold to more serious disorders.

Biological warfare may be produced in the Wuhan Virology Lab at the Wuhan Institute of

Virology (WIV)(16). Washington Times published articles that asserted the virus was a component of a Chinese biological weapons program housed at the WIV (17). The BBC denied this assertion, and later the Washington Post debunked the conspiracy notion in a piece citing US authorities. Senator Tom Cotton of the United States once more indicated that the virus might have been a Chinese bioweapon in February (18). The rise in conspiracy ideas during a pandemic is not a new phenomena, according to prior research: Conspiracy thinking significantly rises, particularly during times of crisis. (19)

Biological weapons are exceptional in that they are undetectable and have long-lasting effects. These elements enable those who employ them to instil terror and bewilderment in their targets while escaping unnoticed. A biowarfare strike would seek to instill dread, panic, and paralysing uncertainty in addition to sickening and killing a huge number of people. It aims to impede military responses, disrupt social and economic activities, and undermine governmental authority.

CONCLUSION:

The choice of the bioweapon depends on the state or organization's economic, technological, and financial resources. It's possible that the Marburg virus, Ebola, and smallpox were picked because of their reputedly more terrible illnesses. Images of medical professionals and law enforcement officers in protective gear news/media reports might frighten and distract a large portion of the population.

Attacks using biowarfare have become a possibility. To improve the possibility of a cool-headed and reasoned reaction in the event of an outbreak, the modern medicine as well as the general population should become conversant with epidemiological studies and control measures. While the medical community analyses the issue of the spread of biological weapons, the ideas that aid physicians in developing countermeasures against illnesses are pertinent. It is relevant and essential for the medical world to continue its education with an emphasis on identifying this hazard.

The foundation of primary prevention is the establishment of a firm worldwide norm against the creation of such weapons. Secondary prevention entails early illness identification and timely medical intervention. By taking part in illness monitoring and reporting and so providing the earliest signal of the deployment of biological weapons, the medical community contributes significantly to secondary prevention. Further strengthening secondary preventive measures will come from ongoing research to enhance surveillance and the look for better diagnostic tools, therapeutics, and response strategies. Finally, it's crucial to remember the importance of prevention efforts, which lowers the risk of disease-related impairment.

ACKNOWLEDGMENT

Author is thankful to Principal, Hansraj College, University of Delhi for her constant support, guidance, and encouragement.

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