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The Effects of Biological Weapons on Human Health: A Comprehensive Review

ORIGINAL ARTICLE



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Abstract

Biological weapons, agents that use pathogens or toxins to cause injury or death in humans, animals, or plants, have raised immense concerns about public health and international security. Despite all the international efforts to outlaw their use, the menace of biological warfare remains an issue of persistence. The current study reviews the most critical biological agents used in wars, such as anthrax, smallpox, botulinum toxin, and plague, while at the same time considering the health implications to the individual and the community. This examination looks at the immediate and long-term effects of biological weapons on human health, based on the underlying biological processes. In addition, this analysis addresses the challenges associated with the diagnosis, treatment, and prevention of diseases caused by biological weapons, emphasizing the need for public health preparedness and international cooperation in mitigating these risks.

Key Words

Biological Weapons, Anthrax, Attacks, Public Health, Weapons, Biological Agents.

Introduction

Biological weapons, also known as bioweapons, are microorganisms or infectious agents (like bacteria, viruses, or fungi), their products (toxins), or other pathogens used intentionally to cause disease or death in people, animals, or plants. These weapons represent one of the most subtle and dangerous forms of warfare, using the harmful infectious or toxic potential of biological agents to cause massive destruction. Unlike chemical and nuclear weapons, biological agents often present themselves undetected until the symptoms appear and, therefore, are tricky to detect and contain. Bioweapons have dangerous effects on human health often leading to severe illness or organ failure, high mortalities, and long-lasting psychological and physical effects on victims. The most dangerous of bioweapons are therefore those that can easily become aerosols, have low infective dose, and that are highly contagious. (Anderson & Bokor, 2012) The consequences of employing bioweapons can be extensive, inducing fear and disorder that extend beyond mere physical destruction.

The use of biological agents as weapons has roots more than 2,000 years old, long before the time when scientific understanding of bacteria, toxins, or viruses was established. Such agents have been used throughout history, especially in World Wars, and international security is still significantly plagued by the possibility of such applications. Notwithstanding the worldwide prohibition against biological warfare implemented by the 1975 Biological Weapons Convention (BWC), the advances in biotechnology have

generated fears that these weapons will be used in acts of terrorism or within state-sponsored military action. During the last century, developments in advanced biotechnology have allowed the design and production of ever more dangerous and potent bioweapons. (Cenciarelli *et al.*, 2013) The threat of bioterrorism, as applied against civilian populations, has emerged as a rising international concern. (Cenciarelli *et al.*, 2013) (Ramasamy&Prorok, 2010). This paper explores the various biological agents used as weapons and their respective health effects.

Biological Agents Used in Warfares

1. Anthrax (*Bacillus anthracis*)

Anthrax is a bacterium infection caused by *Bacillus anthracis*, with the capability of being communicated through inhalation, ingestion, or dermal contact, resulting in severe respiratory distress, systemic infection, or localized necrosis correspondingly (Inglesby *et al.*, 2002). When used as a biologic weapon, anthrax spores are specifically prepared for inhalation, and the disease ensuing is grim and often lethal. The disease often begins with symptoms including fever, malaise, and respiratory failure and can rapidly progress to septic shock and death if not promptly treated. Inhalational anthrax is highly lethal with a mortality rate approaching 100% unless treated immediately. The US anthrax incidents in 2001 brought home the dangers posed by intentional anthrax deployment as a form of bioterrorism, with the loss of several lives and widespread public fear.

2. Smallpox (*Variola virus*)

A highly contagious virus that causes generalized pustular eruptions, high fever, and a high case fatality rate (Henderson *et al.*, 1999). Smallpox, caused by the *Variola virus*, is one of the deadliest infectious diseases in human history. Although smallpox was eradicated from the entire world through vaccination by 1980, its potential use as a biological weapon is still of concern. The disease manifests as fever, malaise, and a characteristic rash that becomes scabs. Smallpox is characterized by an important case fatality ratio, particularly among young children and immunocompromised persons. In the case of a weaponized version caused outbreak, the impact will be disastrous, and more people may die or get seriously ill within the unvaccinated populations. Therefore, as a very contagious and virulent disease, smallpox is still considered a key biodefense agent.

3. Botulinum Toxin (*Clostridium botulinum* toxin)

Botulinum toxin is a neurotoxin that disrupts nerve function. This specific toxin, produced by *Clostridium botulinum*, is one of the most potent toxins known to humans. It causes botulism, a disease characterized by paralysis, potential respiratory failure that can be fatal, and potentially leads to death (Arnon *et al.*, 2001). Even small amounts of botulinum toxin can cause death, and its effects are particularly dangerous because of the difficulty in diagnosing and treating botulism in the early stages. The toxin can be weaponized in aerosol or food forms, leading to mass casualties. The use of botulinum toxin in bioterrorism or biological warfare is of great concern due to its high lethality and potential for large-scale impact.

4. Plague (*Yersinia pestis*)

Plague, caused by the bacterium *Yersinia pestis*, is transmitted by fleas and can result in severe illness, including bubonic, septicemic, and pneumonic plague. The pneumonic form of the disease would be very dangerous in biological warfare because it can easily be spread from person to person by respiratory droplets. There have been outbreaks throughout history with significant deaths, such as during the Black Death in the 14th century. In fact, weaponized plague would have the potential to yield high mortality rates and overwhelm healthcare.

Health Effects of Biological Weapons

Biological weapons can have wide-ranging effects on human health, both in the short and long term. The immediate health effects depend on the type of agent used, the method of exposure, and the health status of the individuals exposed.

1. Acute Health Effects

The acute health effects of biological weapon exposure include severe respiratory symptoms, fever, vomiting, diarrhea, and systemic shock. Acute effects of exposure vary depending on the agent. For example, inhalational anthrax causes respiratory distress, fever, and cyanosis. It has a high mortality rate if untreated, often presenting with flu-like symptoms that rapidly progress to severe respiratory distress (Meselson *et al.*, 1994). Botulinum toxin exposure results in paralysis, and plague can cause sudden fever, chills, and swollen lymph nodes. Smallpox exposure can result in fever, malaise, and a characteristic rash, with complications such as encephalitis in severe cases (Henderson *et al.*, 1999).

2. Chronic Health Effects or Long-Term Health Effects

Survivors of biological weapon exposure may experience long-term health effects, including neurological damage, chronic respiratory issues, and psychological trauma. In the case of anthrax, survivors of inhalational anthrax may experience residual lung damage, while botulinum toxin can result in lasting neurological deficits. Additionally, individuals have Persistent psychological trauma, including post-traumatic stress disorder (PTSD), in survivors of biological attacks (DiGiovanni, 1999).and other mental health issues, particularly in the wake of a large-scale attack.

3. Psychosocial and Societal Impact

The psychosocial impact of biological weapons extends beyond the direct health consequences, as the fear of contagion, isolation, and death can lead to widespread panic and societal disruption. The stigma associated with infectious diseases can further exacerbate social divisions, leading to long-term societal trauma. Historical accounts, such as the anthrax letter attacks in the United States in 2001, highlight significant anxiety and mistrust within affected communities (Tucker, 2002). Misinformation and stigma often exacerbate the societal burden, disrupting healthcare systems and economies.

Historical Examples and Epidemiological Insights

The 2001 Anthrax Attacks

In 2001, powdered anthrax spores were delivered via mail to individuals in the United States, resulting in 22 infections and 5 deaths. This event underscored the ease of dissemination and the challenges of rapid diagnosis and treatment (Jernigan *et al.*, 2002).

Sverdlovsk Anthrax Outbreak (1979)

An accidental release of anthrax spores from a Soviet bioweapons facility in Sverdlovsk caused at least 66 deaths. This incident provided critical data on aerosolized anthrax dispersal and human susceptibility (Meselson *et al.*, 1994).

Preparedness and Mitigation Strategies

Effective responses to biological weapon attacks require:

- **Early Detection:** Development of rapid diagnostic tools for bioagents.
- **Vaccination Programs:** Prophylactic vaccines, such as those for anthrax and smallpox, are crucial.
- **Public Health Infrastructure:** Investment in robust surveillance and emergency response systems.
- **International Cooperation:** Strengthening frameworks like the Biological Weapons Convention to prevent proliferation (Wheeliset *al.*, 2002).

Challenges in Diagnosis, Treatment, and Prevention

Biological weapons are associated with many challenges that relate to diagnosis, treatment, and prevention. Treating the situation will largely depend on whether exposure to the biological weapons occurs early enough. However, most biological agents often produce nonspecific symptoms during the initial stages. This makes it

difficult to distinguish between a natural outbreak and an intentional attack:

- 1. Diagnosis:** Rapid diagnostic tests are essential for identifying biological agents, but they are often not readily available in the field. Surveillance systems and diagnostic laboratories must be equipped to handle potential biological warfare agents.
- 2. Treatment:** The treatment varies with the agent used. Antibiotics ciprofloxacin and doxycycline would be effective in managing acute bacterial infections such as anthrax and plague if administered immediately after exposure. For intoxications with botulinum toxin, antitoxin therapies are available; these interventions are limited by timing for administration. Although eradicated, smallpox presents no treatment that universally would work; however, treatment with antivirals and supportive care could reduce symptoms from occurring if provided promptly.
- 3. Prevention:** The prevention of biological warfare would depend upon international cooperation and enhancing biodefense capabilities. If available, vaccination is the best form of prevention. For example, smallpox vaccination is considered protective against the virus, and pre-exposure prophylaxis with antibiotics may help combat anthrax. The outbreaks will be controlled through quarantine and mass vaccination campaigns.

Conclusion

Biological weapons are among the biggest threats to human health and can cause severe morbidity, mortality, and social disruption. A look into their mechanisms, effects, and history of use underscores the need to fortify public health preparedness and international controls. Impacts of biological warfare reach further than immediate health consequences to include long-term physical and psychological effects on individuals and communities. Strong international cooperation is needed in the prevention, diagnosis, and management of diseases attributed to biological weapons. Unrelenting research and coordination are essential in diminishing threats from these weapons and the protection of public health for the world. Although prohibited worldwide, the threat is ongoing, and alertness needs to be sustained to protect health security globally.

References

1. Anderson, P., & Bokor, G. (2012) Bioterrorism: Pathogens as Weapons. In P. Anderson & G. Bokor, *Journal of Pharmacy Practice* (Vol. 25, Issue 5, p. 521). SAGE Publishing. <https://doi.org/10.1177/0897190012456366>
2. Arnon, S.S.; Schechter, R.; Inglesby, T.V.; Henderson, D.A.; Bartlett, J.G.; Ascher, M.S.; Eitzen, E.; Fine, A.D.; Hauer, J.; Layton, M.; Lillibridge, S.; Osterholm, M.T.; O'Toole, T.; Parker, G.; Perl, T.M.; Russell, P.K.; Swerdlow, D.L. & Tonat, K. (2001). Botulinum toxin as a biological weapon: medical and public health management. *JAMA*, 285:1059-1070. .
3. BWC (1975). *Biological Weapons Convention*. United Nations.
4. Dembek, Z. F., *et al.*,. (2017). Plague as a Biological Weapon. *Emerging Infectious Diseases*, 23(2), 170-177.
5. DiGiovanni, C. (1999). Domestic terrorism with chemical or biological agents: Psychiatric aspects. *The American Journal of Psychiatry*, 156(10), 1500-1505.
6. Henderson, D. A. (2009). Smallpox: Emergence, Global Spread, and the Eradication Effort. *Infectious Disease Clinics of North America*, 23(3), 525-535.
7. Henderson, D. A., Inglesby, T. V., Bartlett, J. G., *et al.* (1999). Smallpox as a biological weapon: Medical and public health management. *JAMA*, 281(22), 2127-2137.

8. Inglesby, T. V.; *et al.*, (2002). Anthrax as a Biological Weapon: Medical and Public Health Management. *JAMA*, 287(17), 2236-2252.
9. Inglesby, T. V.; Henderson, D. A.; Bartlett, J. G.; *et al.* (2002). Anthrax as a biological weapon: Updated recommendations for management. *JAMA*, 287(17), 2236-2252.
10. Jernigan, J. A.; Raghunathan, P. L.; Bell, B. P.; *et al.* (2002). Investigation of bioterrorism-related anthrax, United States, 2001: Epidemiologic findings. *Emerging Infectious Diseases*, 8(10), 1019-1028.
11. Kaufman, A. (2010). Botulinum Toxin: The Weapon of the Future. *Emerging Infectious Diseases*, 16(12), 1869-1875.
12. Meselson, M., Guillemin, J., Hugh-Jones, M., *et al.* (1994). The Sverdlovsk anthrax outbreak of 1979. *Science*, 266(5188), 1202-1208.
13. Ramasamy, M., & Prorok, B. C. (2010). Resonance Behavior of Magnetostrictive Sensor in Biological Agent Detection (p. 535). <https://doi.org/10.1115/imece2010-37162>
14. Sandrock, C. (2013). Biowarfare and Bioterrorism [Review of Biowarfare and Bioterrorism]. *Critical Care Clinics*, 29(3), 717. Elsevier BV. <https://doi.org/10.1016/j.ccc.2013.03.015>
15. Tucker, J. B. (2002). Biological threats: Past and present. *Arms Control Today*, 32(4), 9-15.
16. Wheelis, M., Röttingen, J. A., & Dando, M. (2002). Biological warfare at the 21st century: Threat and response. *Science*, 298(5599), 1029-1032.

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