Original Article

Knowledge and Preparedness of Dentists in Response to Bioterrorism

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Abstract

Introduction: In the current climate of heightened terrorist activity, the deliberate release or threat of biological agents like viruses, bacteria, fungi, or their toxins to induce sickness or death among civilians has become a genuine possibility. The most crucial action during a bioterrorist strike is early warning. The possibility of such an occurrence in dental setting is underestimated. **Methods and Materials:** Seventy five graduate students participated in the research. In a survey on zoonotic diseases, participants were asked whether they were familiar with the transmission from person to person, if the diseases caused significant morbidity and mortality, whether they were simple to produce and disseminate, and whether they posed a high risk of infection. **Results:** Graph Prism was used to examine the data. A single proportion test was used to determine the "Aware Not Aware" group. The first 10 questions assessed dentists objective knowledge of bioterrorism. The importance of the last six questions was determined by their analysis of dentists' preparedness and desire to respond to a bioterrorism associated occurrence via perceived knowledge. **Conclusion:** Given the real danger they may face, dentists needed to be vigilant regarding the prevention, detection, and treatment of zoonotic illnesses transmitted in their offices or as a vector while being commended for their courage in the face of adversity.

Keywords: *Bioterrorism, dentists, infectious diseases*

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Introduction

To intentionally discharge or disperse biological agents is to commit bioterrorism. Bacteria, viruses, and other poisons fall under this category. Although naturally occurring, these agents might be changed

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to increase their pathogenicity, resistance to current treatments, or environmental dissemination. All three of these mediums may be used for the dissemination of biological agents. Since the effects of biological weapons take many hours to days to manifest, they are commonly used by terrorists. There are bioterrorism agents that can be spread from person to person, like the smallpox virus, and others that cannot, like anthrax.[1]

When bacteria, viruses, rickettsia, fungi, or their toxins are used intentionally to kill or incapacitate people, animals, or plants, this is known as biological warfare. Degradation of materials is a potential effect of several biological warfare agents (BWAs), such as bacteria that feed on petroleum.[2] BWAs can be disseminated in several ways, including (1) aerosol sprays, which are the most common; the ideal BWA particle size is 1-5 mm in diameter, which would allow it to be carried over long distances by prevailing winds and inhaled deeply into the lungs of unsuspecting victims; (2) explosive devices (artillery, missiles, detonated bombs); (3) food or water contamination; and (4)[2] numerous ailments are difficult to identify from one another because of the similarity in the clinical presentations of the numerous illnesses produced by diverse bioterrorism agents. Numerous victims of bioterrorism agent assaults all had the same symptoms at the same time, and many of the agents caused a "flu-like" illness. Hospitals and clinics play crucial roles in assessing patients who have become ill as a result of exposure to bioterrorism agents or other sudden illnesses. Patients experiencing certain symptoms often present to hospital emergency departments, when the illness may be misdiagnosed as something quite different. People exposed to bioterrorism agents or infectious diseases will first be collected from clinical specimens by laboratories. They must act swiftly to detect these possible agents and infectious illnesses so that appropriate measures may be taken.[3]

Patients with oral health problems commonly see oral medicine postgraduate students as their initial point of contact with the healthcare system. Although their primary area of expertise is oral health, their knowledge of the mouth and how it relates to the rest of the body makes them useful members of the bioterrorism preparation and response community. Graduates in oral medicine who have taken bioterrorism courses will be better prepared to detect, prevent, and treat oral health problems that arise as a consequence of bioterrorism incidents. Contributing to public health readiness and healthcare systems' overall response capacities via bioterrorism education, monitoring, reporting, and coordination. To effectively respond to such threats, healthcare providers, public health organizations, and law enforcement must work together and coordinate their efforts.

This research was conducted to evaluate dentists' readiness for a biological assault and to learn more about the types of biological agents and how they are disseminated that are used in biological warfare.

Materials and Methods

In 2022-2023, 75 postgraduate students in oral medicine were asked to participate in an anonymous cross-sectional study. The data were collected using a standardized questionnaire developed from an analysis of previous research in the field. After acquiring each student's informed permission, data were gathered using Google Forms.

Anthrax, plague, botulism, and brucellosis, to name a few, had questions about their most lethal forms and how they spread, as well as how contagious they are and whether or not people knew they were spread from person to person. The Cronbach's coefficient for this survey was 0.9.

Oral medicine graduates were polled using a five-page, 19-question survey. The test's 19 questions were broken up into three categories: (1) Three questions pertaining to your gender, age, and year(s) of schooling/years(s) of education. (2) Ten questions assessing respondents' objective knowledge of bioterrorism, seven of which were multiple-choice and three of which were Yes/No; (3) Six questions gauging respondents' perceived knowledge of bioterrorism, including inquiries into respondents' exposure to bioterror (BT)s preparedness training and their willingness to aid the state in its bioterrorism response and control efforts, and so on.

The best choices for the questions' right answers were made using the resources at hand. Their sum was tallied, and the resultant information was statistically examined.

Demographic characteristics of participants

Of the total 75 dental postgraduate students, 63 (84%) were females and 12 (16%) were males of which 6.6% were in first year of study, 38.7% in second year, and 54.7% in third year of study. The majority of the participants in this study were between the age group 25-28 years.

Ten questions were included in the survey to gauge participants' objective knowledge.

Anthrax

Although there was a significant increase in awareness ($P < .005$), only 38.67% of participants correctly identified anthrax and plague as having the potential to spread from person to person; the remaining

41.3% were incorrect and 10.7% did not know. Furthermore, only 38.67% correctly identified which of the following diseases are good biological terrorism threats due to significant morbidity and mortality, ease of production, efficient dissemination, aerosol stability, or high infectivity.

Of those polled, 62.67% correctly recognized inhalational anthrax as the worst form of the illness, whereas 21.33% gave an incorrect response and 17.3% said they did not know. Only 37.33% correctly identified rhinorrhea and sore throat as symptoms that are/are not frequently encountered in inhalation anthrax and, if present, might assist distinguishing an upper respiratory tract infection and anthrax. This indicates a significant lack of awareness ($P < .005$), as 29.33% gave the wrong answer and 33.33% had no idea.

Small pox

About a third of respondents (33.3%) answered "don't know" to the question "Smallpox contains all of the following clinical symptoms except," nearly half (46.6%) gave the wrong answer, and only about one-fifth (20%) got it right when asked whether the virus is spread through direct or indirect contact with open lesions (e.g., by touching an infected lesion or by coming into contact with infected clothing or bedding).

Seventy-three percent of participants got the question "What infection control measures are advised for a person with suspected or confirmed smallpox?" right, with just 26% responding incorrectly, indicating substantial knowledge ($P < .005$).

When asked, "What is the most frequent early presenting symptom associated with the majority of high risk ("Category A") bioterrorism-related diseases (i.e., anthrax, botulism, plague, smallpox, tularemia, and viral hemorrhagic fevers?", 50.66% of participants gave the incorrect answer "influenza similar illness," while 34.67% gave the correct answer.

Virus of Zika

Sixty six point six seven percent of participants with a substantial knowledge as $P < .005$ replied "No" when asked whether mosquitos are the sole vector for Zika virus transmission. There is a high level of knowledge, as 73.33% of respondents correctly responded "yes" to the question "Is Zika virus detected in the saliva of an infected individual?" ($P < .005$).

Corona virus

Seventy-two percent of those with a P value (<.005) of "yes" to the question "Can a dental clinic serve as a potential source of Corona virus transmission through aerosols?" were right in their assessment.

Tabulated below are the findings of our objective knowledge survey on bioterrorism [Table 1].

II. Perceived accuracy of bioterrorism-related information

Participants in the survey were asked, "Can zoonotic diseases be considered as a biological threat?" The majority of them said yes. Do you believe training for bioterrorism preparation is important? Almost half of respondents said they would help the government respond to a bioterrorist attack (44%) ($P < .005$) (53.33%) ($P < .005$).

When asked if they "can identify and recognize a bioterrorism event in human populations," respondents were evenly split. Do you know how to identify the oral symptoms of bioterrorism agents? (58.7) (54.7%).

Significantly ($P < .005$), 40% of respondents agreed that training for bioterrorism preparation was required.

Table 2 displays the findings from the survey measuring respondents' levels of awareness about bioterrorism.

Discussion

A zoonosis is a disease or illness that may spread from vertebrate animals to humans and vice versa, as defined by the World Health Organization.[4] Major emerging zoonoses include H5N1, BSE, feline cowpox, rotavirus infection, norovirus infection, Ebola, hantavirus infection, West Nile fever, canine leptospirosis, MRSA infection, cat scratch disease, severe fever with thrombocytopenia syndrome, Middle East respiratory syndrome, severe acute respiratory syndrome (SARS), and the most recent coronavirus disease (COVID-19).[5]

The purpose of this research was to assess graduate students' preparedness for and understanding of bioterrorism. Similar to the investigations by Katz AR, Nekorchuk DM, Holck PS, Hendrickson LA, Imrie AA, Effler PV,[6] Nofal A, AlFayyad I, AlJerian N, Alowais J, AlMarshady M, and Khan A, *et al*.,[7] the current investigation included questions about both objective and perceived knowledge.

Knowledge level I

Perceived objectivity

Each respondent's responses to a set of 10 questions comprised the objective knowledge assessment.

Smallpox and plague were correctly identified as diseases that could be spread from person to person by 52% of participants ($P < .001$), indicating high levels

Table 1: Objective knowledge regarding bioterrorism

Question	Correct	Wrong	Don't know	*P*	Significance
The following diseases have potential for person-to-person spread?	52%	41.3%	10.7%	<0.05	Yes
Which of the following are good biological terrorism threats because of substantial morbidity and mortality ease of production, efficient dissemination, stability in aerosol, or high infectivity?	38.67%	41%	18.7%	<0.05	Yes
Which of the following is the deadliest form of anthrax?	62.67%	21.33%	17.3%	<0.05	Yes
Which of the following symptoms is/are not commonly found in inhalation anthrax and if present could help differentiate an upper respiratory tract infection from anthrax?	37.33%	29.33%	33.3%	<0.05	Yes
Smallpox has all of the following clinical features except	20%	46.67%	33.3%	<0.05	Yes
What infection control measures are recommended for a person with suspected or confirmed smallpox?	73.3%	26.68%	-	<0.05	Yes
The most common early presenting symptom associated with the majority of high risk ("Category A") bioterrorism-associated diseases (i.e., anthrax, botulism, plague, smallpox, tularemia, and viral hemorrhagic fevers) is	34.67%	50.66%	14.67%	<0.05	Yes
Are mosquitoes the only mode of transmission of Zika virus?	66.6%	33.33%	-	<0.05	Yes
Is Zika virus found in the saliva of an infected individual?	73.3%	26.67%	-	<0.05	Yes
Can a dental clinic serve as a potential source for transmission of Corona virus through aerosols?	72%	4%	-	<0.05	Yes

Table 2: Perceived knowledge regarding bioterrorism

Question	Agree	Strongly agree	Neutral	Disagree	Strongly disagree	*P*	Significance
Do you think bioterrorism preparedness training is necessary?	44%	40%	13.3%	1.3%	1.3%	<0.05	Yes
Do you have the ability to identify and recognize a bioterrorism event in human populations?	22.7%	5.3%	58.7%	9.3%	4%	<0.05	Yes
Do you have the ability to recognize oral manifestations of bioterrorism agents?	28%	5.3%	54.7%	9.3%	2.7%	<0.05	Yes
Do you have the ability to respond effectively to a bioterrorism event?	36%	13.3%	36%	12%	2.7%	<0.05	Yes
Are you willing to provide assistance to the state in response to a bioterrorism event?	53.3%	25.3%	18.7%	0%	2.7%	<0.05	Yes
Can zoonotic diseases be considered as a biological threat?	54.7%	32%	9.3%	2.7%	1.3%	<0.05	Yes

of awareness that are consistent with those found in studies by Katz AR *et al*.[6] (87.2%) and Nofal A. *et al*.[3] (51%).

Anthrax, smallpox, botulism, and plague were all correctly identified as good biological terrorism threats due to their significant morbidity and mortality, ease of production, efficient dissemination, stability in aerosol, or high infectivity by only 38.67% of participants in the present study, which is consistent with the findings of Nofal A *et al*.[3] (32.6%), concluding a significant lack of awareness ($P < .001$) as the majority of participants.

Anthrax

Choose the anthrax strain that poses the greatest risk to human health. Significant awareness was shown by the fact that 62.67% of respondents identified the inhalational form correctly; this finding is in line with the findings of research by Katz AR *et al*.[6] (88%) and Nofal A *et al*.[3] (76.8%).

When asked, "Which of the following symptoms is/are not commonly found in inhalation anthrax and, if present, could help differentiate an upper respiratory tract infection from anthrax?" 37.33% of participants correctly identified "Rhinorrhea and sore throat" ($P < .001$), but the majority of participants in the studies by Katz AR *et al*.[6] (42.1%) and Nofal A *et al*.[3] (27.2%) gave the wrong response.

Small Pox virus

Similar to the findings of Nofal A *et al*.[3] (30.5%) and Katz AR *et al*.[6] (42.1%), the majority of participants in the present study did not know the answer to the question "Smallpox has all of the following clinical features except" ($P < .001$). Similar to the research by Katz AR *et al*.[6] (88.7%), 73.3% of participants in the present study correctly answered the question "What infection control measures are recommended for a person with suspected or confirmed smallpox?" with high levels of knowledge ($P < .001$).

Only 34.67% of respondents correctly identified influenza-like illness as the most common early presenting symptom associated with the majority of high-risk ("Category A") bioterrorism-associated

diseases (i.e. anthrax, botulism, plague, smallpox, tularemia, and viral hemorrhagic fevers), which is consistent with the study's findings that there is a significant lack of awareness ($P < .001$).

Virus of Zika

With regards to the question "Are mosquitoes the only mode of transmission of Zika virus?", 66.6% of students got it right in the present investigation. Of which, 51.3% knew that ZIKA might be spread by mosquito bites and sexual contact with an infected individual, a figure that is statistically significant ($P < .004$) and consistent with the research by Tork SM and Basam SA.[7] Similarly, 53% of respondents in a research by Ibrahim NK *et al.*[6] correctly identified mosquito bites (53%) and the vertical route (50.5%) as mechanisms of ZIKA transmission.

Women who had sex with someone who was infected with ZIKA have only reported a small number of instances of presumably sexually transmitted ZIKA. Sexual transmission of ZIKA is more likely after researchers confirmed the presence of ZIKA RNA in the semen of an infected guy.[8]

Seventy three point three percent of students got the follow-up question right, "Is Zika virus found in the saliva of an infected individual?" This is supported by research showing that ZIKA is present in samples and that patients have the greatest quantities of the virus in their saliva just before the beginning of symptoms.[9,10] Musso D, *et al*.[11] found that ZIKA was present in the saliva of 19.2% of patients.

Corona virus

Ninety six percent of students got the following question right, which was, "Can a dental clinic serve as a potential source for transmission of Corona virus through aerosols?" 94.5% of respondents believed that Corona virus may be detected in aerosols produced during dental operations, which is in line with the research of Pandey N *et al*.[12]

Wang *et al*.[13] investigated the mouths of SARS patients and found a significant amount of SARS-CoV RNA in their saliva (7.08 × 103 to 6.38 × 108 copies/mL), suggesting that coronaviruses might be spread by oral droplets.

II. Perceived knowledge regarding bioterrorism

II Preparedness

Forty percent of dentistry school graduates surveyed in this research believed that having some kind of bioterrorism readiness training is crucial. The capacity to detect and identify a bioterrorism occurrence in a human population was proven by just 17 dental students (22.7%). Only 21 pupils (28%) showed they could identify the oral symptoms of bioterrorism chemicals, and only 27 showed they could successfully react to an attack. The results of this study indicate that dentists have a significant knowledge gap when it comes to bioterrorism.

This is consistent with the results of a research by Gulia *et al.*,[14] which indicated that only 113 dental graduates (65.6% of the total) were familiar with the symptoms and indicators of a bioterrorist assault, while only 106 (61.6% of the total) knew where to report such an attack. Similar findings were found by Bhoopathi *et al.*[15] among dental professionals in New England and Oregon.

Our results are in line with those published by Sridevi *et al.*,[16] who found that more than half of postgraduate (PG) students and staff did not know the symptoms of illnesses that might be caused by bioterrorism.

The majority of respondents (53.3%) in this research said they would help the government in the case of a bioterrorist strike. The results we obtained are consistent with those published by Bhatt *et al*.,[17] who discovered that more than 90% of college and university students would volunteer medical aid in the event of a bioterrorism assault. According to Chmar *et al.*,[18] foundational education and training need to be organically woven into the dentistry curriculum as it stands. Therefore, the authors think that initiatives for continuing dental education or guest lectures on bioterrorism are essential.

Zoonotic diseases pose a significant threat to human health and even life, making them a major concern in public health. As the current COVID-19 pandemic shows,[4] zoonoses may have devastating effects on human populations.[17] This coincides with the results of the current survey, which show that a majority of students (54.7%) agree that zoonotic illnesses pose a serious biological risk.

Limitations

The study's shortcomings include its small sample size and the fact that only recent Oral Medicine graduates were asked to complete the survey. More study is needed to examine knowledge and comprehension of bioterrorism and raise awareness, ideally with graduates of both medical and dental schools and larger sample size from all parts of the nation.

Since prepared healthcare workers may save lives simply by raising awareness, further cross-sectional research is needed to compare the knowledge, attitude,

and behaviors of every healthcare professional or worker across various cities. They also acknowledged the biological threat posed by zoonotic diseases.

Conclusion

This research found that dentistry school graduates knew enough about bioterrorism to be dangerous but know far less than they should. Therefore, there is an urgent need to educate dental graduates at a larger reach about bioterrorism via guest lectures or continuing dentistry education to raise awareness and improve understanding among them to better defend against present and future bioterrorist assaults.

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Conflicts of interest

There are no conflicts of interest.

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