REVIEW ARTICLE

A Dentist Role against Bioterrorism- An Overview

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ABSTRACT

Bioterrorism is terrorism involving the intentional release or dissemination of biological agents (viruses, bacteria, and fungi) or toxins to produce disease and death in humans, livestock, and crops, their attraction in war and for use in terrorist attacks. Biological weapons can be disseminated by aerosol sprays, explosives, or food and water contamination. The preparedness against these agents needs complete knowledge about the disease, better research, training, and diagnostic facilities. Bioweapons are potentially hazardous, and failure in recognition of any of these attacks can lead to devastation. The dental profession could potentially play a significant role in the emergency response to a major bioterrorism attack.

Keywords: Biological agents, Bioterrorism attack, Bioterrorism, Bioweapons, Dental profession

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INTRODUCTION

Bioterrorism is defined as the terrorism involving the intentional release or dissemination of biological agents. These agents (bacteria, viruses, or toxins) may be in a naturally occurring or a human-modified form. In other words, a Bioterrorism attack is the deliberate release of viruses, bacteria, toxins, and other harmful agents used to cause illness or death in people, animals, or plants. These agents are typically found in nature, but it is possible that they could be mutated or altered to increase their ability to cause disease, make them resistant to current medicines, or to increase their ability to spread into the environment.[1]

The routes of entry of biological weapons into the human body are mainly inhalation, contact (skin/mucous membrane), and the gastrointestinal tract. Methods of delivery could be through bomblets delivered by aircrafts or use of spray tanks mounted on aircrafts/tall buildings. The agents of anthrax, plague, brucellosis, smallpox, viral encephalitides, and viral hemorrhagic fevers can be aerosolized and distributed over large geographic areas.[2]

Bioterrorism covers a very broadspectrum of concerns, from catastrophic terrorism with mass casualties, to micro-events using low technology but producing civil unrest, disruption, disease, disabilities, and death. The threat of bioterrorism, long ignored and denied, has heightened over the past few years.[3]

The WHO has defined biological warfare agents as ones that depend for their effects on multiplication within the target organism and that are intended for use in war to cause disease or death in man, animals, or plants.[4]

HISTORICAL PERSPECTIVE

Biological terrorism dates back to Ancient Rome when feces were thrown into faces of enemies.[5] The early version of biological terrorism continued into the 14th century where the bubonic plague was used to infiltrate enemy cities, both by instilling the fear of infection in residences, in the hope that they would evacuate, and also to destroy defending forces that would not yield to the attack.[6]

Some of the bioterrorist attacks are:

- The use of biological weapons in the 6th century B.C. when contamination of water supply with the fungus *Claviceps purpurea* (rye ergot) by the Assyrians.
- The hurling of the dead bodies of plague victims over the walls of the city of Kaffa by the Tartar army in 1346 and the spreading of smallpox through contaminated blankets by the British to the Native American population loyal to the French in 1767 are the most frequently cited episodes of poisoning.
- In the recent past, mycotoxins (fungal toxins) were reported to have been used in Afghanistan in the form of "yellow rain."
- The growth of religious cults and extremist political groups also increases the threat of bioterrorism today.
- The most significant biological attack in the United States (US) was the intentional contamination of restaurant salad bars with Salmonella by a religious cult in Oregon in 1984.
- In 1992, Russia had the ability to launch missiles containing weapons-grade smallpox. A number of

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terrorist organizations, including Al-Qaeda, have explored the use of biological agents.
- In 1995, Sarin gas was released in a Tokyo subway, by the religious sect Aum Shinrikyo, which immediately killed 12 and hospitalized 5000 people.
- In September 2001, the American public was exposed to anthrax spores as a bioweapon delivered through the US postal system. The centers for disease control and prevention (CDC) identified 22 confirmed or suspected cases of anthrax during this attack.[7]

Classification of Biological Agents

The CDC has developed a classification system in which each potential agent was categorized.

Category A

A high priority agent which includes organisms that pose a risk to national security.

These agents:
- Can be easily disseminated.
- Cause high mortality.
- Cause public panic and social disruption.
- Require special action for public health preparedness.

This category includes:

Smallpox

A highly contagious virus, caused by the DNA virus, Variola major transmitted through inhalation of droplets. 14 days after infections, patients usually complaints of high fevers, headaches, prostration, and myalgias. Then, a diffuse maculopapular rash appears leaving pustules that deflate and form scabs resulting in areas of the exposed dermis and subcutaneous tissue. Death usually occurs 6 days after the onset of the rash.[8] It is one of the highest-threat bioterrorism agents, and its infection-control measures include early detection, isolation of infected persons, and public health surveillance of contacts.[9] In the 1970s, a vaccination program against smallpox was introduced worldwide, and smallpox was eradicated.[10] Smallpox occurs only in humans and has no external hosts or vectors.[11]

Anthrax

Caused by the spore-forming bacterium *Bacillus anthracis*, a non-contagious disease. occurs in three clinical forms:
1. Cutaneous anthrax - when spores come in contact with the skin and develop into black lesions, and it occurs most commonly with the handling of infected animals.
2. Gastrointestinal anthrax - it occurs by the consumption of infected animal products and undercooked/raw meat.
3. Respiratory anthrax - it is caused by the inhalation of spores through respiration.[12]

It can be diagnosed by blood culture and enzyme-linked ImmunoSorbent Assay. In its earliest stage, anthrax can be treated with penicillin (IV), tetracycline, ciprofloxacin, or doxycycline. This treatment is effective only in the early stage of the disease, and it is ineffective in the later stages with severe complication. A new method, recombinant proteins mainly the recombinant protective antigen are used effectively to protect human anthrax and are widely available in many countries. The disadvantage of recombinant protein-based vaccines is need of yearly booster doses, short protective efficacy, side effects, and poor tolerance in individuals.[13] When exposed to anthrax, a prophylactic measures of oral ciprofloxacin or doxycycline must be administered for 4 weeks. Anthrax was used in a series of attacks on the officers of several United States Senators in late 2001. The anthrax was in a powder form and delivered by the mail.[14]

Tularemia

It is also called "mild plague," "market men's disease," and "deer fly fever" caused by Francisella tularensis.[15] Tularemia can present in ulceroglandular, glandular, oculoglandular, oropharyngeal, typhoidal, and pneumonic forms. Pneumonic tularemia is the most severe form of tularemia.[16] The onset of symptoms is rapid, and it includes fever, headache, myalgia, sore throat, nausea, vomiting, diarrhea, and dry or slightly productive cough. If Francisella tularensis was used as a weapon, the bacteria would likely be made airborne for exposure by inhalation. The bacteria that cause tularemia occurs widely in nature and could be isolated and grown in quantity in a laboratory.[17,18] The treatment options for tularemia are aminoglycosides, fluoroquinolones, and chloramphenicol.

Botulism

Botulinum produced by the bacterium *Clostridium botulinum* is the most deadliest toxin. Botulism causes death by respiratory failure and paralysis.[19] Diagnosis is difficult as the toxin is not detectable in the serum or stool except in the nasopharynx where it is detectable 24 h after inhalation.[20]

Plague

It is also called as the "black death." It is caused by *Yersinia pestis*. The disease is transmitted to humans by the flea bites and by aerosol in the form of pneumonic plague.[21] Plague mostly presents as the bubonic form but can also appear as septicemic or pneumonic forms.[22] Pneumonic plague can lead to death within

24 h of symptom onset. Options for treatment include streptomycin, doxycycline, and chloramphenicol.[23]

Viral hemorrhagic fevers

These are those hemorrhagic fevers which are caused by the Filoviridae (Marburg and Ebola) and Arenaviridae (Lassa fever and the Bolivian hemorrhagic fever). Death due to Ebola is common because of the multiple organ failure and hypovolemic shock.[24]

Category B

These agents are moderately easy to disseminate, cause moderate morbidity, require enhanced disease surveillance, and public health diagnostic capacity. This category includes Brucellosis (Brucella species), Cholera (*Vibrio cholerae*), Cryptosporidiosis (*Cryptosporidium parvum*), Epsilon toxin of *Clostridium perfringens*, Food safety threats (Salmonella species, *Escherichia coli* O157:H7, and Shigella), Glanders (*Burkholderia mallei*), Melioidosis (*Burkholderia pseudomallei*), Psittacosis (*Chlamydia psittaci*), Q fever (*Coxiella burnetii*), Ricin toxin from *Ricinus communis* (castor beans), *Staphylococcal enterotoxin* B, Typhus fever (*Rickettsia prowazekii*), and *Viral encephalitis* (e.g., Venezuelan equine encephalitis, eastern equine encephalitis and western equine encephalitis).[25]

Category C

These agents include emerging pathogens which could be engineered for mass dissemination in the future and which have potential for high morbidity, mortality, and major health impact. Examples are human immunodeficiency virus, Nipah virus, Henta Virus, and H1N1 strain of influenza virus. Critical biological agent's categories are shown in Table 1.

Dentist Role in Response to Bioterrorist Attack

As dental professionals are an integral part of the health-care community, they can provide care to the public by playing various health-care roles in response to bioterrorist attacks. The dental professionals should be educated regarding the medical and oral manifestations of the diseases that result from a bioterrorist attack. Dentist can educate their patients and correct misinformation that may be circulating throughout the general public. When hospitals become overwhelmed, dental offices can be prepared to serve as decentralized auxiliary hospitals as dental offices are equipped with potentially useful equipments such as sterilization equipment, air and gas lines, radiology capabilities, suction equipment, instruments, and needles. When the nature of the attack has been determined, dentists can provide an individual patient diagnosis by observing the physical and behavioral signs that people manifest. Dentists trained in forensic odontology will work closely with local disaster mortuary operational response teams.[26] A local surveillance may be provided by the dentists to detect any spreading of disease beyond the original area of attack or re-emergence of infections in the original attack area.

Some of the important services dentists may provide includes:

- Dentist can detect characteristic intraoral and cutaneous lesions and report it to public health authorities.
- Providing and assisting in the administration of anesthesia.
- Starting intravenous lines.

Table 1: Critical biological agent's categories

Category A agents	Category B agents	Category C agents
Bacillus anthracis (anthrax) *Clostridium botulinum* (botulism) Variola major (smallpox) Ebola virus (Ebola and hemorrhagic fever) *Yersinia pestis* (Plague) Filoviruses *Francisella tularensis* (tularemia) Arenavirus Lassa virus (Lassa fever) Marburg virus (Marburg hemorrhagic fever) Junin virus (Argentinian hemorrhagic fever and related viruses).	Alphaviruses Eastern and western equine encephalomyelitis viruses (EEE and WEE) Venezuelan equine encephalomyelitis virus (VEE) Brucella species (brucellosis) *Burkholderia mallei* (glanders) *Coxiella burnetii* (Q fever) Epsilon toxin of *Clostridium perfringens* Ricin toxin from *Ricinus communis* Staphylococcal enterotoxin B A subset of Category B agents includes pathogens that are food or waterborne. These pathogens include but are not limited to: *Cryptosporidium parvum* *Escherichia coli* O157:H7 *Salmonella species* *Shigella dysenteriae* *Vibrio cholera*	Hantaviruses Nipah virus Multidrug-resistant tuberculosis Tickborne encephalitis viruses Tickborne hemorrhagic fever viruses Yellow fever

- Treatment of cranial and facial injuries.
- Performing appropriate surgery and suturing.
- Assisting in stabilizing patients.
- Assisting in shock management.
- Collecting pre-antibiotic blood samples.
- Taking medical histories and,
- Providing cardiopulmonary resuscitation.

CONCLUSION

Dentists can play an important role in protecting themselves, their patients and the communities by providing quality information about the potential for attacks, what to watch for, and how to respond appropriately when an attack occurs. Dental schools must have a major obligation in preparing future dentists to fulfill appropriately the responsibility to play a significant role in response to bioterrorism. Dental schools should train all students in a core set of competencies related to bioterrorism and provide additional opportunities for further education.

REFERENCES

1. Centers for Disease Control and Prevention, USA: Bioterrorism Overview. Available from: http//www.bt.edc.gov/bioterrorism/overview.asp.[Last accessed on 2017 Sep 15].
2. Shea DA, Lister SA. The Bio Watch Program: Detection of Bioterrorism. Congressional Research Service; 2003; Report No. RL 32152. Available from: http://www.fas.org/sgp/crs/terror/RL32152.html. [Last accessed on 2003 Nov 19].
3. Hamburg MA. Addressing bioterrorist threats: Where do we go from here? Emerg Infect Dis 1999;5:564-5.
4. World Health Organisation. Draft second edition of Health Aspects of Chemical and Biological Weapons: Report. Geneva: WHO Group of Consultants; 2001.
5. Available from: http://www.answers.com/bioterrorism. [Last accessed on 2017 sep 15].
6. Available from: http://www.wikipedia.com/bioterrorism. [Last accessed on 2017 Oct 10].
7. Lane HC, Fuci AS. Microbial bioterrorism. In: Kasper DL, Braunwald E, editors. Harrison's Principle of Internal Medicine. 16th ed. New York: McGraw Hill; 2005. p. 1279-88.
8. Chopra K, Conde-Green A, Folstein MK, Knepp EK, Christy MR, Singh DP, *et al.* Bioterrorism: Preparing the plastic surgeon. Eplasty 2011;11:e47.
9. Henderson DA. Smallpox: Clinical and epidemiologic features. Emerg Infect Dis 1999;5:537-9.
10. What CDC Is Doing to Protect the Public From Smallpox. Available from: http://www.emergency.cdc/agent/smallpox/prep/cdc-prep.asp. [Last accessed on 2017 Aug 10].
11. CDC Botulism. Available from: http://www.emergency.cdc.gov/agent/botulism. [Last accessed on 2017 Oct 21].
12. O'Brien K, Higdon ML, Halveerson JJ. Recognition and management of bioterrorism infections. Am Fam Physician 2003;67:1927-34.
13. Thavaselvum D, Vijayaraghavan R. Biological warfare agents. J Pharm Bioallied Sci 2010;2:179-88.
14. Dewan PK, Fry AM, Laserson K, Tierney BC, Quinn CP, Hayslett JA, *et al*. Inhalational Anthrax Outbreak among Postal Workers. Vol. 8, No. 10. Washington, D.C: Emerging Infectious Diseases; 2002.
15. Dennis DT, Inglesby TV, Henderson DA, Bartlett JG, Ascher MS, Eitzen E, *et al.* Tularemia as a biological weapon: Medical and public health management. JAMA 2001;285:2763-73.
16. Feldman KA, Enscore RE, Lathrop SL, Matyas BT, McGuill M, Schriefer ME, *et al.* An outbreak of primary pneumonic tularemia on martha's vineyard. N Engl J Med 2001;345:1601-6.
17. Centers for Disease Control and Prevention, USA: Tularemia. Available from: http://www.bt.cdc.gov/agent/tularemia. [Last accessed on 2017 Sep 11].
18. Available from: http://www.bt.cdc.gov/agent/tularemia/facts.asp. [Last accessed on 2017 Aug 30].
19. CDC Botulism Factsheet. Available from: http://www.emergency.cdc.gov/agent/botulism/factsheet.asp. [Last accessed on 2018 Jan 20].
20. Franz DR, Jahrling PB, Friedlander AM, McClain DJ, Hoover DL, Bryne WR, *et al.* Clinical recognition and management of patients exposed to biological warfare agents. JAMA 1997;278:399-411.
21. CDC Plague. Available from: http//www.cdc.gov/agent/ncidod/dvbid/plague/index.htm. [Last accessed on 2018 Mar 10].
22. Inglesby TV, Dennis DT, Henderson DA, Bartlett JG, Ascher MS, Eitzen E, *et al.* Plague as a biological weapon: Medical and public health management. Working group on civilian biodefense. JAMA 2000;283:2281-90.
23. Cavanaugh DC, Elisbergh BL, Llewellyn CH. Plague immunization. J Infect Dis 1974;129:S37-40.
24. CDC Viral Hemirrhagic Fevers. Available from: http://www.emergency.cdc.gov/agent/vh.
25. Bhargava D, Bhargava K, Sabri I, Siddharth M, Dave A, Jagadeesh HG. Bioterrorism my role as a dentist. J Indian Acad Forensic Med 2011;33:254-7.
26. Prakash N, Sharada P, Pradeep GL. Bioterrorism: Challenges and considerations. Forensic Dent Sci 2010;2:59-62.