ISSN 2347-5579

Unique Journal of Medical and Dental Sciences

Available online: www.ujconline.net

Review Article

BIOTERRORISM-A WREAK HAVOC PUSHING LIFE TO LIMITS

Nousheen Nadaf[1], Mahesh J[1*], Veeresh DJ[2], Sapna B[3]

[1]Post Graduate Student, Department of Public Health Dentistry, Bapuji Dental College and Hospital, Davangere, Karnataka, India
[2]Professor, Department of Public Health Dentistry, Bapuji Dental College and Hospital, Davangere, Karnataka, India
[3]Reader, Department of Public Health Dentistry, Bapuji Dental College and Hospital, Davangere, Karnataka, India

Received: 21-01-2016; Revised: 19-02-2016; Accepted: 17-03-2016

*Corresponding Author: **Dr. Jagadeson Mahesh**
#213, 8th Block, Kaviarasu Kannadasan Nagar, Kodungaiyur Place 01, Chennai: 600118, India
Phone Number: +919738814201, +919444550705

ABSTRACT

Humans have regrettably used all the available technologies for destruction of enemies. Biological agents are one of them and their use is termed as Bioterrorism. Bioterrorism has reached the forefront of the public imagination following recent events across the world. The reason why it looks so attractive for the terrorist is due to ease of acquisition, economical for production, lethality, highly stable and infective, low visibility and easy stealth of delivery. This paper reviews what agents are usually used as weapons, the way they are classified, effects of biological attack and the response in function towards it. It highlights the role of dentists in such scenarios. It also throws light on bioterrorism in India and the farput efforts to tackle the same.

Keywords: Bioweapons, Biological threats, Bio terrorism, Health care, Dentist.

INTRODUCTION

"An eye for an eye will only make the whole world blind" said **Mahatma Gandhi**. Similarly war for war will only lead to destruction and pain everywhere. The current day situation is no different. One of the greatest threats to mankind is by man himself. Humans, regrettably, have used all the available technologies for destruction of enemies. Biological agents are one of them and their use is termed as Bioterrorism. Bioterrorism is defined by WHO as the unlawful, intentional or threatened use of microorganisms or its toxins derived from living organisms to cause death or diseases in humans, animals or plants and to generate fear in the population[1]. Use of biological agents as weapons for terrorism is not a novel issue, while it is morally repugnant for us to think about using biological agents as weapons and there's a long history of it.

WHAT MAKES THE USE OF BIOLOGICAL AGENTS SO ATTRACTIVE TO THE TERRORIST?[2]

1. **Ease of Acquisition**: Information regarding biological agents is readily accessible on World Wide Web.
2. **Ease and Economy of Production:** Only basic microbiology equipment, Small labs which do not demand licensing and minimal investment is all that is required.
3. **Lethality:** 50 kg aerosolized anthrax = 100,000 mortality**.**
4. They are very **stable, highly infective.**
5. They possess **low visibility** and **Ease and Stealth of** Delivery (Remote, delayed, undetectable release, Difficult/impossible to trace origin of agent)

WHAT AGENTS ARE USUALLY USED AS WEAPONS?

CDC has given Classification of biological threats[3]

Type A (Highest priority) these organisms can be easily disseminated from person to person, have high mortality rates, can cause public panic and social disruption and demands special action for public health preparedness. The micro-organisms belonging to this category are- Anthrax (Bacillus anthracis), Botulism (clostridium botulinum toxin), Plague (Yersinia pestis), Smallpox (Variola major), Tularemia (Francisellatularensis), Viral hemorrhagic fevers (arena virus, bunyaviridae, filoviridae, flavivirida).

Type B (Second highest priority) are those organisms which are moderately easy to disseminate, have moderate morbidity rates and low mortality rates and specifically enhanced diagnostic capacity. The micro-organisms of this category are Brucellosis (Brucellaspp), Epsilon toxin of Clostridium perfringes, Food safety threats (Salmonella, E.coli), Staphylococcal enterotoxin B, Psittacosis (Chlamydia psittaci), Q fever (Coxiellaburnetii), Typhus fever (Rickettsia prowazekii), Viral encephalitis (alpha virus), Water safety threats (Vibrio cholera).

Type C (Third highest priority) are emerging pathogens, to which the general population lacks immunity and those which

could be engineered for mass dissemination in future. It includes emerging infectious diseases (SARS coronavirus).

Weapons targeting plants and livestock

Destruction of livestock and crops would be easier to achieve than mass human casualties and could have a great impact on the target country. A biological attack on livestock or crops could cause great economic hardship in the target country, which would be reinforced by the trade restrictions which might be imposed by importers of the goods. It could also have effects on the health of the people in the area, especially in poorer countries. There could be food shortages and the elimination of one species from a region might cause an increase in the population of a disease-bearing species such as rats or mosquitoes[4].

New technology in biological weapons

The possibility of using new technologies to create more dangerous biological weapons has been much discussed in the last few years. Biotechnology could be used to increase infectivity, to make an agent more stable, to combine two agents together, to combine a toxin with a mechanism for targetting a particular part of the body, to make diseases difficult to diagnose and therefore treat appropriately or to create a strain which is resistant to certain antibiotics or vaccines[5].

HOW ARE THESE BIOLOGICAL AGENTS DELIVERED?

Aerosol is the most likely method of dissemination as it is easy, silent dispersal, affecting maximum number of victims exposed. Other modes include **Food/Water-borne dispersal.** They are less stable, ineffective for some agents, inefficient compared to aerosol[6].

Delivery of biological weapons: Scud missiles, motor vehicles with spray, hand pump sprayers, by an individual, book or letter, guns, remote control, robotic delivery[7].

EFFECTS OF A BIOLOGICAL ATTACK

The World Health Organization has estimated that 50 kilograms of anthrax spores properly disseminated over an area of 40 km could cause thousands of deaths, or possibly 1,00,000 in a densely populated city. If the biological agent is disseminated in right quantity under right conditions it leads to massive destruction of the mass and would lead to more casualties later through secondary infections. There could be more fatalities in countries which do not have adequate affordable health care. Some biological attacks directed at humans would also infect animals, possibly creating new animal reservoirs of the disease which could cause future outbreaks. The impact of the fear and panic which would be caused by a biological attack should not be underestimated too and in fact could cause more damage than the actual agents. It possess risks to laboratory workers[4].

EVENTS SUGGESTING THE RELEASE OF A BIOWEAPON

Epidemiologic clues of a biologic warfare or terrorist attack[8].

1. The occurrence of an epidemic with a similar disease or syndrome, especially in a discrete population.
2. Many cases of unexplained diseases or deaths.
3. More severe disease than is usually expected for a specific pathogen or failure to respond to standard therapy.
4. Unusual routes of exposure for a pathogen, such as the inhalational route for diseases that normally occur through other exposures
5. A disease that is unusual for a given geographic area or transmission season
6. Disease normally transmitted by a vector that is not present in the local area
7. Multiple simultaneous or serial epidemics of different diseases in the same population
8. A single case of disease by an uncommon agent (smallpox, some viral hemorrhagic fevers)
9. A disease that is unusual for an age group
10. Unusual strains or variants of organisms or antimicrobial resistance patterns different from those circulating
11. Similar genetic type among agents isolated from distinct sources at different times or locations
12. Higher attack rates in those exposed in certain areas, such as inside a building if released indoors or lower rates in those inside a sealed building if released outside
13. Disease outbreaks of the same illness occurring in non-contiguous areas
14. A disease outbreak with zoonotic impact
15. Intelligence of a potential attack, claims by a terrorist or aggressor of a release and discovery of munitions or tampering
16. Multiple disease entities in one patient, indicating that mixed agents have been used in the event

PUBLIC HEALTH EMERGENCY RESPONSE FUNCTIONS AND TASKS DURING THE ACUTE PHASE[9]

Response activities should be initiated during the first 24 hours (i.e., the acute phase) of most emergencies and disasters. Specific functions and tasks are divided into three response timeframes: **Immediate, Intermediate**, and **Extended.** The order in which these activities are undertaken may vary according to the specific incident, particularly during a biological incident or infectious disease outbreak. Because emergency response is a dynamic process, these activities may be repeated at various stages of the response.

Immediate Response: Hours 0 – 2

1. Assess the situation
2. Contact key health personnel within health department that have emergency response roles and responsibilities. Record all contacts, including unsuccessful attempts, and follow-up actions.
3. Develop initial health response objectives that are specific, measurable, achievable, and time-framed. Establish an action plan based on your assessment of the situation. Assign responsibilities and record all actions.
4. A health representative(s) from health department should be assigned to establish communications and maintain close coordination with the local, state, or tribal Emergency Operations Center (EOC) and its associated components, if operational.
5. Ensure that the site health and safety plan (HASP) is established, reviewed, and followed, Coordinate with

the safety officer to identify hazards or unsafe conditions associated with the incident and immediately alert and inform appropriate supervisors and leadership personnel. Ensure that medical personnel are available to evaluate and treat response personnel.

6. Establish communications with other health and medical agencies, facilities and organizations that have emergency response roles and responsibilities and verify their treatment and support capacities (e.g., patient isolation and/or decontamination, etc.)
7. Assign and deploy resources and assets to achieve established initial health responses objectives
8. Effective allocation and monitoring of health resources and assets will be required to sustain 24-hour response operations.
9. As part of the community response effort, ensure that health-related requests for assistance and information from other agencies, organizations and the public are either directed to appropriate personnel within health department or forwarded to appropriate agencies and organizations.
10. Engage legal counsel as part of the emergency response effort Stay apprised of legal issues as they emerge and consult with appropriate personnel within your health department and jurisdiction.
11. Document all the response activities using the form(s) within health department.

Intermediate Response: Hours 2 – 6

1. Verify that health surveillance systems are operational to begin the process of data collection and analysis. Consider human subjects and privacy issues related to data collection, analysis and storage.
2. Ensure that laboratories likely to be used during the response are fully operational to begin the process of specimen collection and analysis. Notify laboratories of any changes in activity during the response. Provide laboratories with lead time to prepare for sample testing and analysis.
3. Ensure that the needs of special populations are being addressed through the provision of appropriate information and assistance.
4. Communicate frequently with the public regarding whether or not health-related volunteers and donations are needed. Volunteer agencies (e.g., the Red Cross) have their own needs that may differ from those of your health department. Volunteer medical personnel must be properly credentialed and insured.
5. Ensure that risk communication messages are updated and coordinated with other responding agencies and organizations as necessary. If a Joint Information Center (JIC) is operational, update and release messages through the JIC. Ensure that messages on public health information "hotlines" are updated as necessary.

Intermediate Response: Hours 6 – 12

1. Collect and analyse data that are becoming available through health surveillance and laboratory systems and evaluate any real-time sampling data. Communicate results to appropriate personnel in a timely manner through established operations plans, procedures or guidelines.
2. Initiate staffing plan and update contact information and rosters to be used by incoming personnel. Apprise incoming personnel of response actions being taken, pending decisions and issues, deployment of resources and assets, updated health response objectives and current media activities.
3. Prepare for the arrival of state onsite assistance and for the integration of these personnel, resources and assets into the locally established response structure.
4. Assess health resource needs and acquire as necessary. Resources and capacity to meet health response objectives must be reviewed periodically and appropriate action taken to ensure their availability. Effective allocation and monitoring of health resources and assets will be required to sustain 24-hour and extended response operations.

Extended Response: Hours 12 – 24

1. Initiate preparations for providing mental and behavioural health services and social services, to health department staff, response personnel and other persons affected by the event. Address required comfort needs of health department staff.

2. Consider and assess public health functions and tasks that will need to be addressed beyond the first 24 hours (i.e., the acute phase) of the incident based on incoming data and developments. Health department may be engaged in extended operations for lengthy periods of time. Also, begin developing a strategy for disengaging and demobilizing public health from the response effort based on the analysis and results of incoming data and existing response objectives.

STRATEGIES TO COMBAT DELIBERATE USE OF BIOLOGICAL AGENTS TO HARM HUMAN HEALTH

Four strategic elements that are needed to strengthen the response to deliberate use of biological agents to harm human health are namely[10]:

a. Preparedness and rapid response
b. Public health infrastructure
c. Risk communication
d. Partnership

BASICS OF HEALTH CARE PROVIDER PREPAREDNESS

Louis Pasteur's (1822–1895) statement, "Chance favours only the prepared mind," can be directed at the medical community, which together with the public health service has to assume a leading role in the nation's response to bioterrorism, a response that must be founded in fact and science[11].

1. Knowing the clinical signs and symptoms of such agents can help providers recognize patients who may be victims of an intentional release.
2. Recognize Suspicious Clusters of Disease- Detecting the release of an agent or a suspicious disease cluster requires asking patients about exposures during the incubation period of the likely etiologic agent. Patient responses provide clues as to whether a group of cases of the same illness are related by a common exposure.

3. Know How to Report Potential Bioterrorism Related Cases, Providers should report patients identifying and demographic information and specific details about the current clinical illness such as date of onset and symptoms, physical examination results, and laboratory and radiologic tests. If there is a suspicious cluster, providers should add information about potential common exposures among patients.
4. Limit the Transmission of Infectious Agents Many biologic agents of highest concern do not cause disease via person-to-person transmission. Nevertheless, current standards of care dictate that all patients seeking health care, including those with suspected or confirmed bioterrorism-related illnesses, should be managed using Standard Precautions

Table1: Standard Precautions for Bioterrorism

• Wash hands frequently.
• Wear utility gloves during at-risk activities.
• Avoid chapped and cracked hands and use a water-based hand lotion frequently. (Petroleum based products break down latex.)
• Wear protective barriers such as gowns, boots, masks, and eye protection when working with blood and blood products, body fluids, or waste that may contain blood.
• Do not recap, shear, or break needles at any time. Discard needles and sharp objects in protective containers.
• Sterilize or disinfect reusable equipment.
• Place items that contain blood in a red biohazard plastic bag.
• Do not pick up broken glass with bare hands.
• Use mouthpieces or resuscitator bags whenever resuscitation is required.

5. Provide Information and Routine Care to Patients. In addition to burdens created by emergency events, victims will still require routine health care following the intentional release of a biologic agent. Maintaining routines can be reassuring to both employees and patients. Providers can keep regular office hours or expand hours to provide both non-emergency and emergency care as needed

NEED FOR OTHER HEALTH PROFESSIONALS INBIOTERRORISM ATTACK?

The Local needs are massive and immediate. Existing medical hospitals are insufficient. This calls for health professionals from different fields. Dentists can play a very important role in such scenarios. Dentists are recommended as they are[12]

- Experts in barrier techniques and infection control
- Trained and skilled in administering drugs by injection
- Skilled in placing sutures and controlling bleeding
- Able to participate in interdisciplinary professional groups
- Adapt at managing uncomfortable patients

(CDC, 2004)

HOW CAN DENTISTS BE OF HELP DURING BIOTERRORISM ATTACK?[13,14]

- **Preparation before an attack**
- **Assistance during an attack**
- **After the initial attack**

Responsibilities of dentists in Preparation before an attack

- Training of dental auxiliaries
- Preparation of dental offices to serve as decentralized auxiliary hospitals in case the need arises
- Continuing education courses about bioterrorism to be made as a part of dental school curriculum.
- Up-to-date sources of information should be made available.
- Dentists can educate their patients and correct misinformation circulating throughout the general public.

Dental offices as mini hospitals- Dental offices have some resources that most of the hospitals have: Sterilization equipment, air and gas lines, suction equipment, radiology capabilities, instruments and needles. When local hospitals become overwhelmed or when the concentration of patients is to be avoided - dental offices may serve as local minihospitals

Role of dentists in Assistance during an attack

Dentists can help in Surveillance and notification, Diagnosis and monitoring, Referral, Immunization, Medications, Triage, Medical care augmentation, Decontamination and infection control

Role of dentists after the initial attack can be to provide local surveillance to detect any spreading of disease beyond the original area of attack or re-emergence of infections in the original attack area

HOW DENTAL SCHOOLS CAN BE HELPFUL IN COMBATING BIOTERRORISM[14]

- Provide education about bioterrorism for the dental profession.
- Develop continuing education programs for established dentists
- Valuable assets during the actual response to an attack.
- Repositories for prestocked supplies and equipment

CATASTROPHE PREPAREDNESS COMPETENCIES FOR DENTAL PROFESSIONALS[15]

Competency 1: Describe the potential role of dentists in the first/early response in a range of catastrophic events.

Competency 2: Describe the chain of command in the national, state, and/or local response to a catastrophic event.

Competency 3: Demonstrate the likely role of a dentist in an emergency response and participate in a simulation/drill.

Competency 4: Demonstrate the possible role of a dentist in all communications at the level of a response team, the media, the general public, and patient and family.

Competency 5: Identify personal limits as a potential responder and sources that are available for referral.
Competency 6: Apply problem-solving and flexible thinking to unusual challenges within the dentist's functional ability and evaluate the effectiveness of the actions that are taken.

Competency 7: Recognize deviations from the norm, such as unusual cancellation patterns, symptoms of seasonal illnesses that occur out the normal season, and employee absences, that may indicate an emergency and describe appropriate action**.**

GUIDE FOR DENTAL SCHOOLS TO IMPLEMENT CATASTROPE PREPAREDNESS[15]

First	• **To provide familiarity and understanding of CBRNE(chemical, biological, radiological, nuclear, and explosive)** • **Ethics course** • **Doctor-patient relationship and methods of communication**
Second	• **Expand students' knowledge about microbiological agents and pathophysiology** • **Students analyze a clinical case that resulted from a terrorist event and a case about a public health emergency.**
Third	• **Certification in CPR, management of simple wounds, and infection control procedures** • **Surveillance activities**
Fourth	• **Small group table top exercises** • **Assessment of role of students as responders in catastrophe event**

BIOTERRORISM IN INDIA

There had been several sporadic incidents of bioterrorism in past but the October 2001 use of anthrax letters in United States was one incident that killed five people and triggered a worldwide alarm. There are no confirmed incidents of bioterrorism attack in India yet, in 2001, the office of the Deputy Chief Minister of Maharashtra had received an envelope having anthrax culture[16]. It wakes up Indian security agencies and consequently several incidents were suspected to be acts of bioterrorism.

In India, the Integrated Disease Surveillance Project (IDSP), a decentralized and state-based surveillance program was introduced in November 2004. It integrates the public sector, private sector, rural and urban health systems and has incorporation of communicable and non-communicable systems (unusual clinical syndromes may be included during public health emergencies). There is also incorporation of medical colleges (both private and Government) and International Health Agencies (WHO, CDC, NIC, etc.). Its major components include integration and decentralization of surveillance activities, strengthening of public health laboratories, human resource development and use of information technology for collection, collation, compilation, analysis, and dissemination of data[17-19].

India's has so far put efforts mainly via NDMA (National Disaster Management Authority), NDRF (National Disaster Response Force) and DRDO (Defence Research and Development organisation). Some DRDO labs are active in this area of research and have developed protective systems and equipment's for protection of Indian troops against the nuclear, biological and chemical warfare. The efforts can be enumerated as follows: National Disaster Management Authority (NDMA) has taken several initiatives has existing battalions of National Disaster Response Force (NDRF), trained to deal with chemical, biological, radiological, and nuclear (CBRN) threats.

List of some of the laboratories in India which have been already linked with National Institute of Communicable Diseases (NACD) is given below and efforts are continuing to include more laboratories. NACD, New Delhi; National Institute of Cholera and Enteric Diseases, Kolkata (diarrheal diseases and other enteric pathogens); Department of Microbiology, AIIMS (Virology); National Institute of Virology, Pune (viral diseases excluding HIV/polio); Entero virus Research Centre, Mumbai (polio); Vector Control Research Centre, Pondicherry (vectors, filariasis); Centre for Research in Medical Entomology, Madurai (vectors and other vector-borne diseases); Defence Research Development Establishment, Gwalior[20].

CONCLUSION

The best approach that can be followed is to protect, respond whenever there is an emergency and defend the health of our citizens against the adverse health effects of bioterrorism. It can be done by developing, organizing and enhancing life-saving public health interventions and to enhance the existing infrastructure to combat the danger of bioweapons. Improved and expanded public health laboratory capacity, increased surveillance, outbreak response capabilities and augmented health communications and training which are supported by focused public health preparedness resources at the National level, state level and local level are very much necessary to enable us to respond when there is a need.

REFERENCES

1. Klietmann WF, Ruoff KL. Bioterrorism: Implications for the Clinical Microbiologist. Clin. Microbiol. Rev. Apr, 2001; 14(2): 364–381.
2. Da Silva EJ. Biological warfare, bioterrorism, bio defence and the biological and toxin weapons convention. Electronic Journal of Biotechnology, 1999; 2(3):100-129.
3. Porche DJ. Biological and Chemical Bioterrorism Agents. J Assoc Nurses AIDS Care, 2002; 13:57-64.
4. Health aspects of chemical and biological weapons, World Health Organization, Geneva, 1970; 1: 9-21.
5. Ernest T, Winegar AJ, Zajtchuk R. Medical challenges in chemical and biological defense. Textbook of Military Medicine, 1997: 677–685

6. Bioterrorism- Public health System To Remain Alert. CD Alert, Monthly Newsletter of National Institute of Communicable Diseases, Directorate General of Health Services, Government of India, vol. 5.September-October 2001. p. 1-12.
7. Bioterrorism. In: Suryakantha AH, editor. Community Medicine (with resent advances). 1st ed. Chap. 58, New Delhi: Jaypee Publishers; 2009. p. 822-4.
8. Pinto V N. Bioterrorism: Health sector alertness. Journal of Natural Science, Biology and Medicine, January 2013; 4(1): 24-28.
9. Public Health Emergency Response Guide for State, Local, and Tribal Public Health Directors. CDC Emergency Response Hotline (24 Hours). April 2011; 2: 1-64.
10. Plianbangchang S. Strategies of Preparedness against the Strategies of Preparedness against the Threat of Biological Warfare and Bioterrorism in South-East Asia. Asian Biotechnology and Development Review, 2005; 8(1): 77-98.
11. Preparation for bioterrorism: The new york city department of health and mental hygiene. City Health Information, February, 2005; 24(2): 7-12.
12. http://www.cdc.gov/brfss/about/index.htm. Accessed on 29/02/2016.
13. Guay AH. Dentistry's response to bioterrorism: A report of a consensus workshop. J Am Dent Assoc, 2002; 133: 1181-7.
14. Flores CS, Shannon C, Shackelford CL. Dentistry and bioterrorism. Dent Clin North Am 2003; 47: 733-44.
15. Glotzer DL, More FG, Phelan J, et al. Introducing a senior course on catastrophe preparedness into the dental school curriculum. J Dent Educ, 2006; 70: 225–230.
16. www.gktoday.in/indias-bioterrorism-preparedness. Accessed on 29/02/2016.
17. Bioterrorism. In: Suryakantha AH, editor. Community Medicine (with resent advances). 1st ed. Chap. 58, New Delhi: Jaypee Publishers; 2009. p. 822-4.
18. Integrated Disease Surveillance Project (IDSP) National Centre for Disease Control (NCDC) Ministry of Health & Family Welfare Government of India. Training Manual for Medical Officers for Hospital Based Disease Surveillance, pg: 1-30.
19. Ministry of Health & Family Welfare. Government of India. Approval of State Programme Implementation Plan, Sikkim, 2012- 13; 1-237.
20. www.undp.org/content/dam/india/.../disaster_management_in_india.pdf. Accessed on 01/03/2016.

Source of support: Nil, Conflict of interest: None Declared