

Biological warfare, bioterrorism, and biocrime

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Abstract

Biological weapons achieve their intended target effects through the infectivity of disease-causing infectious agents. The ability to use biological agents in warfare is prohibited by the Biological and Toxin Weapon Convention. Bioterrorism is defined as the deliberate release of viruses, bacteria or other agents used to cause illness or death in people, but also in animals or plants. It is aimed at creating casualties, terror, societal disruption, or economic loss, inspired by ideological, religious or political beliefs. The success of bioterroristic attempts is defined by the measure of societal disruption and panic, and not necessarily by the sheer number of casualties. Thus, making only a few individuals ill by the use of crude methods may be sufficient, as long as it creates the impact that is aimed for. The assessment of bioterrorism threats and motives have been described before. Biocrime implies the use of a biological agent to kill or make ill a single individual or small group of individuals, motivated by revenge or the desire for monetary gain by extortion, rather than by political, ideological, religious or other beliefs. The likelihood of a successful bioterrorist attack is not very large, given the technical difficulties and constraints. However, even if the number of casualties is likely to be limited, the impact of a bioterrorist attack can still be high. Measures aimed at enhancing diagnostic and therapeutic capabilities and capacities alongside training and education will improve the ability of society to combat 'regular' infectious diseases outbreaks, as well as mitigating the effects of bioterrorist attacks.

Keywords: Biocrime, biological agents, biological warfare, bioterror, bioterrorism, bioweapons

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Introduction

Outbreaks of infectious diseases pose a constant threat to global health. Much attention is given to the emergence of relatively new or unknown pathogens, e.g. Middle East respiratory syndrome coronavirus and Zaire ebolavirus. More often, well-known pathogens such as poliovirus may lead to epidemics. Most epidemics emerge because of external, often climatological or geographical, factors. Sometimes, however, human interference with nature influences the spread of disease. Some zoonoses jump to a human host because the rainforest habitat of former animal hosts is reduced. Deforestation of mountainous areas may also lead to flooding of

populated areas, indirectly leading to outbreaks of cholera and other infectious diseases.

A very special category of human-made outbreaks of disease is the manipulation and distribution of pathogens with the intention of disrupting societies. This may be part of government policy in biological warfare (BW), but is also a means used by terrorist groups or criminals. Although sporadic, the deliberate use of biological agents can lead to general anxiety. We aim to provide a very brief historical overview of the use of biological agents in warfare and terrorist or criminal activity, in the perspective of international regulations, early detection strategies, and coordinated preventive activities. Subsequently, the requirements for deliberate use of a potential biological agent are described, followed

by a summary of lessons learnt from bio-agents used as such in the past. We conclude with trends in, predominantly, bioterrorism, and propose a future approach to deal with an unpredictable, but potentially highly disruptive, threat.

Biological Weapons and BW

The Geneva protocol, ratified as early as 1925 and currently signed by 65 of 121 states, prohibits the development, production and use in war of biological and chemical weapons [1]. The WHO identified the threat of biological and chemical warfare officially in the midst of the Vietnam War and Cold War, after UN resolution 2162B (XXI) was adopted in 1967, condemning all actions contrary to the Geneva protocol. This resulted in the 1970 WHO report 'Health aspects of chemical and biological weapons', updated in 2004 [2] into WHO guidance 'Public health response to biological and chemical weapons'. This WHO document focuses on detecting and responding to unusual disease outbreaks. Important recommendations are standardized surveillance and the provision of adequate healthcare in cases of such emergencies. In the WHO definition, biological weapons achieve their intended target effects through the infectivity of disease-causing microorganisms and other such entities, including viruses, infectious nucleic acids, and prions. The 2004 WHO guidance is mainly concerned with the effects of such pathogens on human beings.

BW is carried out by nation states that seek to undermine the will and abilities of an opponent to fight back. Thus, they may seek to kill or make ill large numbers of the opponent's armed forces, population, crops and livestock by the release of biological agents.

Historically, until World War II, the number of soldiers dying from disease far outweighed the number killed in combat [3,4]. Although the numbers of soldiers dying from both combat and disease have been much reduced by advances in military healthcare and casualty extraction, morbidity in relatively modern wars (95% of US hospital admissions in World War II and 82% of those in the Korean war) has been related to soldiers being incapacitated because of disease and non-battle injuries rather than because of combat actions [3]. For example, malaria alone contributed to 56–75% of all hospital admissions of US Forces in the Vietnam War [5]. It is therefore not surprising that the impact of disease on the ability of an opponent to fight was recognized by the Romans and probably before that, and BW has been carried out in the past by trying to foster an outbreak. Some examples are the catapulting of manure, bodies of dead plague victims or cattle into besieged cities in medieval times, the distribution of blankets from smallpox victims to the native American Indian

population in the eighteenth century, the use of shigella and cholera organisms to poison wells, and the distribution of plague-contaminated fleas by Japanese troops in Manchuria and China during World War II [6–8]. It is probable that examples of retreating troops using dead animals or manure to poison water sources can be found in any war. The discovery of the pathogenic abilities of microorganisms in the 19th century by Pasteur, Koch and others gave insights into the manner of transmission of diseases. It led to the development of industrial-scale microbiology and great advances in ways to prevent and treat infectious diseases, with tremendous benefits for humankind. However, ironically, it also provided insights into ways to misuse this knowledge.

Nowadays, being much less hampered by technical considerations and only inhibited by international opinion or fear of retaliation, nations have a wide number of options to carry out an offensive biological weapons programme. From 1928, a number of nations had offensive biological warfare programmes, and most likely some still do [9]. The USA (until 1972) and, most notably, the former Soviet Union (until 1992) had large and highly developed biological warfare programmes. Both nations developed ten or more agents, including toxins, weaponized to kill or incapacitate humans and to destroy crops and livestock [8,10,11]. The ability to use biological agents in warfare is prohibited by the Biological and Toxin Weapon Convention (BTWC). Since 1972, nations have not been allowed to carry out research to develop biological weapons, or to produce and stockpile them. The BTWC has been signed and ratified by 170 nations. Having said that, the BTWC has no inspection mechanisms, and a biological weapons research and production programme is relatively easy to hide within a nation's biotechnological infrastructure. Furthermore, the Biological Weapons Convention requires, in Article I, of nations who have signed not to 'develop, produce, stockpile or otherwise acquire or retain microbial or other biological agents, or toxins whatever their origin or method of production, of types and in quantities that have no justification for prophylactic, protective or other peaceful purposes'. As such, the convention does not specifically define which agents or toxins are prohibited, and what quantities would go beyond the justification. Regardless of whether or not nations have ratified the BTWC, it is fairly certain that a number of rogue nations or those willing to risk international outrage are secretly carrying out BW research.

Bioterrorism and Biocrime

According to the CDC, bioterrorism is defined as the deliberate release of viruses, bacteria or other agents used

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