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On October 4, 2001, the first case of inhalation anthrax in U.S. history due to an intentional human act was diagnosed; convincing even the most skeptical American that bioterrorism is a real and present threat in this country. Despite its emergence as an important medical and public health issue, a serious deficit in bioterrorism preparedness training has been recognized throughout the medical community, particularly in undergraduate medical education.

In the face of the established need for bioterrorism awareness training, an overriding issue facing medical educators is how to incorporate more information into already over-packed curricula. The sheer volume of medical knowledge is becoming too vast to be taught by "traditional methods". Integration of multiple subject areas, using a variety of presentation formats, is the key to providing medical students with the breadth and depth of skills and knowledge necessary to become competent physicians in the 21st century.

This paper describes a unique adaptable, bioterrorism awareness training module designed for preclinical medical students that is inexpensive and will easily integrate into a wide variety of existing curricula. This course serves not only to educate students about

bioterrorism and weapons of mass destruction, but in addition will increase their understanding of the Public Health system and disease reporting requirements, while providing experience in utilizing on-line resources for knowledge acquisition. The format for this course is based upon educational data derived from two different bioterrorism preparedness training modules presented to first year osteopathic medical students in the academic years 2001-02 and 2002-03.

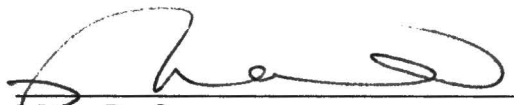
INTEGRATING PUBLIC HEALTH AND INFORMATICS

INTO UNDERGRADUATE MEDICAL EDUCATION: UTILIZATION OF

AN INNOVATIVE BIOTERRORISM AWARENESS TRAINING MODULE

L. Charolette Lippolis, B.A.

APPROVED:



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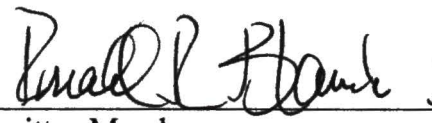
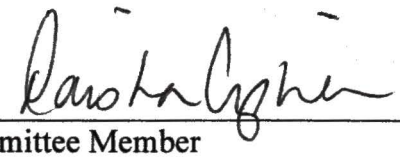


Committee Member



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INTEGRATING PUBLIC HEALTH AND INFORMATICS INTO UNDERGRADUATE MEDICAL EDUCATION: UTILIZATION OF AN INNOVATIVE BIOTERRORISM AWARENESS TRAINING MODULE

THESIS

Presented to the School of Public Health

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In Partial Fulfillment of the Requirements

For the Degree of

Master of Public Health

By

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Integrating Public Health and Informatics into Undergraduate Medical Education:

Utilization of an Innovative Bioterrorism Awareness Training Module

The anthrax mailings following the terrorist attacks of September 11th, 2001 changed the reality of bioterrorism in America forever. A new era in United States history has begun, one in which the hypothetical possibility of bioterrorism has become a stark reality[1]. Unfortunately, most U.S. healthcare professionals are poorly trained to respond in a mass casualty event resulting from a weapon of mass destruction (WMD), particularly a bioterrorist agent. Silvagni et al.[2] reported that literature searches, and telephone interviews failed to identify any specific training programs with WMD education for medical students in the United States. In addition, these authors found that the Public Health principles of population management during terrorist events are, at best, inconsistently taught.

The medical and public health response to the 2001 anthrax attacks demonstrated the necessity of an effective communication network between medical and public health professionals. The initial diagnosis of the index case was made by an infectious disease clinician and local laboratory technicians who had recently completed the CDC-sponsored bioterrorism preparedness training.[3] Given the rarity of inhalation anthrax in the United States, it is unlikely that such a rapid diagnosis would have been possible without the heightened awareness resulting from the training of these health care personnel.

The 22 cases of anthrax resulting from the 2001 incidents had an enormous impact beyond the specific region affected and the direct medical consequences for the

victims[3]. Health care personnel throughout America evaluated patients and fielded questions for tens of thousands of the "worried well". Bioterrorism became an issue not only for those in directly affected areas, but for physicians across the country.

Despite the improbability of a large scale bioterrorist attack in comparison to other known health crises and disasters, the catastrophic potential of such an event makes preparedness a necessity in every community. While police, firefighters and E.M.S. personnel are the traditional first responders in a mass casualty event, unless a bioterrorist attack is announced, it will be local health care personnel who are the initial and most essential line of defense for recognition, notification, diagnosis and treatment of disease.[4]

It is well known that disease outbreaks caused by common or even unusual infectious diseases cause higher degrees of morbidity and mortality than those associated with bioterrorism acts. One such outbreak was detected in August 1999, when an infectious disease clinician in Queens, New York, reported a small cluster of encephalitis with atypical clinical features to the New York City Health Department.[5] This was the first known outbreak of West Nile virus encephalitis in the western hemisphere. In fact, all of the reported cases of the West Nile virus encephalitis outbreak were reported by this one physician, illustrating the impact that even one observant and educated health care provider can have on the nation's health[6].

In truth, when physicians first report unusual or suspicious disease presentations to their local health departments, the origin of the presenting disease is unknown. Medical personnel must rely on the public health system to investigate the epidemiology of the illness and coordinate reports from multiple sources in order to assess the situation.

Most often an unusual disease presentation will not be the result of a bioterrorist agent, but without adequate disease reporting by physicians, the origins of any unusual illness will remain unknown.

One reason cited for the lack of physician reporting is a lack of understanding of how or whom to report an infectious disease.[7] Although 76% of medical schools reported spending an "adequate" amount of time in their curricula on preventive medicine and public health, gaps in certain topic areas were identified. Specifically, a gap was found in the area of "population health".[8]

In addition to public health training, there is also an increasing need for student knowledge of medical informatics. By incorporating a mandatory web-based learning (WBL) component into a course, students gain a greater understanding of medical informatics in conjunction with specific course content. Researchers have provided strong evidence that WBL interventions resulted in medical student knowledge gains equivalent to gains made with other educational methods.[9]

Studies have also demonstrated a preference by students for WBL over slide/tape and text-based materials, as well as a decrease in study time with WBL compared to text-based learning.[10] Some advantages of Web-based learning include: widespread accessibility, ease in updating content, hyperlink functions that allow cross-referencing to other sources, and lower both direct and indirect costs. Cost savings are based on the assumption that the institution has appropriate computer technologies available.[9, 11]

In September 2000 the American Association of Medical Colleges (AAMC) and the Centers for Disease Control and Prevention (CDC) established the AAMC-CDC

cooperative agreement, to move together towards the ultimate goal, "to improve the lot of humankind." [12] While the necessity of collaboration between the medical and public health arenas is exemplified by the AAMC-CDC cooperative agreement and initiatives such as the Medicine and Public Health Initiate, the actual implementation of programs that strengthen the ties between medicine and public health remain largely unrealized[13].

The Association of American Medical Colleges (AAMC) established the Medical School Objectives Project (MSOP) to propose learning objectives that medical schools may use as guides in reviewing their education programs. Report II of MSOP specifically addressed the areas of informatics and population health in medical education. The MSOP panel recommended that due to the far-reaching nature of medical informatics, the most practical and sustainable approach to achieve the outlined objectives is one of integration, enhancing existing curricular elements with informatics and population health elements.[14]

Goals outlined by MSOP that are addressed in the bioterrorism training module described here are:

- An understanding of, and respect for, the roles of other health care professionals, and the need to collaborate with others in caring for individual patients and in promoting the health of defined populations and
- the ability to retrieve (from electronic databases and other resources), manage and utilize biomedical information for solving problems and making decisions that are relevant to the care of individuals and populations.

BIOTERRORISM COURSE OBJECTIVES

The overall objective of this course is to make available to medical schools an adaptable bioterrorism awareness training module for preclinical medical students that is inexpensive and can easily be integrated into a wide variety of existing curricula. The specific student objectives for the course are outlined in Table 1 and closely match recommended objectives previously identified for WMD education goals .[2,]

PROPOSED COURSE DESCRIPTION AND IMPLEMENTATION

The training module begins with 2 hours of introductory lectures which consist of (1) an overview of weapons of mass destruction; (2) an introduction to issues related to mass casualty situations; (3) a description of physician roles and responsibilities to patients, staff and the community at large; (4) reasons to suspect a bioterrorist attack; (5) the public health reporting process, requirements; and (6) government agencies involved in responding to such an event.

During the introductory session, students are given specific course objectives and instruction sheets containing the course assignments and detailing how to access the course web page. This webpage contains: the required reading materials, links to the CDC's bioterrorism website and multiple other related sites, and five bioterrorist attack scenarios.

The bioterrorist scenarios describe fictional incidents involving the five "Class A" bioterrorist agents of concern (plague, anthrax, tularemia, botulism or smallpox). The students are required to read and evaluate the scenarios and then submit ten "thought-

provoking" questions; two questions for each of the five incidents. The students then receive two hours of designated "self-study time" and a total of one week in which to study the course materials and submit their questions. The specific learning objectives guide their independent study and direct their required access to the course website.

The basic clinical presentation, treatment and prevention of diseases caused by the bioterrorist agents and patient isolation protocols, are included in the course handouts accessible on the website. Our module was presented to first year medical students, therefore the focus was on a broad-based understanding of the issues and complications inherent in a bioterrorist event, not just on the clinical aspects of the probable diseases. However, the learning module could readily be adapted to meet the needs of students at different levels of clinical training.

The course concludes with an interactive discussion between the students and an expert panel. Panelists include local health care, public health and other pertinent personnel in order to provide students with information relevant to the local area. The panelists in the 2003 course administration were professors and clinicians from within the institution, American Red Cross and emergency services personnel, as well as local military and public health officials (Table 2).

Panelists were provided with a limited list of the most interesting and most frequently submitted student questions (Table 3). The interactive discussion allowed for moderators to pose the previously submitted questions to the panelists, while also generating spontaneous student questions and comments throughout the discussion.

The format of this bioterrorism module is highly adaptable and flexible, allowing it to be incorporated within a variety of curricula. Although the format outlined above is effective, this course could be taught in multiple other formats and even as an entirely web-based, self-study course with no student/faculty interaction or designated course time outside of student "self-study hours". Content related to biological weapons could be logically integrated into infectious disease, epidemiology, population health, microbiology, clinical medicine and/or medical informatics courses.

ESTIMATED COST OF MODULE IMPLEMENTATION

Because the bioterrorism modules were incorporated into the existing curriculum at the medical school, expenses were minimal. All of the web design, course design and teaching was done by currently existing members of the institution as part of their current job duties and all of the expert panelists volunteered their participation. If this ideal situation were not possible, a potential cost estimate is summarized in Table 4.

VALIDATION OF THE MODEL

METHODS

Two bioterrorism awareness modules were tested at the Texas College of Osteopathic Medicine (TCOM) in Fort Worth, Texas during the 2001-2002 and 2002-2003 academic years. Study participants included first year medical students in their second semester of pre-clinical training. Participation consisted of completing an optional pretest and posttest, graded for data collection purposes only. In 2001-2002, 77 out of 23

students participated and the following year, 103 out of 126 students chose to participate. Test questions assessed general knowledge in subject areas related to: disease reporting; crisis and consequence management; the roles of first responders; and disease diagnosis, treatment, transmission, isolation precautions, epidemiology, morbidity and mortality. Students also answered survey questions reporting their self-perceived bioterrorism knowledge levels and additional posttest questions which assessed their utilization of course materials and resources.

The Spring 2002 instructional method consisted of introductory lectures, group projects and culminated with an interactive expert panel discussion. Each of five student groups was assigned a different agent (plague, anthrax, tularemia, botulism or smallpox) and an attack scenario to research and orally present to the entire class during the interactive discussion at weeks' end.

The Spring 2003 format also utilized introductory lectures and concluded with the expert panel discussion. However, this module utilized self-study in lieu of group projects. The students individually studied all scenarios and agents, then submitted questions to be addressed by the panel on the final day of the course.

Both groups of students were provided objectives, handouts and access to a course website with links and additional resources. The same pretest and posttest were administered to assess the impact of the intervention.

RESULTS

There was no significant difference found between the final posttest scores for the two course administrations (t (180) = 0.000, p = 1.00). However, a one-way ANOVA demonstrated statistically significant knowledge gains from pretest to posttest for both the group project and self-study modules ($F(1,76) = 22.00$, $p < .01$; $F(1,102) = 31.95$, $p < .01$, respectively). (Table 5).

When asked to describe their "current level of bioterrorism knowledge", significant subjective posttest gains were observed (t (181) = 14.685, $p < .01$). Pretest scores indicated that 74% of students felt "somewhat" or "very" uninformed about bioterrorism, compared with only 18% after completing the course.

One of the desired outcomes of the learning module was that students gain knowledge of where and how to find bioterrorism information in the future. After completing the course in 2003, only 6% of students disagreed with the statement that they would "be able to easily find bioterrorism information in the future as a result of this bioterrorism course".

DISCUSSION

Although the pretest to posttest score changes were statistically significant, the change was relatively small when considering the scale of the intervention. The most likely reason for this is that the students had no grade associated with the training module in either course administration. In the upcoming, 2003-04 course administration the class will be recieiving an additional graded exam, separate from the study pretest and posttest.

The working hypothesis is that there will be a marked increase in their posttest scores when motivated to study for a graded exam.

The course administration method did not change the ultimate posttest achievement scores or the students self-reported change in bioterrorism knowledge, allowing either method to be used in a course design. However, the self-study method was preferred by the faculty and students at TCOM due to the ease of implementation. Therefore, the self-study model is the model recommended for duplication.

There was an interesting finding related to the student's self-reported web use. The majority of students (87%) only accessed materials that were directly viewable/downloadable from the course website. Of those who did "link-out", 11% went to sites directly linked and only 2% explored sites not directly linked to the course site. This information should be considered when designing websites for students' use. Sites should include all necessary materials as direct download files for ease of access and viewing. Links should be provided for additional investigation, but not as primary resources for students.

The unique interactive format of the expert panel discussion was by far the most well received aspect of the TCOM course in both administrations. This innovative format allowed students the opportunity to ask their own questions of the "real people" behind the positions they became familiar with throughout the course. This live interaction with persons in positions of authority within the local area helped students to better understand their future roles as physicians and community leaders.

CONCLUSION

The bioterrorism awareness module presented here serves not one, but four major functions within the curriculum: (1) increases awareness of terrorism and mass casualty situations in general, (2) heightens awareness of specific clinical features of bioterrorist agents including diagnosis and treatment options, (3) increases understanding of the role of public health agencies and the requirements and necessity of reporting infectious diseases, and (4) increases student use of the World Wide Web for medically related issues, thus increasing knowledge of medical informatics.

Experts agree that bioterrorism preparedness should be incorporated into medical school curricula.[4,15] The bioterrorism training presented here will help to ensure the public health in the event of a terrorist attack and in a more dynamic, ongoing manner by helping to increase physician reporting of infectious diseases. Ultimately, a change in the education of the nation's medical students is a change in the future health care of the nation.

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APPENDIX 1 – TABLES

Table 1

BIOTERRORISM PREPAREDNESS

LEARNING OBJECTIVES FOR ALL LECTURE AND SELF-STUDY HOURS

After you have studied the lecture and reading material, you should be able to:

For each of the following diseases:

- Tularemia
- Smallpox
- Pneumonic Plague
- Anthrax
- Botulism

1. define the incubation period
2. describe the modes of transmission
   a. How the disease is spread by terrorist activity
   b. How the disease is spread by infected individuals
   c. How the disease is spread naturally
3. recognize the signs, symptoms and physical findings in infected persons
4. describe the epidemiology in the United States
   a. Endemic vs. Non-endemic
   b. Populations at greatest risk of infection with agent
   (i.e. military personnel, persons in rat infested conditions, etc…)

In addition, you should:

5. be familiar with the basic clinical presentation of a person infected with a viral hemorrhagic fever
6. be able to list at least 10 reasons you would suspect a patient is infected with a BT agent
7. recognize when to report a suspected BT infection
8. identify the agency you report to if you diagnose a suspected BT infection
9. describe the major functions/responsibilities of the lead national governmental agencies in the event of a BT attack (FBI, FEMA, American Red Cross)
10. identify who the first responders are in a BT attack
11. list the weapons of mass destruction described by the acronym "BNICE"

READING ASSIGNMENT: Power Point presentations, course handouts and Bioterrorism case scenario accessible at: http://courses.hsc.unt.edu/ under the Year 1 Bioterrorism link.

Table 2

Expert Panelists for 2003 Interactive Discussion

John Apodaca
Director, Tarrant County Director of Emergency Services
American Red Cross

Francis Blais, DO
Professor of Internal Medicine
Certified Infectious Disease Specialist
UNTHSC - Texas College of Osteopathic Medicine

Ronald Blanck, DO
President, University of North Texas Health Science Center at Fort Worth
Chair, Texas Medical Association's Taskforce on Bioterrorism
Former Surgeon General of the United States Army

J.J. Jones
Emergency Management Officer
Fort Worth/Tarrant County Emergency Management Office

John Podgore, DO
Professor of Pediatrics
Infectious Disease Specialist
UNTHSC - Texas College of Osteopathic Medicine

Stephen Putthoff, DO
Chair and Associate Professor, Department of Anatomy and Pathology
Forensic Science Specialist
UNTHSC - Texas College of Osteopathic Medicine

Col. Jackie Vaughn
Vice Commander, 136h Airlift Wing
Texas Air National Guard

Moderators:

Charolette Lippolis
DO/MPH Student
UNTHSC - Texas College of Osteopathic Medicine and School of Public Health

Muriel Marshall, DO, DrPH
Associate Professor of Family Medicine and Social and Behavioral Science
Certified in Preventive Medicine
UNTHSC -Texas College of Osteopathic Medicine and School of Public Health

Table 3

Examples of Student Submitted Questions

(From Texas College of Osteopathic Medicine
Bioterrorism Awareness Training Module 2003)

- Is there any central system of information gathering and/or information reporting which would assist the average family physician in making the connection of multiple cases thereby increasing the chances of a correct diagnosis?
- What is the exact protocol for reporting an illness to the health department or CDC?
- What administrative measures can a hospital take in an epidemic type situation to ensure that their current personnel will show up to work? If nurses or doctors choose not to put themselves in harms way are there any ramifications from a legal standpoint? Could they lose their license?
- Is there any type of plan in place to recruit large groups of medical personnel from out of the city and bring them in to help in such a situation where the doctors here are overwhelmed? Or is there a plan for military/government workers to staff local hospitals in the event of an infectious BT outbreak, and a high absentee rate among regular employees?
- Will health care workers be adequately protected when treating these large numbers of infectious patients?
- How would medical students (with limited clinical experience) be able to assist in patient care in a bioterrorism episode?
- Does FEMA, the CDC, or the U.S. military have an emergency response team available to be anywhere in the U.S. within a day of suspected bioterrorism events?
- What power does the government have to quarantine and keep people against their will who are suspected carriers of a disease? Would it be considered an issue of national defense? Who decides?
- What are the public's rights where preferences for personal and familial body disposal are concerned? Can the government decide what happens to you loved one's body during times of bioterrorism?
- Will health care workers be able to receive prophylaxis and other medical treatments first in order for them to better aid the sick? What is the hierarchy in antibiotic administration? (Who will be served first- Public Officials > Military > Citizens?)
- During the season when flu-like symptoms are common, how does the physician differentiate between a bad case of the flu and the need to notify the public health department?
- What kind of plans are in place to manage the large number of 'well' family members/friends that will accompany many of the critically ill to the hospitals?
- To what degree is the physician liable for misdiagnosing the first round of patients after a biological attack? Is there a degree of immunity granted because of the rare nature of the diseases or toxins?

Table 4

Training Module Implementation Cost Estimate

Faculty hours = $3,000

- 2 hours - initial session, 2 hours - final session, 20 hours - planning/implementation = 24 hour x $150/hr

Web design and technical support for bioterrorism web page = $2,000

- 40 hours x $50/hr.

Cost of printed materials = $50.00

- 10 pages/student x 125 students x $.04/page

Optional compensation and/or travel for expert panel members = $1,600

- $200 x 8 experts

TOTAL estimated cost: $ 6,650.00

Other costs incurred by the institution (not included in total cost)

- Room use for 4 hours
- Computer infrastructure

Table 5

Mean Percentage of All Objective Questions Correct	**Pretest**	**Posttest**
2002 "Group Project" Course Administration	46 %	62 %
2003 "Self-Study" Course Administration	52 %	60 %
Methods Combined	50%	61%

APPENDIX 2 – JOURNAL SUBMISSION COVER LETTER

INTEGRATING PUBLIC HEALTH AND INFORMATICS INTO UNDERGRADUATE MEDICAL EDUCATION: UTILIZATION OF AN INNOVATIVE BIOTERRORISM AWARENESS TRAINING MODULE

L. Charolette Lippolis, BA, Muriel Marshall, DO, DrPH, Daisha Cipher, PhD, and Ronald Blanck, DO

This paper has not been published and is not under consideration in the same of a substantially similar form in any other journal. All of the listed authors are qualified for authorship and all that are qualified to be authors are listed as authors on the byline. To my knowledge, no conflict of interest either financial or otherwise exists.

Respectfully,
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