

Establishing a High Level of Knowledge Regarding Bioterrorist Threats in Emergency Department Physicians: Methodology and the Results of a National Bio-Preparedness Project

Adi Leiba, MD, MHA;¹ Nir Drayman, BA;¹ Yoram Amsalem, MD;² Adi Aran, MD;² Gali Weiss, RN, MHA;¹ Ronit Leiba, MA;³ Dagan Schwartz, MD;⁴ Yehezkel Levi, MD;⁵ Avishay Goldberg, PhD;⁴ Yaron Bar-Dayan, MD, MHA¹

1. Israel Defense Forces (IDF) Home Front Command, Israel
2. IDF Medical Corps, Chemical Biological, Radiological, and Nuclear Medicine Branch, Israel
3. Department of Biostatistics, Rambam Medical Center, Haifa, Israel
4. Faculty of Health Sciences, Department of Emergency Medicine, Ben Gurion University, Beer-Sheva, Israel
5. Surgeon General Headquarters, IDF Medical Corps, Israel

Correspondence:

Col. Dr. Y. Bar-Dayan, MD, MHA
Chief Medical Officer, IDF Home Front Command
16 Dolev St. Neve Savion
Or-Yehuda, Israel
E-mail: bardayan@netvision.net.il

Keywords: anthrax; bioterrorism; botulinum; education; emergency department; smallpox

Abbreviations:

CBRN = chemical, biological, radiological, or nuclear
ED = emergency department
HFC = Home Front Command
MOH = Ministry of Health

Received: 19 June 2006

Accepted: 22 August 2006

Revised: 02 October 2006

Web publication: 19 June 2007

Abstract

Introduction: Medical systems worldwide are facing the new threat of morbidity associated with the deliberate dispersal of microbiological agents by terrorists. Rapid diagnosis and containment of this type of unannounced attack is based on the knowledge and capabilities of medical staff. In 2004, the knowledge of emergency department physicians of anthrax was tested. The average test score was 58%. Consequently, a national project on bioterrorism preparedness was developed. The aim of this article is to present the project in which medical knowledge was enhanced regarding a variety of bioterrorist threats, including cutaneous and pulmonary anthrax, botulinum, and smallpox.

Methods: In 2005, military physicians and experts on bioterrorism conducted special seminars and lectures for the staff of the hospital emergency department and internal medicine wards. Later, emergency department senior physicians were drilled using one of the scenarios.

Results: Twenty-nine lectures and 29 drills were performed in 2005. The average drill score was 81.7%. The average score of physicians who attended the lecture was 86%, while those who did not attend the lectures averaged 78.3% (NS).

Conclusions: Emergency department physicians were found to be highly knowledgeable in nearly all medical and logistical aspects of the response to different bioterrorist threats. Intensive and versatile preparedness modalities, such as lectures, drills, and posters, given to a carefully selected group of clinicians, can increase their knowledge, and hopefully improve their response to a bioterrorist attack.

Leiba A, Drayman N, Amsalem Y, Aran A, Weiss G, Leiba R, Schwartz D, Levi Y, Goldberg A, Bar-Dayan Y: Establishing a high level of knowledge regarding bioterrorist threats in emergency department physicians: Methodology and the results of a national bio-preparedness project. *Prehosp Disast Med* 2007;22(3):207–211.

Introduction

Emergency department (ED) physicians are sentinels. Their early recognition and response to the first cases of a bioterrorist attack can be crucial in limiting morbidity and mortality.¹

A 10-question test was distributed to 115 senior ED physicians in Israel, a country with a long-standing experience of terrorism and a well-established, military-based medical education system. According to the results of this test, their knowledge about anthrax was unsatisfactory. The results were not significantly different after “sentinel drills”, in which mock pulmonary anthrax patients were sent to all Israeli EDs in 2004. The pre-drill test score was 54.5%, while the post-drill score was 59.3%.²

The aim of this article is to present the 2005 national Bio-Preparedness Project. The project attempted to enhance the knowledge of a variety of bioterrorist threats, including cutaneous and pulmonary anthrax, botulinum, and smallpox.

- A 35-year-old male. Generally healthy. Works in a seaport.
- A three days history of fever with drenching sweats. "Changes clothes every hour"
- Headache, nausea, difficulty concentrating

Clinical data (upon request)

- Denies rhinorrhea
- Denies sore throat
- Denies a prodrome of upper respiratory tract infection (URTI)

Epidemiological data (upon request)

- Works in the International Trade Terminal
- One week ago, he assessed an unrecognized transport of flour.
- Three other terminal workers are ill. One of them is mechanically ventilated in another hospital.

Physical Examination (upon request)

- Sluggish thinking. Is not fully oriented to time
- Suspected nuchal rigidity
- Decreased breath sounds and dullness to percussion on the right side

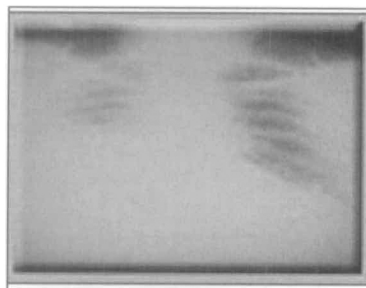
Laboratory Results

- White blood cell count: 10,500/mm³
- Neutrophil count: 80%
- Hemoglobin: 14.3g/dL
- Platelet count: 180,000
- Aspartate aminotransferase: 95 U/L
- Alanine aminotransferase: 80 U/L
- Gamma-glutamyl transpeptidase: 200 U/L

Lumbar Puncture stain (upon request)



Chest x-ray (upon request)



Leiba © 2007 Prehospital and Disaster Medicine

Figure 1—Scenario 1

Methods

Study Design

The Bio-Preparedness Project was designed and executed by military physicians and nurses of the medical department of the Home Front Command (HFC). The medical department of the HFC is integrated with the Emergency and Disaster Management Division of the Ministry of Health (MOH), and is the national Israeli organization responsible for drilling hospitals for all emergency scenarios, especially non-conventional chemical, biological, radiological, or nuclear (CBRN) drills.³ The project was planned and approved by a committee consisting of experts from the MOH, HFC, and the CBRN Medicine Branch of the Israel Defense Forces (IDF) Medical Corps.

Setting and Participants

The project consisted of three steps:

1. A letter declaring the project was sent to all Israeli General Hospital Directors. In this letter, the hospital staff was urged to read about bioterrorism and recommended references were provided.⁴ Hospitals were informed on the seminars and drills that were planned for 2005;

2. A physician from the HFC Medical Department or the CBRN Branch of the Medical Corps gave a standardized lecture to each hospital regarding bioterrorism, including cutaneous anthrax, inhalational anthrax, botulinum, smallpox, and plague, covering the most important "Category A" agents. The lectures were directed mainly to ED staff and internal medicine physicians and nurses. The presentations were provided to Emergency Response Coordinators of the hospital for further intra-organizational teaching; and
3. A standardized, biological drill was conducted in Israeli general hospitals during 2005. The drills were conducted during the morning shift. Hospitals ranged from small "level C" to large "level A" medical centers, but all were university-affiliated medical centers with an academic ED, staffed with at least two senior physicians (trained either in internal or emergency medicine). The exact date for each hospital drill was kept secret. Drills were performed only after the hospital staff participated in the "bioterrorism seminar" (Step 2).

Since all Israeli hospitals were drilled in 2004 with a mocked pulmonary anthrax patient,² the drill scenario was changed. During the 2005 drills, the Israeli Hospital

Name of institution: _____ Date: _____ Scenario Drilled: _____

Serial number	Category	Possible score %	Actual score	Remarks
1	Correct differential diagnosis	10		
2	Complete clinical history	5		
3	Complete epidemiological history	10		
4	Relevant physical examination	10		
5	Ordering and understanding basic laboratory tests	10		
6	Ordering and analyzing imaging results and diagnostic tests	10		
7	Correct isolation precautions	10		
8	Correct treatment	10		
9	Following notification protocols	20		
10	Clinical question (general medicine)	5		

Physician name: _____

Attended lecture on bioterrorism held in the hospital: yes/no

Leiba © 2007 Prehospital and Disaster Medicine

Figure 2—Bioterrorism drills assessment and scoring sheet

Coordinator for CBRN, the drill manager, entered the ED by surprise, and then declared a biological drill. The same drill manager conducted all 29 drills in a standardized fashion, except for the changing scenarios.

In each drill, an ED physician was given drill cards with the history of a patient. According to the physician management, the physician was given more drill cards with data on advanced clinical history, epidemiological history, physical examination, laboratory results, imaging, and advanced work-up. Figure 1 is an example of an inhalational anthrax scenario.

Outcome Measures

As the drill occurred, the drill manager completed the drill checklist (Figure 2) and scored each physician in different aspects of their clinical management. These aspects included: (1) history taking; (2) physical examination; (3) ordering of relevant laboratory and imaging tests; (4) activation of notification protocols (to an infectious disease consultant, ED director, hospital director, and MOH district); (5) correct deployment of contact precautions; and (6) the ability to create a relevant differential diagnosis. Five points were given for the correct answer of a clinical dilemma in the patient management that measured general clinical knowledge, unrelated to bioterrorism.

All of the physicians drilled were senior ED physicians. They were asked whether they attended the bioterrorism seminar in their hospital.

Data Processing

The data were processed with SPSS Version 12 (SPSS Inc., Chicago, IL). A significance level of $p < 0.05$ was considered significant. A t -test was performed to determine whether there was a difference between the attendance in the lecture and the physicians' score.

Results

Twenty-nine seminars were provided to all 24 Israeli general hospitals. Most of the hospitals had one lecture for the entire staff, but five hospitals assigned their staff into one of two groups. Each group went to a different lecture on two different dates. A total of 1,459 physicians and nurses participated in these lectures.

Drills took place in 21 general hospitals. Hospitals that had participated in another large-scale bioterrorism drill were excluded.

Sometimes more than one physician in an ED was drilled in order to have as many drills as possible. This difference had no impact on the results, since the goal of the research was to compare the difference between individual clinicians and not between institutions. For this reason, there were 29 drills—five on an inhalational anthrax scenario (Figure 1), nine on a cutaneous anthrax scenario, six on botulism, and nine on smallpox. The average score was 81.7%. Only 13 physicians (45%) attended the bioterrorism seminar. Although the mean test score of the physicians

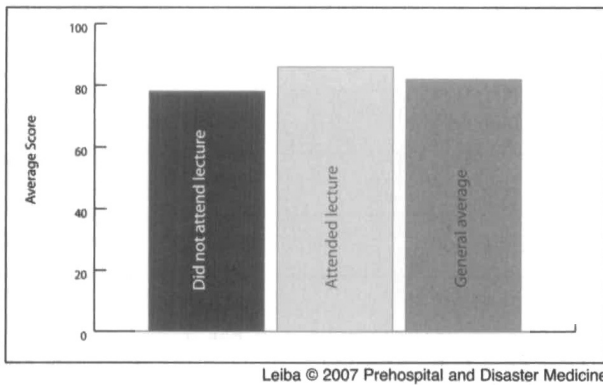


Figure 3—Drills according to attendance in bioterrorism lectures ($p > 0.05$)

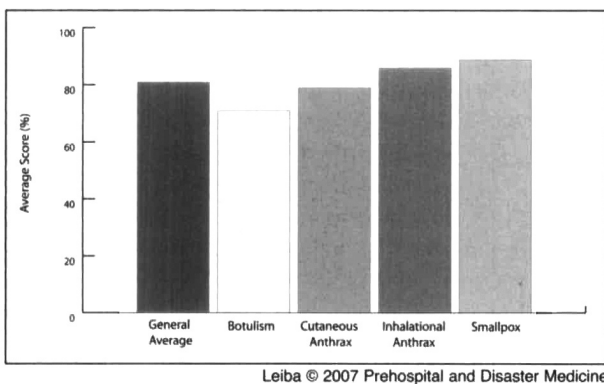


Figure 4—Average scores on the four different scenarios ($p > 0.05$)

who attended the lecture (86%) was higher than the test score of those who did not attend the lecture (79%), the difference was not statistically significant (Figure 3) ($p > 0.05$). The median score was 85%. Scores were not significantly different in all four scenarios (Figure 4).

Drills were performed 2–6 months after the lectures were given. There was no difference between those who were drilled ≤ 3 months after the lecture or > 3 months after the lectures.

Scores also were analyzed according to different aspects of preparedness, implicating a rather high level of knowledge in the first steps of patient management, with lower scores regarding advanced diagnostic tests and medical treatment (Figure 5).

Discussion

Senior ED physicians are on the frontline of defense against bioterrorism. Physicians also are the most trusted source of information for the public regarding bioterrorism.⁵ As such, consolidating and strengthening their medical education on bioterrorism is of paramount importance.^{6–8} Clinicians understand the importance of bioterrorism education and are eager to learn. In a recently published survey, 95% of 178 primary and emergency physicians thought clinicians need more education about bioterrorism.⁹ In another physician survey, the preferred training method was a lec-

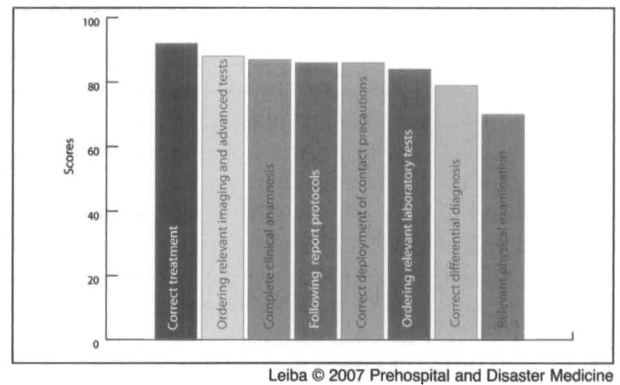


Figure 5—Average scores on the different aspects of bioterrorism preparedness

ture at a professional meeting—similar to the lectures described in this study.¹⁰

It has been demonstrated that the basic knowledge of ED physicians regarding bioterrorism is poor (the average test score was 58%) and that the drills (as were conducted in 2004) are not, by themselves, an efficient educating tool.² Frontal lectures, although less modern than Websites and sophisticated software, still are an efficient way of establishing medical knowledge. The disadvantage of frontal drills is the low attendance of physicians (only 45% of drilled ED physicians attended the lecture).

Cosgrove *et al* have demonstrated the effectiveness of an online didactic module on physicians' knowledge regarding bioterrorism agents.¹¹ They also have shown that basic management and knowledge are poor and can be augmented. They demonstrated a high level of knowledge in a post-test done immediately after completion of a didactic session. The high level of knowledge demonstrated in the current research was a result of an ongoing process of preparedness. Physicians were orally tested (drilled) in a stressful, surprising situation of a "military biological drill" months after they participated in lectures on bioterrorism. This situation seems to better simulate the real situation of a surprise bioterrorist event.

The process of preparedness for the current research consisted of letters to hospital directors, urging them to augment bioterrorism education in their institutions, dispersal of large informative posters on bioterrorism to all EDs, and the above-mentioned formal expert lectures inside of the hospitals. It seems that achievement of a high level of knowledge cannot be attributed to one modality (a single lecture or drill), but it is otherwise a consequence of a continuum of preparedness—a variety of educational tools and biological drills. Emergency department physicians, who were exposed to all these educational modalities, achieved a high level of knowledge regarding bioterrorism.

Conclusions

While many medical institutions are busy preparing for disasters and non-conventional scenarios, there is little data regarding the effectiveness of different modes of preparation or even the general effectiveness of preparedness. This project implies that intensive and versatile preparedness modalities given to a carefully selected group of clinicians can be fruitful.

References

1. Inglesby TV, O'Toole T, Henderson DA, et al: Anthrax as a biological weapon, 2002: Updates recommendations for management. *JAMA* 2002;287:2236–2252.
2. Leiba A, Goldberg A, Hourvitz A, et al: Lessons learned from clinical anthrax drills. Evaluation of knowledge and preparedness for a bioterrorist threat in Israeli emergency departments. *Ann Emerg Med* 2006;48(2):194–199.
3. Tur-Kaspa I, Lev EI, Hendler I, et al: Preparing hospitals for toxicological mass casualties events. *Crit Care Med* 1999;27(5):1004–1008.
4. Lane HC, Fauci AS: Bioterrorism and Clinical Medicine. Microbial Bioterrorism. In: Kasper DL, Braunwald E, Fauci A, et al: *Harrison's Principles of Internal Medicine*. 16th Ed. Volume 1. New York: McGraw Hill Medical Publishing Division, 2004, pp 1279–1288.
5. Artenstein AW, Neill MA, Opal SM: Bioterrorism and physicians. *Ann Intern Med* 2002;137(7):626. (Letter).
6. Steed CJ, Howe LA, Pruitt RH, Sherrill WW: Integrating bioterrorism education into nursing school curricula. *J Nurs Educ* 2004;43(8):362–367.
7. Filoromo C, Macrina D, Pryor E, et al: An innovative approach to training hospital-based clinicians for bioterrorist attacks. *Am J Infect Control* 2003;31(8):511–514.
8. Terndrup T, Nafziger S, Weissman N, et al: Online bioterrorism continuing medical education: Development and preliminary testing. *Acad Emerg Med* 2005;12(1):45–50.
9. Woods R, McCarthy T, Barry MA, Mahon B: Diagnosing smallpox: Would you know it if you saw it? *Biosecur Bioterror* 2004;2(3):157–163.
10. Shadel BN, Rebmann T, Clements B, et al: Infection control practitioners' perceptions and educational needs regarding bioterrorism: Results from a national needs assessment survey. *Am J Inf Control* 2003;31(3):129–134.
11. Cosgrove SE, Perl TM, Song X, Sisson SD: Ability of physicians to diagnose and manage illness due to Category A bioterrorism agents. *Arch Intern Med* 2005 26;165(17):2002–2006.

Establishing a High Level of Knowledge Regarding Bioterrorist Threats in Emergency Department Physicians

Samuel J. Stratton, MD, MPH

Professor, University of California, Los Angeles, School of Public Health and David Geffen School of Medicine
Medical Director, Health Disaster Management, Emergency Medical Services Division, Orange County California Health Care Agency, California USA

Correspondence:

E-mail: sstratton@att.net

Web publication: 19 June 2007

Leiba and co-authors should be commended for their article describing emergency physician bioterrorism preparedness on a national level.¹ The recognition of the relative lack of knowledge of emergency physician study subjects about anthrax, an organism that is recognized as a high potential bioterrorist agent, was particularly interesting. Their description of efforts that were required to alert and educate "front-line" physicians about potential bioterrorist agents illustrates a successful approach to this new area of focus in emergency medicine.

Bioterrorism threats have redefined the role of emergency medicine in relation to population health. Emergency departments can be considered the primary interface between the medical or individual health sector and population or public health sector. Collaboration of emergency care and public health providers is essential for the recognition and control of potential bioterrorism events. Not only is this collaboration important for bioterrorism, but it also is important to any public health emergency including disease outbreaks and natural or man-made disasters.² The detection of potential bioterrorist agents and events by emergency physicians is extremely important as the first alert of the event. The timely notification by the emergency physician of the public health office when a potential bioterrorism threat is suspected is equally important. This notification allows for immediate actions by public health officials to conduct field epidemiologic investigations and control the harmful agent. In fact, it has been recognized that, in addition to community health emergencies, the dominant issues for health and health care today require that the fields of public health and medicine work together as partners.³

It is important that emergency physicians understand that as they see acute illnesses within a population, they become a direct interface between the medical sector and the general community. Emergency physicians are the front-line physicians that are most appropriate for collaboration with public health as experts in surveillance for infectious disease outbreaks including bioterrorist events. An example of this concept is the 2001 US experience with anthrax bioterrorism in Florida. The rapid recognition of anthrax by a clinical laboratory working in connection with an emergency physician allowed for rapid action to be taken within 13 hours by local and national public health agencies.⁴ A lack of recognition and coordination with public health could have allowed for anthrax infections beyond the 11 cases that occurred.⁵ Furthermore, the early recognition of the anthrax bioterrorism event allowed for the isolation of the crime scenes and intervention with the US Postal Service, which was the means of transportation for the anthrax spores.⁵

Emergency physician knowledge of biological, chemical, and radiological agents, along with an understanding of emergency public health techniques and practices, is important for limiting the impact of these agents in an exposed community. Emergency physicians must recognize community health threats and rapidly alert public health officials so that field investigations and control of the threats can be effectively instituted.

During the past 50 years, a cultural divide has developed between public health and medicine, with medicine focused on the health of the individual, while public health has focused on the health of the community.⁶ In addition

to cultural differences, obstacles for understanding have developed further due to the separation of public health and medical schools within health education systems. This separation of medicine and public health has resulted in tensions between the social (public health) and reductionism (medicine) concepts of disease.⁵ Ironically, both medicine and public health systems have the same goal of bettering the health among the world population.

In the current healthcare environment, it is essential that emergency physicians appreciate their role in maintaining the health of a community. This role is exercised best by understanding basic public health principles and techniques. It is equally important that public health practitioners understand the challenges and principles of emergency and critical care medicine. Emergency physicians should understand that they are the interface between acute care medicine

and public health. Public health practitioners must understand that to effectively manage a public health emergency, they must become team members of local emergency departments.

Improving the collaboration between emergency and critical care physicians and public health requires changes. Changes in leadership style and professional education are the most important steps to be taken. Medical educators would be wise to provide more emphasis on public health education in medical schools, and for physicians preparing for careers in emergency medicine. At the same time, public health practitioners should be educated in the practice and challenges of emergency and critical care medicine. With future development of collaborative efforts on the part of medicine and public health, bioterrorism response, infectious disease outbreak mitigation, disaster management, and general global community health will improve.

References

1. Leiba A, Drayman N, Amsalem Y, et al: Establishing a high level of knowledge regarding bioterrorist threats in emergency department physicians. *Prehosp Disast Med* 2007;22(3):205–209.
2. Lasker RD, the Committee on Medicine and Public Health: The Current Predicament, In: *Medicine and Public Health: The Power of Collaboration*. New York: The New York Academy of Medicine, 1997, pp 29–43.
3. McGinnis JM: Can public health and medicine partner in the public interest? *Health Affairs* 2006;25(4):1044–1052.
4. Beall A, Cooke W, Trout J, Robb JA: Detection of the sentinel anthrax case in the United States. *Clin Leadership Manag Rev* 2003;17(5):281–282.
5. Jernigan DB, Raghunathan PL, Bell BP, et al: Investigation of bioterrorism-related anthrax, United States, 2001: Epidemiologic findings. *Emerg Infect Dis* 2002;8(10):1019–1028.
6. Brandt AM, Gardner M: Antagonism and accommodation: interpreting the relationship between public health and medicine in the United States during the 20th century. *Am J Public Health* 2000;90(5):707–715.