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Chilling Threats: Bioterrorism and Its Impact on The World of Dentistry

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Abstract

Bioterrorism is the intentional dissemination of biological warfare agents (BWA), like bacteria and viruses, intending to inflict widespread harm within a population. Usually, these biological agents can be found in the natural world. However, sometimes they can be made more harmful by increasing their ability to cause or spread disease, or to resist medical treatment. Aerosol sprays, food and water contamination, or explosives are some of the ways through which dissemination of BWAs occurs. They can strike suddenly without any warning and cause significant mortality and morbidity that can continue for a long period. These attacks can lead to high levels of panic, contamination of the environment, and tremendous demand for emergency healthcare services. This means that healthcare professionals need to be ready at all times. Dentists possess the clinical abilities and medical knowledge that are great assets in the event of a mass casualty. Dentists can be given the chance to receive further focused training to help them respond to natural disasters and other catastrophic events more skilfully. This paper explores the oral and dental aspects of both naturally occurring and bioengineered pathogenic organisms, as well as the signs and symptoms of biological weapons used in mass devastation. Also, it will enlighten the possible contributions of many health sciences, including dentistry, to the fight against bioterrorism.

Keywords: Bioterrorism, dentistry, dentists, biological agents

Introduction

Bioterrorism encompasses a wide range of issues, including micro-events that use minimal technology yet

result in disruption, disease, disability, and catastrophic terrorism with large victim's demise. The last few years have seen an increase in the long-ignored and rejected threat of bioterrorism [1]. By using them, bioterrorists would also be able to defend themselves and get away before any illnesses are discovered. Although it is nearly difficult to completely undo the harm that a disaster does, it is feasible to reduce the potential danger. Disasters are inevitable. As soon as a threat is detected, appropriate measures must be taken to reduce the attack's morbidity and death [2]. One can reduce the danger by creating early warning systems for disasters, creating and carrying out resilience-building plans, and supporting rehabilitation [3].

Terrorism involving the deliberate release or spread of biological agents is known as bioterrorism. These agents, which include bacteria, viruses, and poisons, can exist in naturally occurring forms or be altered by humans [1]. As human knowledge of disease has expanded, the risk of bioterrorism has radically increased, especially since several unstable nations have reserves of biological agents that could potentially be appropriated and used by terrorist groups [4]. There are several methods for dispersing BWAs, but the most popular one is using aerosol sprays; the optimal BWA particle size is 1-5 mm. The main symptoms present in the victims were those of "flu-like" symptoms.

Several common bioterrorism scenarios may have legendary roots and Hollywood connections in film. These include contaminating food with psychoactive chemicals, using poisons and toxins to kill political targets, conducting biological cloud bomb attacks, using dry viral formulations in spray powder form, as well as low-flying cruise missiles that unleash chaos and destruction with genetically modified microorganisms [5].

The American Dental Association (ADA) described the dentist's involvement in bioterrorism attacks in the year 2002. It states that dental professionals are regarded as essential medical community members because of their important role in countering bioterrorism threats. [4]. The dentistry community emerges as a crucial resource during such crises, providing expertise in patient care, infection control, and emergency medical support. In contrast, standard medical institutions may become overloaded [6]. Although they are an essential part of any health team, dentists' contributions haven't received as much attention as they formerly did. Dentists and other oral healthcare professionals can also be effectively used by the emergency medical response system to establish the necessary collaborations, locate and secure resources, and support policy creation, training, monitoring, and assessment [7].

However, due to a lack of training and expertise, dental staff may encounter difficulties during bioterrorist strikes [9]. Dental schools should teach students pandemic and disaster preparation techniques to reduce morbidity and enhance outcomes during such harmful events. Additionally, this would enable dentistry students to identify and neutralize bioterrorist attacks and catastrophic events [10].

This paper aims to enlighten on some historical events of bioterrorism in ancient and modern history, the categorization of biological agents, biological agents that can potentially be used as a bioweapon, and the role of the dentist in combating biowarfare events.

Material and Methodology

To review the literature, Studies were selected from PubMed, Scopus, Web of Science, and Google Scholar without restrictions on publication year, to provide a comprehensive overview of current knowledge on bioterrorism in dentistry. The review focused on

bioterrorism's causes, history, biological agents, awareness of bioterrorism among dental graduates and dentists, and the role of dentists in countermeasures for dealing with the situation. The search terms included: "dentistry", "bioterrorism", "bacterial and viral agents", "prophylaxis", and "surveillance". The research encompassed, Case reports, laboratory studies, clinical studies, and systematic reviews.

History

Using plant and animal poisons for hunting and warfare by prehistoric societies proves biological warfare has longstanding roots [Supreet Kaur], also back to the times of Ancient Rome when opponents flung faeces in their faces [1].

Some examples of ancient bioterrorism:

- The Assyrians used rye ergot to poison an enemy well in the sixth century BC, resulting in convulsions when consumed [6].
- When besieging a town, armies put dead animals into water sources to spread sickness among the defending populace [1].
- The Tartars besieging the town of Caffa in the Crimean War (1346) experienced a plague epidemic. They used catapults to launch the dead's corpses into the city of Caffa, turning this catastrophe into a weapon of war [8].
- It is said that British soldiers gave blankets laced with smallpox to American Indian tribes fighting with the French during the French and Indian War in 1520, which led to a major outbreak of diseases [6].
- In India, the first bio-crime happened in 1933 when Binayendra Chandra Pandey killed his brother with the use of Pasteurella pestis, or the so-called plague bacteria, which had been taken from the Pasteur Institute in Calcutta. Pandey pricked the victim with a pin laced with the bacterium [8].
- In World War I, the US and Germany devised biological weapons to taint animal feed.
- During the Cold War, the US and the USSR amassed arsenals of biological weapons to be used in combat and against civilian populations [1].
- More recently, in 1915, hundreds of cattle sent for Allied forces in Europe were infected with Bacillus anthracis and Pseudomonas malle by Dr. Anton Dilger, who had the support of the German government [6].
- The Oregonian pseudo-Buddhist Rajneeshee cult dispersed Salmonella in eateries and supermarkets in 1984 in an attempt to assassinate local officials and seize power. [1].
- Russian missiles carrying smallpox that were fit for use as weaponry were launched in 1992. Several terrorist groups, such as Al-Qaeda have investigated biological agents. [1].

Incidents of modern bioterrorism

- Letters containing anthrax spores were delivered to a US senator, a television news anchor, and other persons in 2001. As a result, several people died and others were hospitalized [1].

Bioterrorism Agents and Their Types

A biological agent can be any germ, bacterium, or virus; however, some are thought to be more likely to be used since terrorists can easily obtain them and spread them easily [6]. The three categories used by the U.S. Centres for Disease Control and Prevention (CDC) to classify biological agents and illnesses are considered "select agents" because they may represent a serious risk to public health and safety [1][7]. They are as follows

Table 1:

Category	Definition of category	Diseases	Organisms(s)Agent(s)
A	High-priority agents are organisms that are considered a danger to national security because they: • It is simple to disseminate or transfer from one individual to another. • Has the potential to affect public health significantly and cause a high rate of death. • Can cause agitation in the community and fear among the public. • Prioritize preparing for public health emergencies.	Anthrax Botulism Plague Smallpox Tularaemia Viral Haemorrhagic Fevers	Clostridium botulinum Yersinia pestis Bacillus Anthracis toxin Variola major Francisella tularenis Arenaviruses
B	The second-highest priority agents are those who: • Want improvements in particular laboratory diagnosis capabilities and improved illness monitoring. • lead to low death rates and modest rates of morbidity.	Brucellosis Epsilon toxins Staphylococcal Viral encephalitis Water safety threats	Brucella species Clostridium perfringens Salmonella species Rickettsia prowazekii Alphaviruses (eg, Venezuelan equine encephalitis, eastern equine encephalitis, western equine encephalitis)
C	The third highest priority agent is an emerging disease that may be produced for widespread distribution in the future. This is due to: • Availability • Streamlined production and delivery. • Serious health repercussions and a high risk of morbidity and death.	Infections that are becoming more common	Nipah virus Hantavirus Tick-borne hemorrhagic fever viruses Tick-borne encephalitis viruses Yellow fever Multidrug-resistant tuberculosis

Biological Agents That Can Be Potentially Involved In Bioterrorism

These are a few agents that have been used in bioterrorism or as weapons in combat. These agents are the most appropriate as they have the highest chance of making a significant impact [11]

Table 2:

Disease	Agents	Organism persistence	Infective dose	Human to human transmission	Infectivity	Incubation period	Symptom	Mortality	Treatment
Anthrax	Bacillus anthracis spores	Spores may endure for up to 40 years in soil and are incredibly	8000-50000 spores	No	-	1-6 days	Fatigue, fever, malaise, cough, mild chest discomfort, respiratory	High	Ciprofloxacin or doxycycline

		stable.					distress, shock		
Brucellosis	Genus Brucella	In the dirt, dust, or water, it will take 6 to 10 weeks.	10-100 organisms	No	-	5-60 days	Fever, headache, malaise, chills, sweating, myalgia, arthralgia, depression	5% in the absence of treatment	Doxycycline adjunct with Rifampicin
Plague	Yersinia pestis	It is viable for 1 hour following aerosol discharge, although it can persist in soil for up to 1 year.	100-20,000 organisms	High	After starting therapy, patients may still be infectious for up to 3 days.	1-6 days	High fever, headache, malaise, chest pain, cough, dyspnoea, stridor, cyanosis, haemoptysis	Bubonic plague: 30–60% without treatment, Pneumonic plague: 100% without treatment, but Septicaemic plague: 20–25% without treatment	Ciprofloxacin, levofloxacin and moxifloxacin.
Q-fever	Plague	It lasts for weeks to months and is resistant to heat and drying.	1-10 organisms	Though unusual, it is possible.		7-41 days	Headache, malaise, fatigue, anorexia, weight loss, endocarditis in chronic cases	Less than 2% of people with acute Q fever die from it, but 65% of people with chronic Q fever do so.	It is advised to start therapy with doxycycline for two weeks.
Smallpox	Variola virus: Variola major	It may remain in fabric and dust for up to a year.	10-100 organisms	Indeed, proximity is necessary for transmission.	It is primarily contagious within the first week following the onset of the rash.	10-14 days	Severe headache, high fever, extreme prostration, backache, chest and join pains, anxiety, exanthema, maculopapular rash that becomes vesicular	mortality rate of 30%	The sole defense against smallpox is vaccination.

Shigellosis	Genus Shigella	On average, the duration is 2 to 3 days, but under favourable circumstances, it can last up to 17 days.	10-100 organisms	Faecal-oral transmission	During the acute phase, there is a lot of excretion in the stools; in the absence of antibiotic medication, this can last for up to 4 weeks.	1-7 days	Fever, abdominal cramps diarrhoea, hemorrhagic colitis	<1%	Ciprofloxacin or Azithromycin
Salmonellasis	Genus Salmonella	able to tolerate temperatures of 57–60°	Unidentified High	Faecal-oral transmission	in faeces for a maximum of 4–5 weeks	6-48 days	Nausea, vomiting, mucopurulent or bloody diarrhoea, abdominal cramps, headache, maculopapular exanthema	<1%	Ampicillin, fluoroquinolones such as ciprofloxacin and levofloxacin. drink extra fluids as long as diarrhoea lasts
Venezuelan Equine Encephalitis	Alphavirus, (Venezuelan Equine)	unstable in its environment	10-100 organisms		-		Malaise, spiking fevers, rigors, headaches, myalgia, nausea		symptomatic and supportive

Identification of A Bioterrorism Event

The first sign of a possible epidemic is a sharp increase in disease cases that occurs quickly often in days or hours resulting in a sizable inflow of patients all at once. This outbreak is unique in that a concerning number of formerly healthy people are afflicted. Severe pneumonia, dyspnoea, and septic shock are common symptoms that indicate the severity of the illness, which is marked by high rates of morbidity and death. Any recent terrorist claims or actions that increase concerns about deliberate damage are grounds for raising suspicions. Additionally, an epizootic unexpected spike in animal diseases or deaths serves as a significant warning of a possible bioterror.[11]

Role of Dentist in Bioterrorism

In a large bioterrorism strike, dentistry may be heavily involved in the emergency response. There wouldn't be much time to prepare a response during a significant attack. The dental profession can offer emergency help in some areas, thus it's important to identify these areas and train dentists appropriately in case they are called upon to play this position [1].

When it comes to anticipating and responding to bioterrorism strikes, dentists are indispensable and greatly impact the result. The need for emergency medical attention in the case of a significant bioterrorism attack might be enormous, requiring alternative medical facilities like dentist offices. Dentists are qualified to perform various vital medical procedures, such as

treating damage to the face and jaw, using an anesthetic, inserting an IV line, and providing basic life support. Forensic odontologists trained can work with disaster mortuary operational response teams (DMORTs) for disease spread monitoring and local surveillance outside of the original assault location.

Dental and maxillofacial offices, equipped with air and suction lines and sterilization capabilities, can act as auxiliary hospitals, aid stations, prophylactic dispensing sites, or quarantine facilities during bioterrorism events when medical facilities are overwhelmed. Oral surgeons, crucial communicators within the medical referral network, can receive specialized training to become skilled responders in managing hazardous disasters, both natural and man-made. The COVID-19 outbreak highlighted dentists' importance in handling mass casualty incidents [6].

Awareness of Dental Personnel toward Bioterrorism

Dental professionals' lack of training and experience may cause them problems in bioterrorist scenarios. According to studies, dentists who have been exposed to bioterrorism have poor levels of readiness for such incidents. A sizable fraction of dentists find it difficult to recognize or handle these types of assaults. Less than 15% of dentists were able to identify a bioterrorism incident, and less than 10% were confident in their capacity to repel a bioterrorist attack, according to a different survey. Dental schools should incorporate disaster preparedness and pandemic preparedness training into their curricula to increase preparedness and reduce damage during such crises [6].

Preparing the Dental Students for A Bioterrorism Attack

Training on Bioterrorism Dental students should be prepared to react if an assault is identified by their dental schools. Dentists' ability to react varies greatly depending on the degree of training they have undergone. Every dentistry student should get training up to the emergency medical services (EMS) level. Furthermore, in the case of an assault, all dentistry students have to get training on how to help contain an agent and isolate afflicted people. The impact of an assault can be significantly impacted by prompt and appropriate measures taken to stop the spread of an agent. additional cardiac life support (ACLS) and immunization capabilities may be imparted to students through optional additional training. To allow dentists to react quickly to a terrorist incident and lessen the threat's impact and spread, basic skills should be inculcated.

Lastly, it should be possible for dentistry students to notify the proper parties about surveillance information. Reports may include continued tracking of the disease's progress and recurrence after the first course of therapy. By teaching all dentistry students these fundamental skills, they will provide them with the knowledge and abilities needed to respond appropriately if biological or other terrorist agents are used in an assault.

Their prompt reaction will aid in the situation's detection, containment of the agent to lessen its influence on the affected area, and notification of the proper authorities to start the required emergency measures. In addition, students will learn enough information to help the responding emergency community if they so desire. Furthermore, students can participate in more comprehensive training, allowing them to offer greater assistance in the case of a significant assault.

Dental schools have a big responsibility to prepare upcoming dentists to carry out this task in an acceptable manner if dentists are to respond to bioterrorism in a meaningful way. All dental students should receive

instruction in a basic set of bioterrorism-related competencies and extra chances for further study [1].

Conclusion

The threat posed by bioterrorism, or biological warfare is not new and is not likely to go away very soon. Considering the technological constraints and challenges brought forth by the need to work covertly, the potential for a successful bioterrorist attack assault is rare and more likely to occur in the low-tech other end of the spectrum from the high-tech finish. Despite the likelihood of few victims, a bioterrorist attack can nonetheless have a significant impact. be noteworthy, impacting several lives and resulting in substantial expenses, both direct and indirect. Consequently, it is It is preferable to be ready to handle the consequences.

Because biological attacks may spread quickly and sometimes resemble flu symptoms, making diagnosis difficult, they represent a major threat. Dental specialists may be quite helpful in handling these situations because of their knowledge of patient care and infection prevention. Including bioterrorism education in dentistry, curricula guarantee that all dental students have the information and abilities they need. In particular, oral and maxillofacial surgeons need to be knowledgeable about the concepts of surveillance and how to notify any situation. They can respond to bioterrorism occurrences efficiently by helping with containment efforts and taking part in surveillance operations as ordered by authorities thanks to mandatory training in critical competencies.

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