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Bioterrorism and Biological Warfare

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Abstract: ***Bioterrorism (BWs) is defined as the deliberately use of toxins and microbes, whom provenance is microbial, plant or animal resulting in illness and fatality to humans, livestock and agriculture and livestock. To assign bioweapons in war, and for use in terroristic attacks is credited to easy access to a comprehensive gamut of disease-producing biological pathogens, affordable inexpensive, not easily detected by routine security procedures, and ease in their transshipment from one place to another. Moreover, new advancements in novel and accessible technologies lead to the emergence of such weapons that have consequences for regional and global security. International consultation and co operation is required to obliterate threats, and in securing the culture and defense of peace. The major concern related to bioweapons is due to the rising number of countries that are embroiled in the proliferation of such weapons and their procural by terrorist groups.***

Keywords: Bioterrorism, Biological Warfare, Microorganisms, Bacteria, Toxins, plague, hemorrhagic Viruses

1. Introduction

Bioterrorism has been is clearly characterized as the intended use of a lethal microorganism or biological products to call forth harm to plants, human, animal, or any other living organisms to pressurize the government or to frighten off or terrorize common citizens . [1] Apart from the conventional weapons various countries have developed a variety of weapons of mass destruction e.g. Nuclear, chemical & biological weapons. Terrorists can get control of these weapons and can cause havoc. The concept of employing disease as a weapon has existed for centuries because biological agents are easy to develop as weapons, their lethal intensity is higher than the chemical weapons, cost effective and are not easily detected than nuclear weapons (2). These are some factors that have influenced a number of countries to pursue Biological Warfare (BW) throughout the 20th century. Epidemics caused by biological agents are not merely a public health issue but also a threat to national security. International agreements, such as Biological Weapons & Toxins Convention (BWC), have arguably done little to deter BW programs. [3] Sometimes the purpose is causing panic instead of destruction with mega bomb. Conventional bombs with nuclear waste which spread on detonation & people get panicky. Biological warfare & bioterrorism is a powerful tool in the hands of the states and terrorists. A bioterrorist can include any non-state actor who uses or threatens to use biological agents on behalf of a political, religious, ecological, or other ideological cause without reference to its moral or political justice. The reasons responsible for attraction towards bio weapons are as followed reasons; Firstly, due to its cost effectiveness – some time also called as the "poor man's atomic bomb"[4] .Other weapons of mass destruction like atomic bombs, conventional weapons & nerve-gas weapons, would cost approximately $2000, $800 & $600 per causality however, for Bioweapons, the cost would be about $1 per causality. Secondary, Easy access to an enormous range of disease producing biological Pathogens and agents. Tertiary, difficult to detect by routine security system and easy transportation. Quarterly-High fatality: among the toxic agents known biological toxins are the most toxic e.g. the quantity of Botox in the form of a dot is enough to kill ~10 people. Likewise one kilogram of anthrax powder has the potential of killing 100,000 people depending on the mechanism of delivery [5,6] Bioweapons have added advantage of destroying an enemy while leaving his infrastructure intact as a prize for the winner.

2. History of Bioterrorism

The conscious and intended use of lethal micro organism or morbific matter derived from them has been occurred over the centuries during war and peace time period by the militias, countries, consortia's and individual.[7,8,9] In 184 BC, Snakes were used by the Carthaginian soldiers led by Hannibal as a biological agents in the war against Eumenes King of Perganium to finagled victory and he won.[10,11] In300 BC, the drinking water supplies of the foes were polluted by the Greeks with animal corpses by the Greeks. In 1346, The Tartars catapulted Plague infected bodies into Caffa (now Ukraine) on the 3rd day of besiege. In a playlet ' *Philoctetes' written* by 'Sophocles' *(404 B.C.),* he describes Philocthetes as a main character wounded by a poisoned arrow on his way to the Trojan War. This may be legend or myth but maybe legend has its origins in reality. English word for poison or toxin is derived form the Greek word *toxikon,* which in turn is derived from the Greek word for arrow, *toxon.* The Scythians archers of the Black Sea employed poison-tipped arrows as delineated by Herodotus, Greek historian of the fifth century B.C .In his work he reported that Scythians put the decaying bod of various autochthonous poisonous adders, mixed them with human blood, animal dung into sealed pots and then buried these pots until the mixture was sufficiently putrefied. This poison would certainly contain the bacteria of gangrene and tetanus (*Clostridium perfrisngens* and *Clostridium tetani*) while the venom would attack red blood cells, nervous system and could even induce respiratory paralysis.[12]The inhabitants of Central and South America were The indigenous American population was decimated after contact with old world Spanish conquistadors which are accompanied by small pox and measles [13]. In (1754 – 1767) eighteenth century British doled out blankets used by small pox patients to the Native Americans resulting in utmost mortality in some tribes. Biological weapons were used against both

against the Mongolians & Chinese during II world war by Japanese in several military campaigns. [14] In 1940 the Japanese Army Air Force bombed Ningbo with ceramic bombs full of fleas carrying the bubonic plague. In 1942, two Chinese cities - Quxian and Ning-hsien, were bombard by unit 731 with 15 million plague infected fleas resulting in at least 120 deaths. Contamination of Water supplies and food items and water resources with B. anthracis, V. Cholera, Shigella spp., Salmonella spp. and Yersinia pestis. [15] In 1970, a revolutionary group Weather Underground of United states planned to obtain agents at Ft. Detrick by blackmail and to temporarily incapacitate United States cities to exhibit the impuissance of the government. In 1972 R.I.S.E.College students persuaded by ecoterrorist ideology and 1960's drug culture intended to use pathogens of typhoid fever, dysentery, diphtheria, and meningitis to target the whole world population initially and later narrowed the plan to five cities near Chicago. The attack was terminated when cultures were castoff. In 1978 Georgi Markov a Bulgarian defector was assassinated in Lauda, ricin-filled pellet was used with a spring-loaded device masked by an umbrella. In 1979 Sverdlovsk, Russia at least 77 cases and 60 deaths occurred due to the inhalation of anthrax which was accidently released from Soviet bioweapons facility. In 1984 Rajneeshee (Osho) religious cult deliberately contaminated 10 restaurant salad bars with *Salmonella typhi* which causes food poisoning in 751 individuals in Dallas, Oregon. [16] The plot was divulge when the cult slumped and members turned informants. The incident was the first and single largest bioterrorist attack in United States history. [17] Aum Shinrikyo is an extensive well financed alliance that was attempting to formulate biological weapons . Organizations like these were expected to cause the greatest harm, as they have access to scientific expertise, biological agents and most significantly to dissemination technology. In 1992 Some cabalist of this alliance had traveled to Zaire to cadge samples of Ebola virus. [18] In 1995 New age this Aum Shinrikyo were in criminal possession of huge quantities of nutrient media, anthrax cultures , botulinium toxin .This cult has seeked out to establish a theocratic state in Japan. They attempted at least 10 times to use anthrax, botulinum toxin, Q fever agent and Ebola virus in aerosol form. All attempts with biological weapons were unsuccessful.This Japanese cult Aum Shinrikyo intentionally released nerve gas Sarin in the Tokyo subway 12 were killed and 5500 were injured in that attack.[19] In 1991Minnesota members of Right wing "Patriot" movement obtained Ricin by mail order. They intended to deliver ricin through skin with DMSO and aloevera or as aerosol against IRS officials, US Deputy Marshals and local law enforcement officials. Group was sneaked by Federal Bureau of Investigation (FBI) informants. In 1997, Texas intended contamination of donuts and muffins with pure laboratory cultures of *Shigella dysenteriae* leads to the hospitalization of 4 workers and rest of 45 laboratory workers experienced gastroenteritis. In 1998, Larry Wayne Harris allegedly threatened to release "military grade anthrax" in Las Vegas, Nevada Obtained plague and anthrax (vaccine strains), repeatedly isolated several other bacteria. Made obscure threats against US federal officials in lieu of right wing "patriot" group.[20] In 2001,Unknown individual/group intentionally disseminated anthrax spores through the Postal System of US leading to the death of five people, infection of 22 others and contamination of numerous government buildings. Investigation regarding the attacks did not led to any conclusions so far. [21]

3. The Potential agents of Biological weapons and their threat

The agents having the capacity of biological terrorism includes bacterial, fungal and viral pathogens and toxins produced by living organisms. Biological agents are classified into 3 categories depending on their transmission, severity of morbidity and likelihood of use. A few of them are listed below in **table 1**(22, 23, 24)

Table 1: Some potential agents of bioweapons are listed in the table

Category		Bacteria	Toxins	Viruses
Category A	This category includes the highest priority agents that pose a risk to national security	*Bacillus anthracis*	Botulinium toxin	Small pox
		Yersinia pestis		
		Francisella tularensis		
		Clostridium Botulinium		
Category B	This category includes the second highest priority agents because they are moderately easy to disseminate	*Coxiella burnetii*	Ricin Toxin	Alpha virus
		Brucella Species	Epsilon toxin	Venezuelan equine encephalomyelitis
		Burkholderia mallei	Trichothecenes	Eastern equine encephalomyelitis
		Burkholderia pseudomallei	Chlorae toxin	
		Rickettsia promazekii	Enterotoxin B	
		Chlamydia psittaci	*C. perfringenes* toxin	
		Shigella dysenteria	T-2 Mycotoxins	
		Salmonella Species	Tetanus toxin	
		E.coli O157	Saxitoxin	
		Vibrio cholera	Tetrodotoxin	
		Cryptosporidium parvum	Toxin from blue green algae	
			Volkensin	
			Modescin	
Category C	This category includes the third highest priority emerging pathogens that could be engineered for mass dissemination	MDR Tuberculosis		Nipah virus
				Hanta virus,
				SARS.
				H1N1 strain of Influenza (Flu)
				Viral hemorrhagic fever

4. Biological Warfare and Bioterrorism

Biological, weapons possess the property of wreaking mass destruction. This broad practice of biological warfare probably arised from the fact that the agents of such warfare are biological in origin e.g., microorganisms toxic metabolites produced by microorganisms. Destruction of economic progress and stability is one of the main goals of biological warfare. The emergence of biowarfare as a weapon of mass destruction can be traced to the development in sciences and use of biological agents against economic targets such as crops, livestock and ecosystems. Moreover, such warfare can always be carried out under the covert of natural circumstances that lead to outbreaks of diseases causing havoc. There are numerous factors that make biological agents more lucrative for weaponization, and to be used by terrorists in comparison to chemical weapons or Dirty bombs. Production of biological weapons has a higher cost efficiency index these weapons does not require any massive financial investments as those required for the manufacturing of chemical and nuclear weapons. Again, invisible microgram pay loads of biological weapons causes' higher mortality than the bigger payloads of chemical and nuclear weapons. Delivery systems or application of biological weapons differ with those used for chemical and nuclear weapons to a great extent. Delivery systems of bioweapons against humans and animals ranges from the spraying of infective powders and aerosol sprays of dried spores and use of live vectors such as insects, pests and rodents .In the case of plants, spreading of plant disease is carried out via different delivery systems that includes propagative material such as contaminated seeds, root and plant tissue culture materials, organic carriers such as soil and compost dressing, and use of contaminated water .

Amongst all lethal weapons of mass destruction biological are the most feared are bioweapons because of its killing power. [25] Research pionerred by microbiologists and biotechnologists results in the development of a bioarmoury comprised of powerful antibiotics, toxoids, antisera, and vaccines to neutralize and eliminate a wide range of diseases. Despite the use of biological agents in military campaigns and wars, it is only since the mid- 1980s that the attention of the military intelligence has been attracted by the spectacular breakthroughs in the life sciences [26, 27]. The rise of bioterrorism is now a priority concern in the agendas of international concern and co-operation and is now being mirrored in the establishment of verification procedures to guard against contravention of the Biological and Toxin Weapons Convention, and in efforts in institutionalizing a desirable and much needed state of preparedness. [28] Conservationists and curators of biological diversity, public health officials, biosecurity and Biosafety personnel, and developing emergency preparedness provide convincing statements to continue to maintain live viral stocks for the preparation of new vaccines in protecting against the reappearance of virola major or virola minor as a result of either accidental release or intentional use in bioterrorism. The microbiological community and specially culture collections have an important role to play in educating the public to contain unexpected and sudden outbreaks of diseases through minimizing the easy acquisition of microbial cultures for use in bioterrorist threats. To countervail the illicit use of microbial cultures, obtained through either fallacious or veritable means, the microbiological community of course occupies a key role in answering the challenges posed in the making of bioweapons. Therefore there is a need for the development of a verification protocol that dissuades and discourages the violation of the Biological and Toxin weapon Convention.

5. Controlling and Managing System

The best way to belligerency with biological warfare and terrorism is to be embattled for a biological weapons attack. [29]By rising our preparedness to respond to biological weapons, many lives can be blest and terrorists denied their goal of creating swivet and havoc throughout the country. There is urgency of Biodefense systems and public health to protect against deadly disease outbreaks initiated by bioterrorists. Computer networks can aid in epidemiological investigations of unusual disease outbreaks pattern [30]. Rapid detection of a biological weapons attack will be aided by the creation of high-speed computing networks at the state level to analyze large volumes of data and to correspond rapidly with local and national health officials and other government agencies. Current anti bioterrorism tactical measures includes the devising of unconventional effective countermeasures to combat misuse of pathogens encountered naturally or in genetically modified form. [31]

6. Conclusion

Under the camouflage of natural outbreaks biological warfare can be used with impunity of disease to annihilate human population and to exterminate livestock and crops of economic significance by terrorists and rogue states. We must take provident steps to protect against biological weapons and to ensure that our responses effectively enhance global security. However, we must also make sure that actions to protect against biological warfare and bioterrorism do not detract from critical biomedical research and public health responses. Efforts should be made to provide training programs for first responders and for stockpiling of antimicrobials, antidotes, and vaccines to extenuate the impact of a bioterrorist attack. New antimicrobials, especially antivirals, and new protective vaccines are important components of biodefenses for both military and civilian populations. Improved detection methods and epidemiological capability to detect unusual disease outbreaks are also critical components of the public health infrastructure needed to protect against biological weapons. Given the threat of catastrophic terrorism, support must be provided to the public health community-its preparedness is essential to prevent mass casualties from bioterrorism. By strictly following to the Biological and Toxin Weapons Convention, reinforced by confidence-building measures is crucial and necessary step in protecting the humanity and reducing and eliminating the threats of biological warfare and bioterrorism

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