

Bioterrorism: Health sector alertness

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Abstract

The global events of the last two decades indicate that the threat of biological warfare is not a myth, but a harsh reality. The successive outbreaks caused by newly recognized and resurgent pathogens and the risk that high-consequence pathogens might be used as bioterrorism agents amply demonstrate the need to enhance capacity in clinical and public health management of highly infectious diseases. This review article provides a concise overview of bioterrorism, the agents used, and measures to counteract it, with a relevant note on India's current scenario of surveillance systems, laboratory response network, and the need for preparedness.

Key words: Alertn, bioterrorism, healthsector

INTRODUCTION

Bioterrorism is a planned and deliberate use of pathogenic strains of microorganisms such as bacteria, viruses, or their toxins to spread life-threatening diseases on a mass scale in order to devastate the population of an area.^[1] People have described the next hundred years as the “century of biology.” Incredibly rapid and profound changes in genetic modifications in bio-molecular engineering and enhanced bio-production technologies, however, may make it easier for terrorists to overcome the barriers that inhibited acquisition of biological weapons in the past.^[2] Historically, biological weapons have been a threat to humans for many centuries. At those times, very crude methods such as fecal matter, animal carcasses, etc. were used to contaminate water sources, but now the concentrated forms of biological agents such as dried spores and genetically modified organisms are available, which are fatal even in minute quantity.^[3,4]

The threat of biological warfare has been engaging the

attention of Indian defense and medical experts for a long time. There have been a few episodes that have raised suspicion in the past. During the Indo-Pakistan war of 1965, a scrub typhus outbreak in north-eastern India came under suspicion. India's defense and intelligence outfits were alert to the outbreak of pneumonic plague – well known in biological warfare – in Surat and Bubonic plague in Beed in 1994, which caused several deaths and sizeable economic loss.^[5] In 2001, the anthrax scare reached Mantralaya^[6] and, even as India tries to prevent terrorist attacks such as the one in Mumbai in November 2008, security experts say that despite not facing a biological attack so far, the country must not ignore that threat.^[7]

WHAT IS BIOTERRORISM?

A bioterrorism attack is the deliberate release of viruses, bacteria, or other germs (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 changed to increase their ability to cause disease, make them resistant to current medicines, or to increase their ability to be spread into the environment.

What (agents likely to be used)

Bioterrorism agents are classified as categories A, B, and C.

Category A: High-priority agents include organisms that pose a risk to national security because they can be easily disseminated or transmitted from person to person, result

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in high mortality rates, and have the potential for major public health impact. They might cause public panic and social disruption, and require special action for public health preparedness.

Agents/diseases include anthrax (*Bacillus anthracis*), botulism (*Clostridium botulinum* toxin), plague (*Yersinia pestis*), smallpox (*Variola major*), tularemia (*Francisella tularensis*), and viral hemorrhagic fevers [filoviruses (e.g. Ebola, Marburg) and arenaviruses (e.g. Lassa, Machupo)].

Category B: The second highest priority agents include those that are moderately easy to disseminate, result in moderate morbidity rates and low mortality rates, and require specific enhancements of CDC's diagnostic capacity and enhanced disease surveillance.

Agents/diseases include brucellosis (*Brucella* species), epsilon toxin of *Clostridium perfringens*, food safety threats (e.g., *Salmonella* species, *Escherichia coli* O157:H7, 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*), viral encephalitis [alphaviruses (e.g. Venezuelan equine encephalitis, eastern equine encephalitis, western equine encephalitis)], and water safety threats (e.g. *Vibrio cholerae*, *Cryptosporidium parvum*).

Category C: The third highest priority agents include emerging pathogens that could be engineered for mass dissemination in the future because of availability, ease of production and dissemination, and potential for high morbidity and mortality rates and major health impact.

Agents include emerging infectious diseases such as Nipah virus^[10] and Hanta virus, and *Mycobacterium tuberculosis* (multidrug-resistant strains).^[8]

Newer trends are products of microbes that can kill or incapacitate targeted hosts, e.g. hormones, neuropeptides, cytokines called as “designer substances” to target a particular organ or type of enemy. Others are “ethnic bombs” and parasite biological weapons under trial to affect cash crops.^[4]

Where (the target population)

The target populations are likely to be big metropolitan cities, big urban conglomeration, and districts having international borders. However, no part of the country can be considered as non-vulnerable.

How (the mode of attack)

The mode of attack would depend upon the type of agents used. In order to infect or affect a large population, it is possible that aerosol mechanism would be used in closed, confined areas where large numbers of people assemble, e.g. departmental stores, cinema halls. The contamination of food and water with toxins and pathogens could also be another measure. Deliberate infiltration of infected animals, pests, or vectors through the borders could be other modes of attack.^[2]

Delivery of biological weapons: Scud missiles, motor vehicles with spray, hand pump sprayers, by an individual, book or letter, guns, remote control, robotic delivery.^[4]

THE COUNTERMEASURES FOR BIOTERRORISM

Successfully meeting the challenges of bioterrorism requires a multifaceted response. No single approach will by itself be successful. The key countermeasures for bioterrorism include the following.^[2]

Deterrence (certainty of being punished for the act perpetrated)

To strengthen the area of biodefense, the US senate passed the “Bioterrorism Act of 2002.” According to this law, there is an essential element of national preparedness against bioterrorism and the focus is on safety of drugs, food, and water from biological agents and toxins. However, we in India are still waiting for a law on bioterrorism.^[1]

Prevention (reducing the opportunity, enhanced intelligence) Action at international and national level

Currently, there is a lacuna in international legislations and treaties to curb or prevent biological weapons' attacks. Launched in 2004 under the aegis of a \$1 million grant from the US-based Alfred P. Sloan Foundation, Interpol held its first “Interpol Global Conference on Preventing Bioterrorism” at its headquarters on 1-2 March 2005. The March conference sought to “examine the risk of bioterror attacks, case studies, prevention of attacks, preparation and training of law enforcement personnel, and the related legal and political framework.”^[11]

The National Disaster Management Authority (NDMA) has begun preparedness, but concedes more cooperation is needed from companies and communities. To strengthen the existing eight battalions of the National Disaster Response Force, each consisting of 1000, two more battalions have been sanctioned. Half of the existing force is specifically trained to deal with chemical, biological, radiological, and nuclear (CBRN) threats. NDMA has also asked the state governments to get part

of the state forces trained in such areas.^[7] The revised International Health Regulations came into force in India in June 2007. The regulations will help to ensure that outbreaks and other public health emergencies of international concern are detected and investigated more rapidly and that collective international action is taken to support affected states to contain the emergency, save lives, and prevent its spread.^[12]

Surveillance and assessment (early detection or awareness) by epidemiological methods

Well before any event, public health authorities must implement surveillance systems so that they can recognize patterns of non-specific syndromes that could indicate the early manifestations of a biological warfare attack. The system must be timely, sensitive, specific, and practical. Primarily, the surveillance activity will be around the following key elements.

- i. Harnessing information, which are considered to be epidemiologic clues of a possible biological warfare

Epidemiologic clues of a biologic warfare or terrorist attack

 - The occurrence of an epidemic with a similar disease or syndrome, especially in a discrete population
 - Many cases of unexplained diseases or deaths
 - More severe disease than is usually expected for a specific pathogen or failure to respond to standard therapy
 - Unusual routes of exposure for a pathogen, such as the inhalational route for diseases that normally occur through other exposures
 - A disease that is unusual for a given geographic area or transmission season
 - Disease normally transmitted by a vector that is not present in the local area
 - Multiple simultaneous or serial epidemics of different diseases in the same population
 - A single case of disease by an uncommon agent (smallpox, some viral hemorrhagic fevers)
 - A disease that is unusual for an age group
 - Unusual strains or variants of organisms, or antimicrobial resistance patterns different from those circulating
 - Similar genetic type among agents isolated from distinct sources at different times or locations
 - 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
 - Disease outbreaks of the same illness occurring in non-contiguous areas
 - A disease outbreak with zoonotic impact
 - Intelligence of a potential attack, claims by a terrorist or aggressor of a release, and discovery of munitions or tampering

- Multiple disease entities in one patient, indicating that mixed agents have been used in the event
- ii. Verification, immunization, and confirmation
- iii. Initiation of appropriate prevention and control measures

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 system, 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.^[4,13,14]

Laboratory investigation for diagnosis and characterization/sensitivity of the biological organism

The main role of the hospital-based clinical microbiology laboratory in support of a biothreat, biocrime, or act of bioterrorism is to “raise suspicion” when a targeted agent is suspected in a human specimen. It should be prepared to recognize and respond to a covert event involving the collection, preservation, transport, and testing of human specimens. Consequently, emergency medicine physicians and other primary healthcare providers, including the clinical microbiology laboratory staff, are the sentinels or medical first responders and will most likely identify the initial cases.

To be successful in this role, laboratory personnel, including the laboratory director, in conjunction with infection control and administrative personnel should develop both laboratory- and institution-wide response plans. These plans must include the following: (i) criteria for distinguishing the type of bioterrorism event; (ii) information regarding access to and utilization of the Laboratory Response Network, including diagnostic testing protocols; (iii) safety guidelines; (iv) communication and notification protocols; (v) criteria for the safe packaging and transport of infectious substances; and (vi) measures to increase laboratory security.^[9]

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); Enterovirus Research Centre, Mumbai (polio); Vector Control Research Centre, Pondicherry (vectors, filariasis); Centre for Research in Medical Entomology, Madurai (vectors and other vector-borne diseases); Defense Research Development Establishment, Gwalior.

Various commercial tests utilizing biochemical, immunological, nucleic acid, and bioluminescence procedures are currently available to identify biological threat agents. Newer tests have also been developed to identify such agents using aptamers, biochips, evanescent wave biosensors, cantilevers, living cells, and other innovative technologies.^[15]

Medical management (preventive, promotive, and curative services)

Prophylaxis in response to a bioterrorism incidence means administering chemoprophylactic drugs to prevent the spread of the disease. For undertaking such exercise, the following things will be required: Medicines and vaccine to be provided; the category of population to be given chemoprophylaxis/immunoprophylaxis identified; availability of the requisite quantity of drugs or vaccine; and outline of the mechanism of administration with health infrastructure.

Dissemination (public safety and law enforcing agencies)

Training and education

Management of biological attack has two critical elements:

- i. Warning network such as hospitals and public health agencies
- ii. Individual clinical expertise of medical personnel

Proper training of medical personnel, laboratory technicians, public health officials, epidemiologists, and veterinary public health and emergency personnel is essential to a comprehensive detection, assessment, and response framework. Efforts must be made to attract medical personnel to training sessions. Distance learning program available through the Internet (websites like: <http://www.bt.cdc.gov/bioterrorism/>, www.who.int/topics/bioterrorism/en/, <http://en.wikipedia.org/wiki/bioterrorism>) or otherwise should receive attention. Medical personnel should be involved with the planning of local and state government response efforts.

General public sensitization

Preparedness and response capability, therefore, will rely heavily on effective information, dissemination, and communication. So, information should try to address issues to reduce panic and simultaneously give the

factual details to enable the people to take appropriate decisions.

NEED OF THE FUTURE

To create awareness among the public and doctors; to stock pile drugs and vaccines; allocation of separate funds; preparedness: this is not a cause for panic—it is a cause for serious, deliberate long-term concern; international collaboration; microbiologists are the main focal points of action because the biological weapons are the products of their specialty.^[4]

CONCLUSION

Bioterrorism differs from other types of terrorism (chemical, radiological, or nuclear). In fact, it imposes particularly heavy demands on the nation's public health and health care system because ultimately it will be the public health system that will be called on to mitigate and ameliorate the consequences of a bioterrorism attack. To meet the challenge of bioterrorism, coordinated and concerted efforts of different agencies, viz. the intelligence agency, the army, the BSF, SSB, law enforcement machinery, health departments most importantly (surveillance, laboratory response network, alertness of medical and paramedical faculties), civil administration, etc. are required.

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