# BIOTERRORISM - IS THE THREAT REAL?

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**by**

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**Abstract:** *Given the evolving geopolitical situation around the globe it will not be an exaggeration to say that the threat posed by bioterrorism is a real one. Biological agents catch up the populations unaware and by the time a confirm diagnosis is reached upon several thousand already get affected. Though the world powers have advanced weaponry in their armory to target any nation on the globe with utmost precision, they lack the ability to target a biological agent since they are invisible and can be present anywhere and the perpetrators have the advantage to act stealthily and wreak havoc. History is reminiscent of the acts of genetic engineering making the biological agents even more lethal and resistant to whatever possible treatment options available. The availability of biological agents, the technology to convert them into weapons of mass destruction and the presence of the quintessential mindset makes a deadly cocktail and a matter of serious concern too costly and risky to overlook. Though the developed nations have started building up their public health capacities and capabilities to tackle such threats, but a clear majority of the world population is not having even basic medical care available to them leave apart the protection from bioterror attack. Since a sizeable proportion remains so vulnerable the threat of spread increases manifolds as it is extremely difficult to contain it within borders. Preparedness against such attacks seems to be the best option but it is very difficult and resource intensive affair. There is no such literature available to demonstrate the extent of preparedness of the world community to face the threat of biological agents. Health care providers will be the first responders and a lot will depend on their ability to detect a bioterrorist attack and be able to institute available treatment options. Integration of the world community regarding intent, technology, resources and knowledge sharing is inescapable and the sooner the better.*

**Keywords:** Bioterrorism; Anthrax; Botulism; Plague; Smallpox; Public health emergency; Surveillance; Preparedness to bioterrorism

## Introduction

*"Bioterrorism is the intentional release or threat of release of biologic agents (i.e. viruses, bacteria, fungi or their toxins) in order to cause disease or death among human population or food crops and livestock to terrorize a civilian population or manipulate the government". (Lt Col S Das, Brig VK Kataria)*[14].

Use of biological agents to wreak havoc on mankind, animals or crops always has an ill mind with certain ulterior motives. The aim is to establish an identity for themselves and get their motives fulfilled by using bioterror as a weapon.

Bioterrorism as a Public Health threat has long been ignored and denied and the world community is yet to waken up to this harsh reality. Countries in Asian continent are more vulnerable due to dense population and poor awareness and preparedness to such threats. The issue requires a center stage in policy decisions lest it is too late for the world community to cope up with the imminent bioterror threat if possible. Bioterrorism is the use of biological agents by individuals, groups or even nations to fulfil their ulterior motives. There are mischievous nations and individuals in this world who harbor such ill intentions and are motivated, have access and skills to cultivate some of the most dangerous pathogens and use them as biological weapons[1]. Biological weapons could become more devastating in the future because new knowledge is getting added due to advances in biotechnology[29].

The knowledge provided by Koch's postulates made isolation and production of stocks of deadly pathogens increasingly possible[3]. The advancements made in the microbiological sciences in the first half of the 20$^{th}$ century has allowed nations to utilize these scientific developments with military connotations[2]. 1930s and 1940s saw development and expansion of the biological

weapons programs in several countries[2]. Although modern medicine has evolved better to deal with disease outbreaks, but the use of biological agents may pose the greatest threat more so due to new or genetically modified agents capable of causing catastrophic outcomes[3]. Bioterrorism comes unannounced without a large explosion[13]. No smell, taste, or sight of biological agents[13].

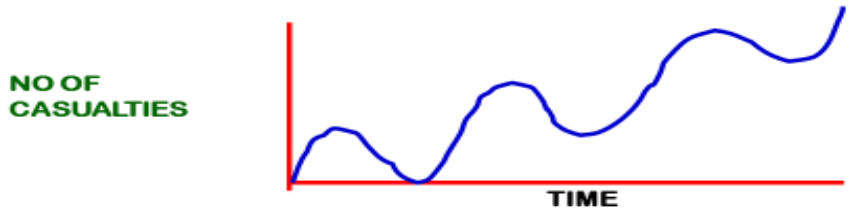
The horrendous September 11 attack on World Trade Center proves that determined terrorists can develop the capability to carry such attacks on the soil of such a powerful nation. Saddam Hussain had huge piles of biological agents of all sorts and had also weaponized them to be used against western powers. Terrorists like Osama bin Laden had demonstrated their intentions to use biological agents and in fact was working on them. The way situations are unfolding in the middle east especially at places like Syria use of biological agents can't be ruled out since it has become a battleground for the world superpowers and all kinds of fringe elements. If a closed country like North Korea can dare to challenge a world power like USA it is highly likely that they may be having biological agents to be used as a warfare agent and can even ship such consignments to likeminded groups.

The sick patients arrive in hospitals long after the terrorist has left the scene[13]. There is a sudden increase in the number of patients reporting to the hospital emergencies. Health care providers are the first to get exposed to such patients and are also the first responders to detect and treat cases of bioterror attacks. The ability of the health care providers to detect and treat such cases and to prevent further spread to themselves and to others will be very crucial. It's a matter of concern that even the health care providers are not clinically exposed to such cases and the treatment regimen to be followed. Thus, it becomes imperative to train the health care providers to detect cases of bioterror attack and be able to take preventive and therapeutic measures.

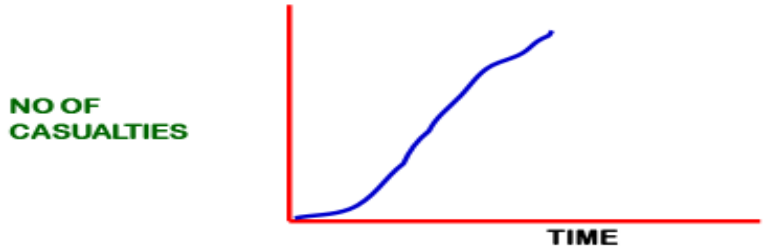
The issue can't be dealt in isolation since the threat is not limited to any border or geographical area rather its global. Given the interconnectedness of today's world, an exposure in any part of the world puts every nation and its population at risk as such the biological agents knows nobody. Any further delay in the acknowledgement and preparation to deal with such threats will be to our own peril. Technical capabilities in the global biotechnology industry has enhanced and the terrorist groups have also engaged themselves in getting the expertise as is evidenced in many incidents in the past. Today terrorism is a global phenomenon and no nation is immune to it. Bioterrorist attacks are generally covert and by the time its sign and symptoms surface the perpetrators vanish.

A holistic approach is required to understand the psyche of the terrorists, the reasons that motivates them, to check the cycle of violence and achieve an enduring peace and security[19]. Bioterrorism does not have a ground zero[6]. These are covert operations which culminates in mass casualties and its literally impossible to find out where and how the act was carried out. There was overemphasis on worst-case scenarios at the cost of more probable middle- and low-casualty attacks[4]. Release of a biological agent in an aerosol form in which those exposed would become severely ill or even die constitutes the worst case scenarios[4]. Scenarios involving contagious pathogens, such as smallpox or plague, are worrisome and in the absence of appropriate measures, the numbers infected would increase exponentially[4]. Bioterrorism should act as a catalyst to integrate the unorganized, uncoordinated and ill-equipped public health system to be able to respond effectively to such threats[35].

A bioterrorist attack may be like a naturally occurring infectious disease outbreak but can occur anywhere, at any time of year and without warning[15]. Terrorism arsenals in future are likely to expand beyond traditional acts of violence, to the greatest terrorism challenge modern medicine may face that is bioterrorism[6]**.** The threat of bioterrorism is special as it invariably has a thinking enemy who is predetermined and premeditated[19].




CAS RATE PATTERN IN NATURALLY OCCURRING EPIDEMICS




CAS RATE PATTERN IN BIOLOGICAL AGENT ATTACK

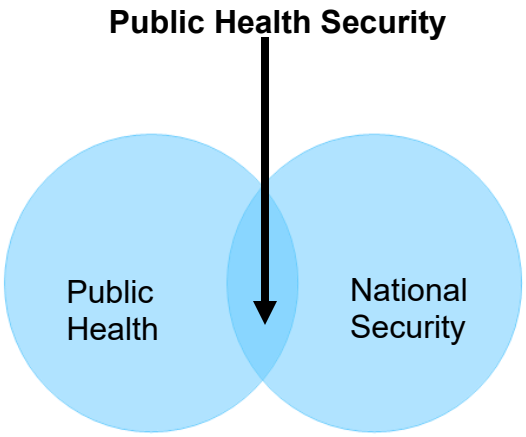
**Four observations merit attention**. (a) The likelihood of bioterrorism is more compared to the past and is more devastating than explosives and chemicals[1]. (b) The funding and support required to tackle the imminent threat is far less than the needed[1]. (c) It is extremely difficult to prevent and tackle bioterrorism as the knowledge of developing biological weapons is easily available on the internet and it requires minimal of finances and training to produce the biological weapons[1]. (d) It is almost impossible to detect someone making such biological weapons[1].

The only place we can find out evidence of such biological attacks are the emergency rooms of hospitals[1]. The first line of defense would be the specialists in the infectious diseases[1]. The speed with which proper diagnosis and preventive measures are instituted will decide the number of casualties[1]. In fact, **the very survival of the first line of defense is highly questionable**[1]. The care providers would hardly have seen a single case of smallpox, anthrax or plague[1]. The laboratory diagnosis of such cases is extremely low as very few are equipped with the capability to do so[1].

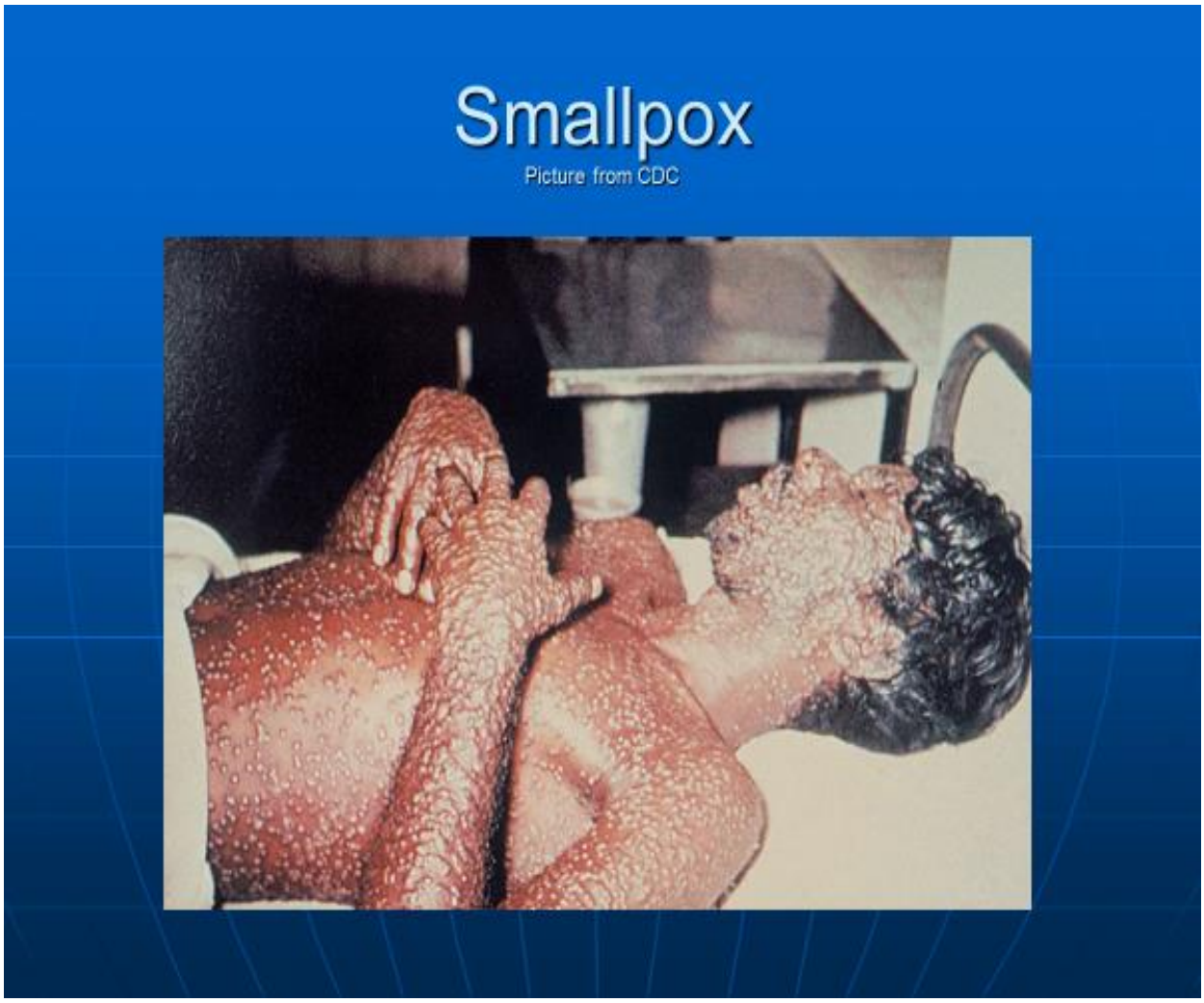
There is a long list of pathogens which has a potential to become a biological weapon but only few are there which are easy to prepare and disperse which can cause severe disease, paralyze a city or a whole nation[1]. Anatoliy Vorobyov a Russian bioweapon expert, in 1994 presented a report to a working group of National Academy of Sciences[1]. The report was a conclusion of Russian experts regarding the potential agents that can be used as a biological weapon in which smallpox (Variola virus) topped the list followed by anthrax (Bacillus Anthracis) and plague (Yersinia Pestis)[1]. The list of probable biological agents is very long.

The **existing public health systems of most nations are often caught "off guard"** and unprepared when a new disease outbreak like Zika or Ebola, or a bioterrorist threat occur[21]. There is a history of terrorism in East Africa and Ebola is present there naturally and can be used as a bioweapon[26].

There is a **public health-national security overlap**[20] leading to an emergence of public health and national security intersection that will define the scope of public health security. The fear of biological weapons is much more than the fear of nuclear war with serious implications against security[27].




**Smallpox and Anthrax are of special concern** [1]. During 1970s two epidemics of smallpox in Europe and release of aerosolized Anthrax in 1979 by accident at a bioweapon facility in Russia are discerning[1]. **Smallpox** is a viral disease and spreads through person to person contacts. Experimental studies (Harper, 1961) have shown that virus can survive for long periods when the relative humidity is low[34]. The infection is invariably symptomatic with a development of characteristic high-grade fever, rash and pain[1]. The disease is very frank with no mild or subclinical infections in unvaccinated persons[1]. It has an incubation period of 10-12 days. The rash starts as a small papule that progress into pustules on day 7-8 and then there is a formation of scab at around day 12[1]. There is no specific treatment available for this disease and about 25-30% of unvaccinated patients die[1].



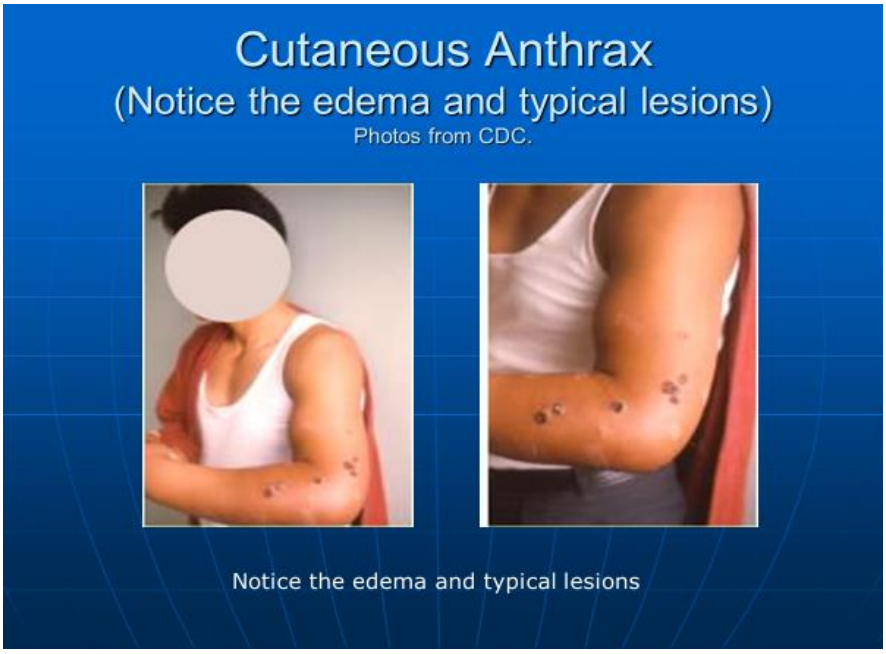

There are several smallpox importations into Europe that are well documented and **two are worth mentioning**[1] (box) showing the degree of infectivity of smallpox and how the community is caught unaware and the disease spreads at a fast pace making it difficult to contain.

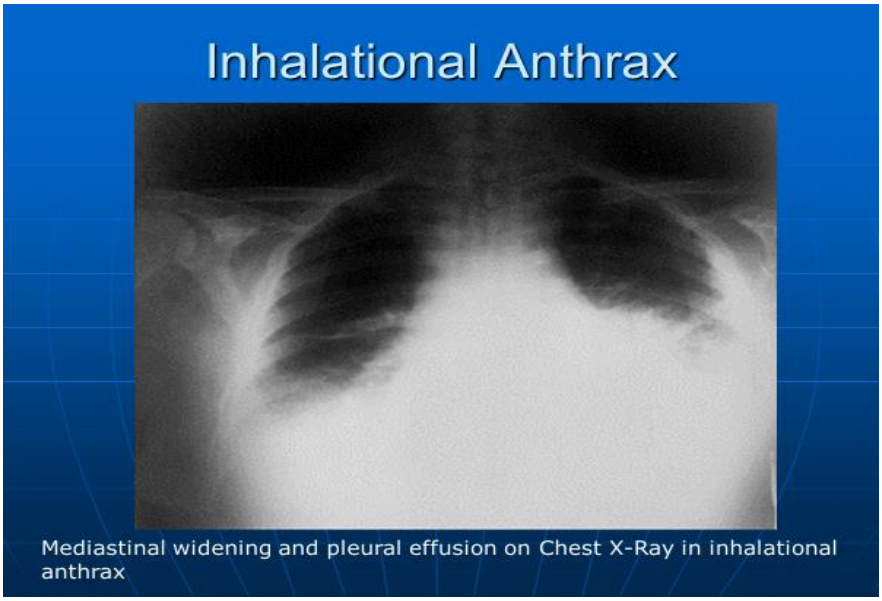
**(a) A single case of smallpox in US in 1962 elicited extreme response from US authorities** wherein a Canadian boy returning from Brazil travelled through New York, Toronto, Albany and Buffalo both by air as well as train journeys. He developed rashes shortly after arriving Toronto and was subsequently hospitalized. US officials alarmed by this single case planned emergency measures like closing the Canadian border, to mass vaccination campaigns in all cities traversed by the boy especially targeted to the population in these cities who could have been exposed to the Canadian boy by his travel via different modes of transport to various places.

**(b) An outbreak in Germany in the year 1970** established the potential threat due to aerosolized smallpox and its ability to spread to a considerable distance and its infectivity even at low doses. On Jan 11 a German electrician was admitted to the hospital as a case of high grade fever and diarrhea. He had returned from Pakistan. He was kept in an isolation ward on the ground floor as a suspected case of typhoid fever and was looked after by only two nurses for the next three days. He developed rashes on Jan 14 and was confirmed as a case of smallpox on Jan 16. He got shifted to one of Germany's special isolation ward and a mass vaccination drive was carried out. The attending hospital staff and other patients were quarantined for four weeks and vaccinated, and vaccinia-immune globulin was given to the seriously ill patients. However, this patient had a very unusual presentation of cough which is hardly seen in smallpox cases. Coughing produced large volumes of aerosols that further infected others around. 19 new cases were diagnosed from the hospital and included patients from the same floor as of the patient and two to three floors above also. One of the two contact cases was a visitor who just happened to open the door of the corridor to ask for directions and was about 30 feet away from the patient. One of the three nurses who contracted the disease succumbed.

**Anthrax**[1]**:** Bacillus Anthracis can be produced very easily in large quantities. It is easy to store since it is very stable in dried form. Aerosolized anthrax is highly lethal when inhaled as evidenced in the **1979 Sverdlovsk epidemic**. Such is the lethality that out of 77 confirmed anthrax cases 66 died. An accidental airborne release of a few milligrams of anthrax in Sverdlovsk affected the people living in the vicinity or working nearby the facility. The release was accidental and for few minutes only but still the results were devastating. This affected not only the population in the area but also the animals like cows and sheep as far as 50 kms from the military bioweapon facility. Incubation period ranged from 9 days to 6 weeks after exposure but with certain death after 1 to 4 days of the onset of the symptoms. However, penicillin prophylaxis and anthrax vaccine increased the number of survivors. The catastrophic impact of release of even such a miniscule amount shows how devastating it can be and it certainly merits attention.

Hospitals would get flooded by such patients having high grade fever with breathing difficulties after 3-4 days of exposure. Before some definitive treatment can be instituted it would be too late and the patients would die within 24-48 hours. The situation is further aggravated by almost nil exposure of the health care providers to a case of inhalation anthrax and the inability of the laboratories to properly diagnose such cases.



## The Biological and Toxin Weapons Convention

BTWC entered into force in 1975 prohibiting the use of these weapons[2]. Based on this we need to institute measures to prohibit the development and production of biological weapons and ensure compliance[1]. Under BTWC there is an obligation to submit annual declarations of specific biotechnological activities followed by 50–100 random visits to such facilities to verify the declarations with a possibility to carry out further inspections in suspicious cases[2]. All the states except USA agreed on the contents of the negotiations even though USA has been at the forefront in raising awareness of this threat[2]. Though there is a requirement to build a strong moral consensus against the biological weapons, it cannot be expected out of extremists. It involves an unequivocal and unstinted support from all nations without exceptions to engage on a common platform for a common cause since no one can claim immunity from the catastrophic outcomes that ensues post bioterror attack. Circumstances are very dynamic, and it may happen anytime that such preserved viruses will fall into the hands of terrorists and they are not going to show any leniency in its usage against mankind and others.

## Rationale for the study

Evolving geopolitical scenario and the way terrorism is getting global it is necessary to be aware and be prepared for any possible bioterror attacks. The terrorist's groups around the world have expressed their desire to develop biological agents and use them against their enemy nations. This puts the entire humanity and other living beings under threat since the biological attack on any nation is not going to get contained in its boundaries. This literature review tries to re-invigorate the discussion on this very important issue that has the potential to snowball into an unmanageable scenario if left unattended. There are precedents of biological attacks in the past and the intent and

content remains amidst many unscrupulous elements around the globe and the matter requires an urgent intellectual debate amongst the scientific community and the policy makers.

## Objectives

a. To find out the occurrences of biological attacks in the historical background.

b. To assess the threat of bioterrorism to public health in the present and the future.

c. To assess the preparedness of the global community to deal with a bioterror attack.

## Methodology

Descriptive study based on review of secondary literature. The secondary literatures were selected based on inclusion criteria of having the keywords; Bioterrorism; Anthrax; Botulism; Plague; Smallpox; Public health emergency; Surveillance; Preparedness to bioterrorism. Selection of literature was guided by our listed objectives. Literatures having only the details of the biological agents and their morphologies were excluded.

## Results

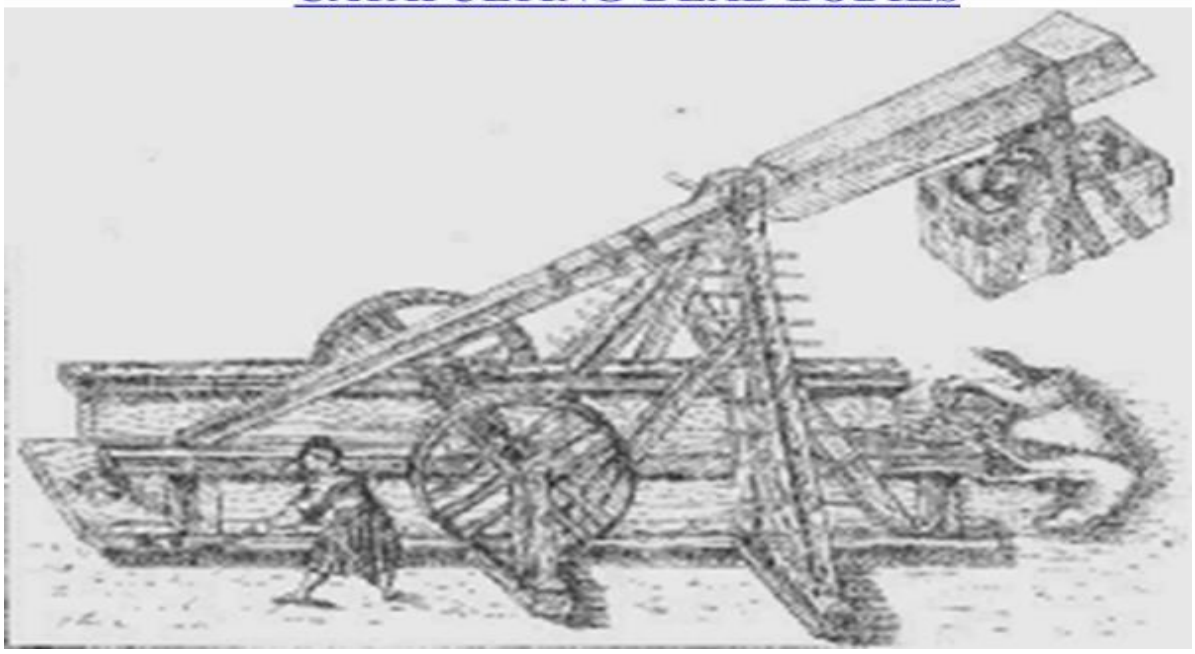
### a) Historical background showing occurrences of biological attacks

The roots of bioterrorism could be traced back to **before Christ days** as several instances from history reflect the human psyche of causing death and disease to a large mass of people in a subtle way of spreading viruses and infection.

**As early as 600 BC**, the Assyrians poisoned enemy wells with a fungus (rye ergot), that causes convulsions when ingested[2].

The **plague** also called as the black death started **in Europe** and was spread by the **Mongolian** tartars besieging the Genoese city of Caffa (now Feodosia, Ukraine) on the Crimea in 1346. When they failed to capture the city, the Mongolians catapulted corpses of their soldiers who had died of plague over the city walls thus an epidemic was initiated which spread via those who fled by ship from the Crimea to the Mediterranean region further to Europe[2].

**CATAPULTING DEAD BODIES**



In **1422**, Karolstein catapulted dead bodies of soldiers on the enemy[3].

Francisco Pizarro had given **smallpox-laced clothing** to South American Natives in the 15th century[3].

Swedish forces and Russian troops used the **cadavers of plague victims** during battle in 1710[3].

**Sir Jeffrey Amherst**, the British commander ordered the use of smallpox against the native Indians during the French-Indian War in 1754[3].

The strategy of using infectious substances for **polluting wells** and other sources of water was in use in many 20th-century conflicts like the American and European wars[3].

Germans tried to **ship horses and cattle inoculated with anthrax** to the USA and other countries during World War I[3]. Germany also spread plague in Russia and cholera in Italy[3].

Although the **1918 Spanish flu** was naturally occurring, it was the deadliest pandemics in the world history in which over 500 million people were infected and between three to five percent of

the world's population died[3]. Such pathogens have been cultured and developed in the laboratories and weaponized due to advancements in the technology posing a serious threat to the mankind upon its usage as an agent for bioterrorism.

The Japanese tested agents like anthrax, plague, cholera, gas gangrene on the prisoners of war as a part of the most **notorious biological warfare program (called Unit 731)** where more than 10,000 prisoners are believed to have died because of such experimental inoculations between 1932 and 1945[3].

The Japanese military released plague infected fleas **against civilians in China to initiate plague epidemics** that resulted in more than 10,000 casualties ed in the city of Changteh alone in 1941 due to the weaponized plague[3].

**Post-World War II**

*"In the 20th century, only ten events were recorded during the first 70 years, whereas 17 and 153 events were recorded from 1970 to 1989 and from 1990 to 1999, respectively"*. (*Greub, G., & Grobusch, M. P. 2014*).

**North Korea** is accused of starting cholera epidemic in South Korea in 1970.

Countries like **Iraq** had cultivated pathogens like *Bacillus Anthracis*, Botulinum toxin and Clostridium perfringens and had developed potent modes for their dispersal like bombs, rockets and aircraft spray tanks[1]. In 1985, Iraq had produced bioweapons like 19,000 liters of botulinum toxin (10,000 into munitions) and 8,500 liters of anthrax (6,500 into munitions)[13]. During the **Gulf War**, Iraq armed 100 bombs and 15 missile warheads with botulinum toxin and 50 bombs and 10

missile warheads with anthrax[13]. It had the capability to deliver biological agents from crop sprayers and remote-controlled helicopters for spraying aerosol agents such as anthrax[13].

Mischievous individuals like **Aum Shinrikyo** from Japan had released Sarin a nerve gas in the Tokyo subway[1]. Not only this but he had further plan of using anthrax bacillus, botulinum toxin with their supportive nutrient media and disperse them through drones having spray tanks[1]. His group had even **travelled to Zaire in 1992 to get the samples of Ebola virus** and be able to culture and weaponize them[1].

**Russia had a bioweapons facility named Vector in Koltsovo**, Novosibirsk that had been cultivating smallpox virus along with others like Ebola, Marburg and the Machupo and Crimean-Congo hemorrhagic fever viruses[1].

**A religious group in Oregon in USA** spread Salmonella typhimurium bacteria in several salad bars and caused 751 disease cases, so that members of that sect might win a local election[2].

Countries involved in the biological weapons program has increased from 4 in 1960s to 11 till 1990s[1].

The horrendous terror attacks on world trade center and the Oklahoma City Federal Building are discerning to understand the reach of the terror groups and the possibilities of bio terror attacks[1].

**Biological warfare agents can be easily spread as an aerosol using equipment such as spray devices, or via bombs or missiles from airplanes, ships, or vehicles, and via food or water or via letters**[2]. Terrorist organizations like Al Qaida, have expressed their desire to use biological weapons to cause mass casualties[13]. Documents recovered from **Al Qaeda facilities in**

**Afghanistan** showed that Osama bin Laden was **pursuing biological weapons research program** in a facility in southern Afghanistan near Kandahar[13].

The **anthrax mailings in the USA** had the military-grade anthrax agent, its delivery was in an unsophisticated way but surely proves terrorists' ability to acquire high quality anthrax[4]. **Bacillus Anthracis has been deliberately released via mail delivered to USA**, to the US State Department, the Pentagon, and news media such as ABC, NBC and the New York Times[2]. Since September and October 2001, 22 persons had been diagnosed with B. anthracis infection, either cutaneous or pulmonary, five patients with confirmed pulmonary anthrax infection died[2].

**History is reminiscent of doctors who have committed heinous crimes**, betraying the quintessence of medicine[6]. Nazi doctors tried in 1946 at the Nuremberg Medical Trial for unethical practices, Ishii Shiro led the Japanese biological warfare research initiative, known as Unit 731, in Manchuria where human beings were infected with anthrax, yellow fever, and at times were dissected alive to study the effects[6]. In 1999, 4-year trial was conducted for Wouter Basson, a South African cardiologist for his alleged involvement in attempts to genetically engineer pathogens to infect only non-white people, for the deaths of political prisoners used in research, and for the use of toxins for assassination of political adversaries[6]. This shows the extent to which individual thoughts can proceed and get engaged into such inhuman, unethical and despicable acts. Thus, the presence of such biological agents in any part of the world under whatever security, the possibility of them being misused can never be ruled out as such custodians of the deadly biological agents are amenable to manipulation either at the behest of other nations or due to their own personal beliefs may be due to religious fanaticism or other vested interests.

## b) Assessment of threat posed by various Biological Warfare Agents

Microorganisms like bacteria, virus and fungi or toxins, can be deliberately dispersed to incapacitate or cause disease and death to humans, animals or plants on a large scale[2]. Biological warfare agents can be naturally occurring but also can be genetically modified and is very worrisome if misused, opening new and dangerous possibilities[2]. Many of these pathogens are relatively easy to produce and are inexpensive and very basic microbiological training is needed[2]. The effects of these agents are not immediate as they require some incubation period to grow and produce the signs and symptoms thus allowing the perpetrators to silently operate and vanish before being caught[2]. The healthcare system is overburdened and the risk of epidemic spread of the disease looms large[2].

**Characteristics of biological agents:**

"*Biological weapons share seven characteristics that make them ideal weapons for rogue nations and terrorists: 1) ease and low cost of production; 2) ease of dissemination as aerosols; 3) efficient exposure of great numbers of people through inhalation; 4) delayed effect; 5) high potency; 6) high subsequent mortality and morbidity; and, 7) their ability to wreak psychological havoc".* (*Bullock, B. F. 2002*).

The probability of attack with a biological agent is the most common method used for assigning priority in developing public health policy for a bioterrorist attack[23]. Using 10 criterion to category A agents (CDC), anthrax scored the highest, followed by smallpox. Tularemia was the lowest scoring agent[23].

"*Disease impact criteria were as follows**: infectivity of the agent** (person-to-person transmission potential), **case fatality rate, stability** in the environment and ease of decontamination, **incidence** of disease per 100,000 exposed persons in the worst-case release scenario, and reports of **genetic modification** of the agent for increased virulence. Probability of attack criteria was designated as: **global availability** and ease of procurement of the agent, **ease of weaponization**, and **historical examples** of use of the agent for an attack. Prevention/intervention criteria were categorized as: **lack of preventability** of the disease (such as by vaccination) and **lack of treatability** of the disease (such as by antibiotics). For each of the scoring categories, a score of 0 to 2 was assigned for each category A agent as follows: 0 _ no, 1 _ some/low, and 2 _ yes/high. The sum of these scores (of a total possible score of 20) was used to rank priority."*. (*MacIntyre, C. R., Seccull, A., Lane, J. M., & Plant, A. 2006*). (Tables I-XI).

Based on **priority and risk assessment grid** (*MacIntyre et al*), using 10 criteria to category A agents (CDC), **anthrax scored the highest**, followed by smallpox. Tularemia was the lowest scoring agent. (Table XI).

## c) Assessment of Preparedness in response to a possible biological attack

It is needed to be vigilant and prepared for unexplained illnesses as an inescapable part of the public health effort to protect against bioterrorism[33]. Response to a bioterrorist attack involves important issues in public health, bioethics, and progressivism[22].

We **seriously lack an effective level of preparedness** to be able to provide a countermeasure to mitigate the catastrophic outcome in the event of a terrorist attack with a biological weapon[1]. There is a requirement of more international cooperation for threat assessment and planning, and to

enhance awareness, at the same time to limit the proliferation of knowledge and technology of production of biological weapons to rogue states or groups[2].

The world has witnessed the use of chemical and nuclear arsenal which has certainly garnered lots of attention, but the challenges posed by chemical and nuclear explosions are far more manageable compared to a biological exposure. **The biological attack in the form of smallpox or anthrax is going to be more devastating and challenging** in terms of its containment given its nature, magnitude and speed of spread. It's like a silent bomb exploding in our vicinity and we are caught unaware. By the time a confirmatory diagnosis is made its often quite late and the biological agent would have spread across the length and breadth.

**Response to such an emergent situation**: In a short span of time there is a huge influx of patients putting the existing healthcare setup under extreme pressure that too in a situation where the diagnosis is also not definite. The availability of adequate number of hospital beds with proper isolation is a matter of serious concern. The healthcare providers are the most vulnerable population as they come in direct contacts with the patients and are largely unprotected. By the time some definitive diagnosis is made large number of healthcare providers already get exposed to the disease. The number of people like relatives, friends and others in contact with such patients is generally very high and in thousands. It is extremely difficult to manage such large numbers given the resource constraints. Early and confirm diagnosis through proper and reliable laboratory tests is the key to isolate the confirmed cases thus obviating the need to cater for a large suspected population. However, availability of such tests is a matter of concern at a global scale. Mass vaccination is the probable solution. Huge logistics planning must be in place for effective and efficient vaccination. It is a matter of policy decision regarding who needs to be vaccinated whether

the contacts of the confirmed cases or all the population and not sparing even one person. The vaccines stocks would deplete fast and would overwhelm the manufacturing capacity.

**Response to Anthrax**: There is hardly any vaccine available to be used on a mass scale. Use of antibiotics as a prophylactic measure is a policy decision and if so which antibiotic and to whom? Production of such antibiotics on a large-scale need's consideration. Defining the susceptible population is important for definitive action. It is quite challenging to segregate the cases of anthrax from common fever and cough cases that is also evident during winters is very difficult since the premonitory symptoms of anthrax are same, but the cases proceed to death in just 24-48 hours.

It is **incumbent upon the medical fraternity to educate the policy makers and the public** regarding the impending threat and the serious and urgent need to put in place an effective preventive and response mechanism.

The preparation must be in terms of **detection**, **diagnosis**, **epidemiological characterization** and an **effective and efficient response** to bioterrorism. This must be along with the creation of a **trained pool** of adequate numbers of **clinicians, researchers and epidemiologists**. The capacity for **surveillance** needs augmentation at all levels coupled with creation of a vast **network of laboratories and diagnostic equipment's**,[1].

There is an inescapable and urgent need to have a **strategic plan** in place for emergency distribution of medical supplies, especially antibiotics and vaccines to cope with the magnanimous threat posed by bioterrorism. Creation of a trained workforce, to the **stocking of vaccines and other medicines** is a time and resource consuming activity that requires due deliberation and appropriate resource allocation. It's a humungous task at hand to be ignored to our own peril[1].

**Public-health infrastructure** must be strengthened as an effective step to reduce the suffering that could be inflicted by terrorist groups upon a large section of population using biological agents[2]. There must be an effective and efficient **coordination and communication mechanism** with a **unified command system** controlling all the levels of healthcare involving the authorities from local to central levels to reduce the response time[2].

The greatest challenge faced by those engaged in activities of bioterrorism preparedness is a **lack of explicit standards**[6]. Vulnerabilities across a community can be easily assessed and defined but it is extremely difficult to define preparedness because of variety of options available for terrorist attacks[6].

The **US General Accountability Office** found that the efforts of public health agencies have improved the capacity to respond to major public health threats, but **gaps in preparedness remains in terms of workforce shortages and in disease surveillance and laboratory facilities**[9]. Many hospitals lack the capacity to respond to large-scale infectious disease outbreaks due to lack of adequate equipment's, medical stockpiles, personal protective equipment's, isolation facilities, and staff trained for disease detection is insufficient[9].

**Biodefense initiatives** have the potential to reshape the future of global public health[10]. Although every outcome cannot be predicted, nor the mistakes be prevented but surely, we can learn from the distant and immediate past[10].

Protection from bioterrorism is **primarily a central governments issue** and cannot be left on to the states. Laws should provide for funding for training in the detection and treatment of diseases caused by pathogens that could be used as biologic weapons[10]. Laws should also provide for improvements in communication and coordination in response to such an attack[10].

**Few key factors**: The ability of medical professionals to identify the bioterror attack, the capability of laboratory professionals to rapidly detect and confirm the agent, an epidemiological investigation to determine the source of the infection, and communication and coordination among all the responders involved in the event will determine an effective response to bioterrorism[12].

The **public health infrastructure cannot be rebuilt overnight** after years of neglect[13]. The policy window exists for a finite period and public apprehension created should be used to generate public and political support for broader public health concerns and define the nature of the problem creating the window[16].

The **preparedness involves cross cutting issues** as many of the objectives inherent in bioterrorism preparedness apply to emergency preparedness and public health as well[17]. Anti-bioterrorism programs should be based on enough evidences, public debate, independent reviews, considering the real nature of the threat and the negative consequences of the responses[18].

Expert analysis with **participatory decision-making** involving citizens and empowering patients to take a more active role in their treatment will go a long way in tackling the posed threats[22]. A strong **partnership between the public and private sectors** will also be important[30]. The best way seems to be bringing to command some top military generals who by their training and discipline can deliver the best results in such catastrophic events[31].

The preparations for future bioterrorist incidents, must be at the **national level**[4]. Threat assessment methodologies must consider all the factors comprising the threat instead of a single factor focus either on the terrorists or the biological weapon[4].

**Policy makers and scientists must consider four key elements** of the threat: ***who* (the actor), what (the agent), *where* (the target), and *how* (the mode of attack)**, the interaction of these

components will determine the impact of a bioterrorist attack[4]. The release of a very contagious agent by a highly efficient dissemination technique could result in thousands or more casualties[4]. The options available to terrorists to cause catastrophic casualties are few but available with vast future potential though there are technically difficulties[4]. The option of producing a low- to mid-range bioterrorism incident are more numerous, technically less challenging and are more suited to the concepts of terrorism[4].

Despite the low probability of a catastrophic bioterrorist attack, the **uncertainties surrounding bioterrorism will remain** with ample cause for concern as the rapid development of biotechnology and the diffusion of knowledge may lower the technical bar over time[4].

Since the **financial resources are finite** we should invest in measures that promote preparedness for a variety of agents and scenarios[4]. Money spent on preparing for a specific agent, such as building stocks of smallpox or anthrax vaccine or purchasing antidote for botulinum toxin, cannot be spent on the preparedness for other organisms which requires a different kind of resource to cater to its different requirements[4].

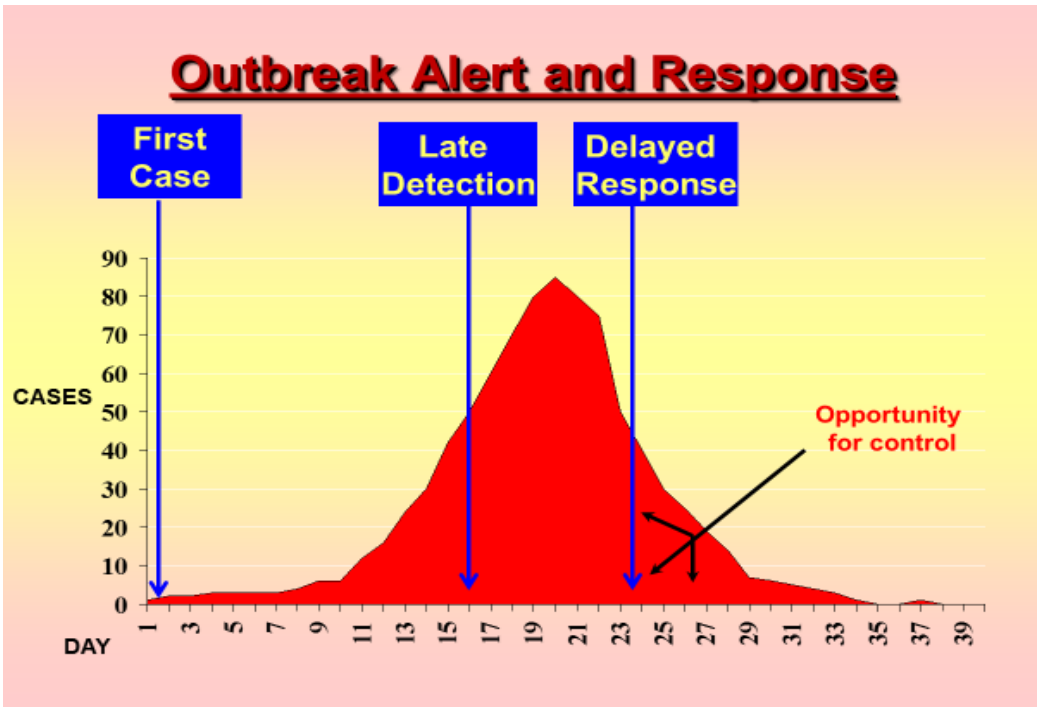
The emphasis should be on **building capacity in the public health system** that must be capable of detecting and assessing many bioterrorism scenarios and addressing most contingencies given the variety of combinations among actors, agents, targets, and dissemination techniques[4]. We must focus on building a **"system of systems"** that integrates a broad range of activities capable of addressing both a wider range of bioterrorist contingencies and natural outbreaks of infectious diseases[4].

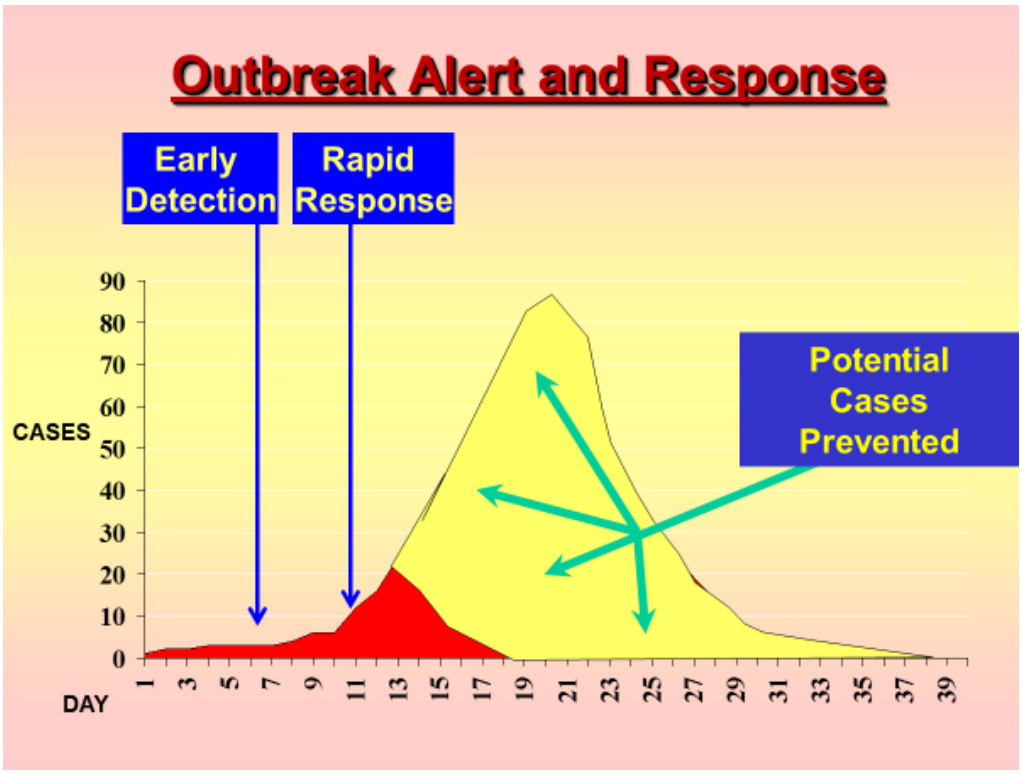
**Public health resources like surveillance systems, epidemiological expertise, and laboratory networks, must be integrated and connected for sharing information and communicating across other sectors like health care, emergency management, law enforcement systems**[4].

Covert attacks would strain the public health system to detect the attack, diagnose the agent and illness, and determine the scope of exposure and future course of the illness[4]. Early detection of a bioterrorist event will allow an early assessment of the event, early institution of medical care to the exposed[4]. A **national surveillance system** will provide an early warning of unusual outbreaks of disease and will be a critical component of our preparedness[4]. This system will depend on an information from electronic data networks connecting one and all and providing regular analyses of the data for the presence of unusual trends that could indicate a bioterrorist attack[4]. Additional data like increase in flu-like symptoms, over the counter drug sales, or absenteeism can provide crucial information regarding possible bioterror attacks and that requires a robust information infrastructure for collecting, analyzing, and sharing information from all possible sources[4].

**Epidemiologists** play an important role in surveillance and detection and in tracing the outbreak back to its source to determine who was in the exposed area at the time of release and recommend medical management accordingly[4].

**Public health laboratories** play a critical role in the detection of bioterrorist incidents and in identifying the biological agent released[4]. Upgrading laboratory capacity by increasing the range of bioterrorist agents that can be identified and making diagnostic exams faster and more accurate will be critical to an effective preparedness system[4].




Surveillance, epidemiology, and laboratory capacities for detection, assessment, and response system will all depend on a **robust information infrastructure** to meet the bioterrorist threat[4].

Accurate and timely information will be crucial for decision making process in crisis and will provide credible and consistent information to the public to reduce panic[4]. Any response system must have a **built-in flexibility**, so that it can respond appropriately to a large-scale or small-scale event based on a tiered, scalable approach commensurate with the scale of the attack[4].

The public health system will require **sustained investment in people, technology, and materials** to be able to cater to any kind of possible bioterror attack[4]. A strong partnership between the central, state and local governments and the public and private sectors especially private health care institutions like hospitals and private-practice physicians will be very important to enhance the capacity[4].

**Doctors are the first line responders** as patients will turn to their doctor, who will be expected to **maintain a high index of suspicion** and recognize and act against the rare diseases that top most threat lists[6]. Most of the illnesses resulting from such an attack will have an **incubation period**, **providing a window of opportunity** which can be strategically used by the doctors to start a prophylactic treatment[6].

Measures such as bio-surveillance, global laboratory and research cooperation, diagnostics, stockpiles of effective medical stores, and increased response and mitigation capabilities aim to **reduce consequences of an attack**, afford earlier detection, and reduce vulnerability but they do not act as a direct deterrence to the motivation of the fringe elements but are passive, defensive deterrence measures[5].

**Active deterrence strategies** which involves actions and policies including the application of expressive force inflicting punishing retaliation against aggressors, preventing them from doing something like a bio-terror attack, by sending a strong political message[5]. Active deterrence is

more dynamic vis-à-vis passive and may incorporate escalating threats in response to an adversary[5]. During Gulf war such strategies were used against Saddam Hussain's regimen. In the present war going on in Syria the world powers are constantly threatening Bashar-al-Assad's regimen not to resort to any kind of chemical weapon usage against anyone including civilians.

There are several types of definable strategies like **Indirect deterrence focusing on third party** players with heavy retribution for their roles in terrorist attacks, **Collective actor deterrence** utilizing the power and influence of institutions like the United Nations, NATO, **Internalized deterrence** plays off the psyche and subconsciously deter a terrorist through social taboos and norms, **Tailored deterrence** to individualize each situation leveraging cultural political, social and other specific knowledge[5].

**A strong public health infrastructure reduces the vulnerability** to bioterrorism attack since the biological weapon will have little or no effect on the target country because of a robust public health sector, this may deter a foreign terrorist from launching a biological weapons attack[5]. On the contrary if the public health infrastructure is weak it rather encourages the terrorist to resort to bioterror attack as it is going to cause heavy casualties[5].

The present-day medical curriculum does educate about bioterrorism but surely it requires to get instilled in practice rather than just remaining a theory in medical books. The developed world is bracing up to the increased threat of bioterrorism given their robust public health infrastructure and conduct frequent drills to tackle an emergent situation of such nature, it remains to be seen how far such preparations can be effective in containing the spread. The developing and the third world countries don't have even basic public health system in place leave apart any preparations for bioterror attack. There is no such literature available to demonstrate the extent of preparedness

of the world community to face the threat of biological agents. Since the threat of bioterrorism is global therefore preparations in isolation is not going to deliver the desired outcomes as the borders cannot contain the spread of the biological agents given the interconnectedness of today's world and the fact that the spread of the disease occurs very fast before diagnosis is established and treatment is instituted.

## Discussion

The anthrax mailings in the USA had the military-grade anthrax agent, its delivery was in an unsophisticated way but surely proves terrorist's ability to acquire high quality anthrax[4]. This shows that the terrorists are keeping pace with the advancements in the biotechnology and are using biological agents that are highest in the risk assessment grid. The turmoil in various parts of the world creates a situation of frustration that can push the rogue nations and the disgruntled elements to resort to biological weapons as they are relatively easy to procure and disseminate causing mass casualties without exposing the perpetrators.

The first responders in the present times and may be in future also would have hardly seen any such cases arising out of biological attacks and may not be aware about the diagnostic and treatment modalities available. By the time some conclusive diagnosis is made it would be quite late and several hundreds would have already got infected and passing on the infection to the next susceptible hosts who are caught unaware. This will have a cascading effect unless an urgent and immediate check is instituted to stop the spread and treat the already infected. This whole exercise is going to be quite resource and effort intensive. There is no effective means to diagnose and treat conditions arising out of such attacks and the existing public health infrastructure in most of the

countries are in dismal state. Though the developed nations are building up their public health capacities but still it's a long way to go to achieve any credible results.

The awareness regarding bioterrorism is gaining pace at the world arena and efforts to deal with a possible bioterror incident is also slowly picking up. But **it's going to be a long and arduous process before any credible awareness and preparedness builds upon**. It is going to be a **very resource intensive**, heightened security measure needing substantial resource allocation and preparation at a war footing.

The extent of damage in a chemical and nuclear disasters can be defined, the injured and the dead can be counted, the efforts can be effectively channelized to stabilize and recover but **in biological attacks the cases keep on pouring in from various geographical locations and the reaction time is very less**.

**Spread of biological agents cannot be kept contained within borders of any nation** and given the interconnectedness of the world today it spreads across the globe and by the time such attacks are confirmed hundreds and thousands of patients already get exposed and infected and the spread of the diseases is exponential.

## Recommendations

Based on the threat perception and the preparedness to respond to such emergent situations it is recommended that the **international institutions and public health bodies must get their acts together** and build upon the common consensus to face this global threat. Working in solitude thinking that the borders are safe, and any kind of threat posed by bioterrorism can be warded off based on national preparedness will be a mistake with grave consequences.

Public health response needs to be timely because of only a **short window** to provide prophylaxis to minimize the number of casualties[11]. Based on **CDC** guidelines focused on preparedness activities **five functional areas** need special importance: **preparedness planning and readiness assessment, surveillance and epidemiology capacity, biological laboratory capacity, chemical laboratory capacity, and health alert network and training**[11].

There is a requirement of **integration of the surveillance and epidemiology capacity, biological laboratory capacity, chemical laboratory capacity, and health alert network and training**. This integrated network will build upon the global capacity to detect and respond towards the threat in any part of the world and effectively and efficiently contain the spread of such deadly consequences.

There is an inescapable requirement to **develop vaccines through more and more research against the dangerous biological agents and vaccination for one and all should be incorporated in the routine schedule**. This seems to be the best and cost-effective strategy to make the global community immune to any such deadly disease from occurring and spreading across populations.

We must build capacities like stockpiles of vaccines, antibiotics, and other supplies and ensure rapid distribution of these materials and **connect the "front-end" awareness and assessment** capacities **to the "back-end" of the bioterrorism response system**[4]

**Procurement of personal protective equipment's** (PPE) at least for the first responders so that they are safe to provide necessary care to those who require attention. Sample of the PPE is given below:

## Conclusion

Bioterror attack is very difficult to detect or interdict as they are silent, but its impacts are lethal and more crippling than the actual wars. Its use is done in a very covert manner. By the time the effects are visible it is generally too late and containment of the spread of the biological agents becomes a very difficult and challenging task. Advancements in the biotechnology has made it easy for the development of biological weapons. There are individuals, groups, and governments who in the past have developed, intended and even used biological agents against humanity. Medical sciences have made remarkable progress within the last two centuries, but despite that the threat can't be written off as it remains a potent in the present and the times to come. It is pertinent to mention that the only way to safeguard against such threats is through international deterrence, cooperation and integration of services involving surveillance, detection, diagnosis and treatment. Upgradation of the public health infrastructure across the world is an expensive and inescapable requirement.

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## TABLE I

## INFECTIVITY OF CATEGORY A AGENTS

| Agent | Score | Rationale |
|---|---|---|
| Anthrax | 0 | Inhalational anthrax is not transmissible and infectivity of treated cutaneous anthrax is negligible. |
| Smallpox | 2 | Smallpox is infectious. The value of *R* could lie between 3 and 15, but is unknown given levels of contemporary immunity and underlying immunosuppression. A consensus statement by the U.S. Public Health Service estimates $R_0$ to be 5. |
| Botulism | 0 | Not infectious from person to person. |
| Plague | 1 | Only pneumonic plague is infectious. The bubonic form is not infectious. |
| Tularemia | 0 | Not infectious from person to person. |
| Viral hemorrhagic fevers | 2 | Of category A agents, only the filoviruses (Marburg, Ebola) and arenaviruses (Lassa fever and New World arenaviruses) are infectious from person to person. The most likely viral hemorrhagic agent for bioterrorism would be that with proven record of person-to-person transmission. |

Source: MacIntyre, C. R., Seccull, A., Lane, J. M., & Plant, A. (2006)

## TABLE II

## CASE FATALITY OF CATEGORY A AGENTS

| Agent | Score | Rationale |
|---|---|---|
| Anthrax | 2 | Case-fatality estimates for inhalational anthrax are based on incomplete information. A case-fatality rate of 86% was reported from Sverdlosk (1979), a rate of 89% was reported for a U.S. outbreak. In the 2001, attacks in the U.S., 5 of 11 cases died. Records in the U.K., before the availability of antibiotics, record a 97% case fatality. Death from cutaneous disease is rare if treated with antibiotics. About 10% of cutaneous cases progress to systemic disease if not treated with antibiotics. |
| Smallpox | 2 | The mortality of variola major is about 30%, but these data are from an era where there were significant levels of population immunity to the virus. In an outbreak in 1972 in the former Yugoslavia, 35 of 175 cases died. The current population has virtually no immunity to smallpox, a higher proportion of immunocompromised people, but we also have access to better medical care. |
| Botulism | 1 | The case fatality varies by toxin type, with type A causing more severe disease than other types. Inhalational botulism has only been described in three human cases. A bioterrorist attack is more likely to involve contamination of food or small water supplies. The case fatality rate is between 5 and 10%, but is higher (up to 60%) without critical care. |
| Plague | 1 | Without antibiotic therapy within the first 24 hours, primary pneumonic plague results in death from overwhelming sepsis, usually within days. Without therapy, mortality of pneumonic plague approaches 100%. With rapid therapy, it is about 25%. |
| Tularemia | 0 | The case fatality rate in the U.S. is 1.4%. Prior to antibiotics, the overall mortality from the more severe type A strains was 5–15%, and fatality rates as high as 30% to 60% for untreated pneumonic and severe systemic forms of disease have been reported. |
| Viral hemorrhagic fevers | 2 | These include Ebola, Marburg, Lassa fever, New World arenaviruses, Rift Valley fever, yellow fever, Kyasanur Forest disease and Omsk hemorrhagic fever viruses.<br>The case-fatality rate is 1–90%, depending on the infection—it is low for Lassa fever, but high for Ebola. If used in an attack, more virulent agents are likely to be chosen. |

Source: MacIntyre, C. R., Seccull, A., Lane, J. M., & Plant, A. (2006)

## TABLE III

## STABILITY IN THE ENVIRONMENT OF CATEGORY A AGENTS

| Agent | Score | Rationale |
|---|---|---|
| Anthrax | 2 | Stable in the environment and difficult to decontaminate. |
| Smallpox | 1 | Smallpox is inactivated by standard disinfectants or ultraviolet light. However, virus can survive for very long periods (years) in a protein matrix such as a scab, if protected from ultraviolet light. |
| Botulism | 1 | Toxin is naturally inactivated in fresh water within 3–6 days, and inactivated by standard chlorination of potable water within 20 minutes. The heat resistance of spores varies. Many strains require temperatures above boiling for spore inactivation. Some spores may survive boiling for up to 3–4 hours or temperatures of 105°C for 100 minutes. Spores are readily killed by chlorine (either as chlorinated water or as diluted solutions of hypochlorite). Although botulism spores are heat stable, botulinum toxin is heat labile. Botulinum toxin can be inactivated by heating ( 85°C for 5 minutes). |
| Plague | 1 | *Yersinia pestis* does not sporulate and does not persist in the environment for prolonged periods. In a recent study, it was viable for up to 5 days on paper under controlled conditions, but only several hours in normal conditions. Estimates for survival in sunlight are about 4 hours. It is estimated that an aerosol would be infectious for about 1 hour. Commercially available bleach or 0.5% hypochlorite solution is adequate for cleaning. |
| Tularemia | 2 | Stable in the environment, but in the case of water-borne attacks, chlorination is thought to have at least some inactivating effect. |
| Viral hemorrhagic fevers | 1 | The stability varies depending on the virus. Filoviruses (Marburg, Ebola) are probably moderately stable in the environment. For both filoviruses and arenaviruses, close contact is required for transmission, and hospital infection control is a key factor in disease control. |

Source: MacIntyre, C. R., Seccull, A., Lane, J. M., & Plant, A. (2006)

## TABLE IV

## INCIDENCE OF DISEASE IN WORST-CASE SCENARIO OF RELEASE OF CATEGORY A AGENTS

| Agent | Score | Rationale |
|---|---|---|
| Anthrax | 2 | The hypothetical worst-case scenario is 3 days after release of 50 kg of spores along a 2-km line upwind of a city of 500,000, 125,000 infections might occur, producing 95,000 deaths.[4] This is a rate of 50,000/100,000. Actual point release in Sverdlosk caused 100 cases (77 confirmed, exposed population approximately 5,000 in a city of 1 million) in a narrow band to 4-km downwind of the factory. This is a rate of 2000/100,000 exposed population. |
| Smallpox | 2 | Modeling by Bozette et al suggested a high-impact airport scenario would result in 50,000/100,000 exposed people. This is a minimum number, as second-generation cases are not counted. Assuming airborne spread indoors (away from direct sunlight/ultraviolet light), with an efficient aerosolizer, a higher attack rate could result from an attack in a large office building with an air distribution system. |
| Botulism | 0 | Said to be technically very difficult to disperse and less effective as an aerosol. Ingestion is more toxic than inhalation. Aerosol release was attempted three times by Aum Shinrikyo without success. A point source release is thought to result in 10% fatalities in the population within 0.5-km downwind. In U.S. outbreaks of foodborne botulism, an incidence of 2.6 cases per outbreak is the average. The incidence from food or airborne attack is therefore probably low. However, water contamination is a potential mechanism of attack, and if enough toxin is produced, large urban supplies could be effectively contaminated, resulting in a higher attack rate. |
| Plague | 1 | A 50-kg bomb released over city of 5 million might result in an estimated 150,000 infections and 36,000 deaths. The aerosol would last about an hour and spread up to 10 km. The estimated incidence from this type of attack is 3000/100,000. This assumes a method to protect the organisms from the heat of the explosion, which will not necessarily be the case. Aerosol spread such as from a small crop-dusting plane is more likely due to the relative ease of this method compared to a bomb. In this case, the incidence would be much lower. |
| Tularemia | 1 | A World Health Organization model suggests a 50-kg bomb over a city of 5 million would produce 250,000 incapacitating illnesses and 19,000 deaths. This is an incidence rate of 5000/100,000. |
| Viral hemorrhagic fevers | 1 | The worst-case scenario would involve filoviruses (Marburg/Ebola), which are transmissible from person to person. There have been 18 documented outbreaks resulting in 1,500 cases. Nosocomial transmission is of major importance in developing countries where appropriate barrier precautions have not been in place. Up to 425 cases per outbreak were recorded in African outbreaks, and lower rates where appropriate barrier precautions in place. Data for other viral hemorrhagic fevers are inadequate. |

Source: MacIntyre, C. R., Seccull, A., Lane, J. M., & Plant, A. (2006)

## TABLE V

## REPORTS OF GENETIC MODIFICATION TO INCREASE VIRULENCE OF CATEGORY A AGENTS

| Agent | Score | Rationale |
|---|---|---|
| Anthrax | 1 | Modification of anthrax toxin lethal factor can result in decreased toxicity; therefore, it is plausible that genetic modification to achieve the opposite effect is possible. Genetic modification of anthrax for tetracycline resistance has also been reported. |
| Smallpox | 2 | The India-1 strain used in the former Soviet Union had a shorter incubation period in non-human primates. The Soviets reportedly experimented with inserting Lassa virus genes into variola. The genome is fully sequenced, so genetic modification is possible. The ectromelia virus, an orthopoxvirus which causes mousepox, and which is genetically closely related to smallpox, has been engineered to become 100% lethal. |
| Botulism | 0 | No reports. |
| Plague | 1 | There are reports of the Soviet program developing strains of *Yersinia pestis* resistant to multiple antibiotics and engineered to overcome the protection of available vaccines. |
| Tularemia | 1 | Reports have been made of modification to change antibiotic resistance profiles of *Francisella tularensis*. |
| Viral hemorrhagic fevers | 1 | There is a report of Lassa virus genes being incorporated into Variola in the Soviet program. |

Source: MacIntyre, C. R., Seccull, A., Lane, J. M., & Plant, A. (2006)

## TABLE VI

## GLOBAL AVAILABILITY AND EASE OF PROCUREMENT OF CATEGORY A AGENTS

| Agent | Score | Rationale |
|---|---|---|
| Anthrax | 2 | Widely available |
| Smallpox | 0 | There are only two documented repositories of smallpox in the world, both in level 4 containment facilities. However, large amounts of smallpox were produced in the former Soviet bioweapons program, and these stocks have not been accounted for. |
| Botulism | 2 | Widely available, including as a cosmetic formulation. |
| Plague | 2 | Widely available. |
| Tularemia | 0 | Difficult to obtain and procure. |
| Viral hemorrhagic fevers | 0 | Difficult to obtain and procure. |

Source: MacIntyre, C. R., Seccull, A., Lane, J. M., & Plant, A. (2006)

## TABLE VII

## EASE OF WEAPONIZATION OF CATEGORY A AGENTS

| Agent | Score | Rationale |
|---|---|---|
| Anthrax | 2 | Simple means of attack, such as through the postal system, are available. |
| Smallpox | 1 | The former Soviet bioweapons program developed weaponized (aerosolized) smallpox. |
| Botulism | 2 | Readily introduced into food or water sources |
| Plague | 1 | Plague has been successfully weaponized by the former Soviet bioweapons program, but not the U.S. |
| Tularemia | 1 | *F. tularensis* has been weaponized by USSR and USA and modified for resistance by USSR. |
| Viral hemorrhagic fevers | 1 | Ebola, Marburg, and Lassa viruses have been weaponized in the USSR.[25] Yellow fever and Rift Valley fever viruses have been weaponized in the U.S. |

Source: MacIntyre, C. R., Seccull, A., Lane, J. M., & Plant, A. (2006)

## TABLE VIII

## HISTORICAL EXAMPLES OF USE OR ATTEMPTED USE OF CATEGORY A AGENTS

| Agent | Score | Rationale |
|---|---|---|
| Anthrax | 2 | Several examples, including recent attacks in the United States of use of anthrax as a weapon. |
| Smallpox | 1 | The suggestion of spread of smallpox to American Indians in contaminated blankets by Lord Jeffrey Amherst is documented. However, other European contacts might have had a role in the spread of smallpox through the immunologically naive population. |
| Botulism | 1 | Aerosol release was attempted three times by Aum Shinrikyo without success. |
| Plague | 2 | The Japanese released plague-infected fleas in Manchuria in WWII, producing outbreaks. |
| Tularemia | 2 | An outbreak of tularemia in 1942 affected thousands of German and Soviet troops in the Crimea, with a 70% incidence of the pneumonic form. |
| Viral hemorrhagic fevers | 0 | There have been no documented instances of VHF's being used in human populations. |

Source: MacIntyre, C. R., Seccull, A., Lane, J. M., & Plant, A. (2006)

## TABLE IX

## LACK OF PREVENTABILITY OF THE DISEASE (SUCH AS BY VACCINATION OR ANTIBIOTIC PROPHYLAXIS) BY CATEGORY A AGENTS

| Agent | Score | Rationale |
|---|---|---|
| Anthrax | 0 | A vaccine is available, but not in large quantities. The major role of vaccine would be in protecting armed forces and in a post-attack scenario, e.g., to allow postal workers to return to work. |
| Smallpox | 0 | An effective vaccine is available and was used to eradicate smallpox globally. Stockpiles of first generation vaccines are limited, but several second-generation vaccines are being produced. |
| Botulism | 2 | Antitoxin is available, but of limited value. It does not prevent or reverse disease, but prevents worsening of paralysis if given early enough. |
| Plague | 1 | Antibiotic prophylaxis is thought to be effective, but not supported by extensive data. |
| Tularemia | 1 | Antibiotic prophylaxis is effective if given early. |
| Viral hemorrhagic fevers | 1 | An effective yellow fever vaccine is available. |

Source: MacIntyre, C. R., Seccull, A., Lane, J. M., & Plant, A. (2006)

## TABLE X

## LACK OF TREATABILITY OF THE DISEASE CAUSED BY CATEGORY A AGENTS

| Agent | Score | Rationale |
|---|---|---|
| Anthrax | 1 | Supportive treatment, plus some evidence of benefit from antibiotics if given early in the course of inhalational anthrax. |
| Smallpox | 2 | The role of antivirals such as Cidofivir and its derivatives is unknown. |
| Botulism | 2 | Supportive treatment only. Antitoxin is of limited value, since it does not reverse disease. |
| Plague | 0 | Antibiotics are effective. |
| Tularemia | 1 | Antibiotics are of limited use. |
| Viral hemorrhagic fevers | 2 | Supportive treatment only. |

Source: MacIntyre, C. R., Seccull, A., Lane, J. M., & Plant, A. (2006)

## TABLE XI

### PRIORITY AND RISK ASSESSMENT GRID FOR CATEGORY A BIOTERRORISM AGENTS[A]

| | Anthrax | Smallpox | Viral Hemorrhagic Fevers | Botulinum Toxin | Plague | Tularemia |
|---|---|---|---|---|---|---|
| Person to person transmission | 0 | 2 | 2 | 0 | 1 | 0 |
| High case fatality | 2[b] | 2 | 2 | 1 | 1 | 0 |
| sStable in environment | 2 | 1 | 1 | 1 | 1 | 2 |
| High number of infections in worst-case scenario | 2 | 2 | 1 | 0 | 1 | 1 |
| Reports of genetic modification of agent for increased virulence | 1 | 2 | 1 | 0 | 0 | 1 |
| Wide global availability | 2 | 0 | 0 | 2 | 2 | 0 |
| Simple methods for weaponization | 2 | 1 | 1 | 2 | 1 | 1 |
| Historical examples of use of this agent as a bioweapon | 2 | 1 | 0 | 1 | 2 | 2 |
| Prevention not possible | 0 | 0 | 2[c] | 2 | 1 | 1 |
| Effective treatment not available | 1 | 2[d] | 2 | 2 | 0 | 1 |
| Final score (20) | 14 | 13 | 12 | 11 | 10 | 9 |

[a] Score: 0 No or low/rare; 1 possible/moderate; 2 yes/high. Source: MacIntyre, C. R., Seccull, A., Lane, J. M., & Plant, A. (2006)

[b] Inhalational anthrax.

[c] Yellow fever is preventable by vaccine.

[d] Cidofivir expensive, not widely available and no demonstrated clinical efficacy.