

# Development of an Interactive Bioterrorism and Emerging Infections Curriculum for Medical Students and Internal Medicine Residents

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## SYNOPSIS

While awareness of bioterrorism threats and emerging infectious diseases has resulted in an increased sense of urgency to improve the knowledge base and response capability of physicians, few medical schools and residency programs have curricula in place to teach these concepts. Public health agencies are an essential component of a response to these types of emergencies. Public health education during medical school is usually limited to the non-clinical years. With collaboration from our local public health agency, the Emory University School of Medicine developed a curriculum in bioterrorism and emerging infections. By implementing this curriculum in the clinical years of medical school and residency programs, we seek to foster improved interactions between clinicians and their local public health agencies.

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Several events in recent years have emphasized the importance of developing and implementing clinical curricula in bioterrorism and emerging infections. On September 11, 2001, the United States faced the most serious terrorist attack in its history. Later that year, bioterrorism resulted in 22 cases of anthrax, five of whom died. In 1999, 59 patients were hospitalized in New York City with West Nile Virus, an infection previously undiagnosed in the United States; seven of those patients died. West Nile Virus has subsequently spread throughout the United States, causing significant morbidity and mortality. In 2003, a previously unknown viral illness was identified in Southeast Asia. This new disease, Severe Acute Respiratory Syndrome (SARS), resulted in more than 8,000 cases worldwide, with at least 774 deaths. We live in an era when rapid worldwide travel is common, and physicians today are likely to encounter a victim of an emerging infectious disease.

Prior to 2001, there had been no comprehensive effort to teach physicians-in-training about these topics. For example, results of the 2001 Association of American Medical Colleges (AAMC) annual medical school survey indicated that only one of 125 medical schools offered a separate required course in biological/chemical terrorism.<sup>1</sup> Shortly thereafter, the AAMC characterized biological terrorism as an important topic and established guidelines to assist in curriculum development.<sup>2</sup> As a result, an increased number of medical schools now offer some type of training in bioterrorism. When the AAMC survey was repeated in 2002, 63 medical schools reported they had a required course on bioterrorism; however, this still left 62 schools without a required course.<sup>3</sup>

The fundamental concepts of bioterrorism and emerging infections training are very similar. They include:

- Recognition of agents that may be used in a terrorist event, or the emergence of an infectious disease of public health significance;
- Treatment of victims of a terrorist event or infectious disease outbreak in a safe and proper manner;
- Increased awareness about the combination of factors unique to bioterrorism and emerging infections (e.g., communicable diseases, exposed response personnel, and dual epidemiologic and law enforcement investigations);
- Assessment of plans for information sharing with public health and other agencies (including communication and information flow within and among response agencies);
- An understanding of public health agencies' capacity to detect an unannounced attack or emerging disease outbreak;
- An understanding of state and federal roles and responsibilities; and
- Establishment of close working relationships with partnering agencies.

This article reports on a collaborative effort between the Emory University School of Medicine (EUSM) and the DeKalb County Board of Health to improve the knowledge, preparedness, and coordination of our medical and public health communities related to bioterrorism and emerging

infections by developing and implementing a curriculum for undergraduate and postgraduate medical students.

## BUILDING A PARTNERSHIP

In 2002, a group of EUSM clinicians took the initiative to develop a bioterrorism and emerging infections curriculum for undergraduate and postgraduate medical education. This group included an infectious diseases specialist and four general internal medicine clinicians (two of whom had also trained at the Centers for Disease Control and Prevention [CDC] as Epidemic Intelligence Service officers). With considerable resources on bioterrorism and emerging infections already available, the group sought to adapt existing interactive educational activities and provide a multidisciplinary approach. The group felt that tabletop exercises already being used to teach graduate students at the Emory University Rollins School of Public Health could be an integral part of the planned curriculum. The tabletop exercises were developed and conducted by the DeKalb County Board of Health. Tabletop exercises have not been validated extensively in the literature as tools to train clinicians. In fact, the Agency for Healthcare Research and Quality summary on *Training of Clinicians for Public Health Events Relevant to Bioterrorism Preparedness* identified only one study that focused on tabletop exercises and found them to be useful tools.<sup>4</sup> However, this study was more of a large-scale drill than a true teaching program. The EUSM group agreed that evaluation of the Emory curriculum could be used to gauge the effectiveness of tabletop exercises in training clinicians about bioterrorism and emerging infections.

The DeKalb County Board of Health works actively with the community on a range of health promotion and disease prevention issues. In 1999, the CDC funded DeKalb County and two other local health departments through a competitive grant process to develop exemplary Centers for Public Health Preparedness (CPHP). This federal grant program directed local health agencies with existing baseline response capacity to create model practices in public health surveillance, operational readiness, and workforce training. In February 2000, the DeKalb CPHP began developing a series of bioterrorism tabletop exercises to educate and build credibility with first responders and other community stakeholders. By participating in these exercises, key community individuals (e.g., chiefs of fire and rescue departments and chiefs of police) and their organizations became better prepared for possible bioterrorism events.

Because the effectiveness of tabletop exercises can be enhanced by tailoring them to each audience, the DeKalb CPHP collaborated with the National Association of County and City Health Officials (NACCHO) to develop BtCreate, an interactive tabletop exercise generator that can be used to customize a training exercise with the appropriate look and feel for the target audience.

Recognizing the DeKalb CPHP's experience, the EUSM group approached them to assist in developing the medical school curriculum. The EUSM group was able to assist with adapting these tabletop exercises to the realities of daily life during medical training. This partnership resulted in an innovative method for educating medical students and phy-

sicians-in-training. In the process, the DeKalb CPHP advanced public health preparedness and enhanced its credibility within the academic and clinical community.

## CURRICULUM DEVELOPMENT AND IMPLEMENTATION

### Need

The need for an organized curriculum on issues related to bioterrorism and emerging infections in health profession schools is well documented. There is a deficiency in both the knowledge base of students in these schools as well as a curriculum to train them on issues related to bioterrorism and emerging infections. Two surveys of nurses, physicians, nursing students, medical students, infection control practitioners, and nurse educators at Thomas Jefferson University revealed that knowledge about bioterrorism was low, with less than one-fourth of the knowledge questions being answered correctly.<sup>5</sup> A study published in 1999 showed that emergency medicine residency programs were not adequately training their physicians to respond to terrorism.<sup>6</sup> The study identified specific weaknesses, including poor access to reference materials and experts. Often, the only recognized consultants available were toxicologists and poison control specialists, neither of whom possessed the appropriate expertise to identify rare infectious diseases. Approximately two-thirds of the emergency medicine residency program directors surveyed felt inadequate to diagnose or treat victims of a bioterrorism attack. While these studies addressed knowledge and aptitude in responding to a bioterrorist event, the same data would likely be relevant to these providers' skills in responding to an emerging infectious disease.

All clinicians need to be educated about appropriate responses to bioterrorism and potential emerging infectious diseases, as they will be the front-line responders. When patients were surveyed about who they would seek assistance from if they thought they had smallpox, 52% stated they would go to their own physician, 40% would go to the emergency room, and 7% would go to the public health department.<sup>7</sup>

In 2002, the leadership of the Woodruff Health Sciences Center at Emory University convened a task force to explore the need and available resources to train health care providers in graduate and postgraduate education in bioterrorism. The result of that study revealed that while available expertise existed on campus, there was no repository or coordinated program that would allow training at all levels and across disciplines.

### Goals

Goals for the curriculum were developed using the AAMC report of the expert panel on bioterrorism education.<sup>1</sup> The goals, reviewed and agreed upon by the EUSM group and the DeKalb CPHP, are shown in Figure 1.

### Content

We followed recommendations of the AAMC expert panel that the curriculum consist of didactic and experiential learning sessions.<sup>1</sup> The entire curriculum was reviewed by all members of the EUSM group and the DeKalb CPHP. With the expertise of the infectious disease specialist, the EUSM

### Figure 1. Bioterrorism and emerging infections curriculum goals

1. Be able to provide a basic knowledge of the characteristics of bioterrorism agents.
2. Be able to recognize red flags and symptom complexes that could represent outbreaks.
3. Be able to treat victims.
4. Be able to protect yourself and other health care workers.
5. Be able to understand the public health system and its interactions with clinicians.
6. Be able to keep current with bioterrorism and emerging infections information.

group developed a didactic lecture emphasizing the basic concepts. This is given during the first hour of the course. It is followed by a two-hour interactive workshop developed by the DeKalb CPHP with input from the clinicians in the EUSM group.

The foundation of the workshop is the tabletop exercise that is customized using BtCreate. The interactive Power Point-based simulation is presented by one or two facilitator(s). Each student is assigned a role, such as the primary care doctor, the hospital epidemiologist, the county health official, the state health official, etc. They participate according to their role in a real-time simulation. The student is able to learn not only how to approach these cases medically, but also how to activate and understand the roles, interactions, and responses of the various public health officials. After the simulation, participants are given handouts that contain resources and references. Though each exercise is tailored to the needs of the participants, the episodes follow a consistent sequence:

- *Introduction.* Background narrative for the exercise, including its purpose, goals, format, and participants' roles.
- *Outbreak.* Introduces the initial cases and activities that may raise the suspicion of the players.
- *Detection.* Elaborates on the initial cases; may include laboratory and medical examiner findings.
- *Communications.* Addresses public concerns, media, and communications among the responders.
- *Investigation.* Describes the epidemiologic and possible law enforcement investigations; it may also include additional information relevant to the earlier episodes.
- *Resolution.* Provides the results of the investigations and the scenario's conclusion.

One of the goals of the collaboration was that the EUSM faculty learn how to use BtCreate to develop their own tabletop exercises. The DeKalb CPHP demonstrated how to customize, update, and run the tabletop exercises. Each time the exercise was presented, it was modified to include local information and current events, making the scenario more relevant to the participants. The exercise has been presented jointly by the DeKalb CPHP and EUSM faculty.

### Implementation

This curriculum was successfully implemented in the Internal Medicine Residency program at Emory University in January 2004. Through monthly sessions with approximately 10 residents, the program trained 60 residents by June 2004; 38 residents completed the finalized pre- and post-test. The curriculum is also currently being implemented for all 110 third-year Emory University medical students. The students will complete the curriculum during their internal medicine clerkship. Implementing the curriculum during medical students' clinical years, rather than in the basic science years, reinforces the relevance of the interaction between clinicians and the public health infrastructure.

### EVALUATION

The evaluation process is important because it ensures that we are meeting our educational goals and provides an objective measure of the curriculum's impact. The curriculum is being evaluated and adjusted by means of a pre-test and post-test, as well as open feedback from participants. The EUSM group and the DeKalb CPHP developed the pre-test and post-test collaboratively. In addition, faculty and students in the Emory University Rollins School of Public Health are reviewing the curriculum as a case study for students in a curriculum development course offered in the Career Master of Public Health Program.

The pre-test and post-test contain 11 questions that highlight the goals of our curriculum. They examine general themes such as knowledge of bioterrorism agents, including identification, transmissibility, and treatment; knowledge of the public health infrastructure, its responsibilities, and which organization or individual to contact; knowledge of the vaccines available and their uses and contraindications; and knowledge of how to protect oneself when dealing with an unidentified agent.

In the pilot stage, we determined that overall initial knowledge is low. The mean pre-test score for internal medicine residents was 54%. The participants' initial perception of the importance of the issue was also low, with only 3% considering it very likely and 24% considering it likely that they will encounter a patient who has acquired an infection by an emerging agent or who has been the victim of a bioterrorism event. This is despite the fact that there have been multiple examples of both in the past, including anthrax attacks in the neighboring state of Florida, cases of West Nile Virus at the Emory-affiliated hospitals, and the presence of the CDC main campus only a few hundred yards from the University Hospital where these residents train.

Post-test data demonstrated the curriculum's impact on both knowledge of bioterrorism and emerging infectious diseases and attitudes toward the likelihood of having to address either event in the future. Test scores increased by a mean of 11.05% ( $p < 0.0001$ , 95% confidence interval [CI] 5.9, 16.2) to a post-test mean score of 65%. Participants found it more likely that they might have to deal with the issues of bioterrorism and emerging infectious diseases at the end of the workshop (Chi-square 11.5,  $p < 0.025$ ). The distribution of their responses is shown in Table 1. Participants in the program have given the following written feedback: "It kept my interest and attention for 2 hours. The

**Table 1. Participants' opinions on the likelihood of encountering a bioterrorist-related outbreak or emerging infectious disease**

	Pre-test (percent)	Post-test (percent)
Very likely	3	8
Likely	24	24
Neutral	37	47
Unlikely	31	13
Very unlikely	5	8

questions addressing our responsibilities as house officers greatly helped to keep the presentation pertinent to me." And, "Great format, presentation, interactive approaches. I learned a great deal about potential bioterrorism that I may be on the front line to diagnose."

Data collection for the long-term impact of the curriculum and for medical students is ongoing. As we continue to gather data during our curriculum implementation, we will use it to improve information content and delivery and continually evaluate the effectiveness of tabletop exercises as a teaching tool for medical students.

### DISCUSSION

Until recently, there was little or no organized curriculum in medical schools for undergraduate or postgraduate education on bioterrorism and emerging infections. Given recent events, it is now considered an essential piece of education for physicians-in-training. However, guidelines and experience in developing this curriculum are sparse. Most medical schools integrate public health education as a small part of the biostatistics and epidemiology course during the first two years of medical school. Since these are usually the non-clinical years, it is difficult for students to envision their interaction with public health agencies as future clinicians. Possibly as a consequence, public health officials are perceived as lacking relevance and credibility with clinicians. Bioterrorism and emerging infections both require a unified, coordinated response by clinicians and public health officials. Public health personnel are logical partners for developing curriculum that will shape future physicians' responses to these events. By implementing this curriculum in the clinical years, it reinforces to physicians-in-training the relevance of their interaction with the public health infrastructure.

The BtCreate software developed by DeKalb's CPHP in conjunction with NACCHO is a user-friendly program that allows creation of customized tabletop exercises. To our knowledge, this has not been used as an educational tool in other medical schools. We demonstrated that this inexpensive (\$50) software can be easily used by medical schools as part of an effective curriculum in bioterrorism and emerging infections.

The long-term success of our curriculum is yet to be determined quantitatively as we complete our implementation and evaluation, but it has fostered a collaborative relationship between the EUSM and the DeKalb CPHP. Academic medical centers and public health agencies share similar educational goals about medical issues related to bioterrorism and emerging infections. Development of curriculum to address these important topics offers an ideal opportunity for collaboration. This project has provided DeKalb's CPHP with an opportunity to advance public health preparedness while enhancing their credibility with the academic and clinical community. It has benefited EUSM by introducing the academic community to an innovative method for educating health profession students. This work has benefited the community by increasing the collective capacity for emergency response and improving overall public health preparedness efforts. We believe this project can serve as a model for other communities and for other collaborations between local public health and academia.

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## REFERENCES

1. Association of American Medical Colleges. Number of US medical schools teaching selected topics, 2000–01 [cited 2003 Jun 21]. Available from: URL: <http://services.aamc.org/currdir/section2/LCMEHotTopics.pdf>
2. Association of American Medical Colleges. Training future physicians about weapons of mass destruction: report of the expert panel on bioterrorism education for medical students. Washington: AAMC; 2003.
3. Association of American Medical Colleges. Results from question 21 of the LCME Annual Medical School Questionnaire 2001-2002 [cited 2004 April 2]. Available from: URL: [http://services.aamc.org/currdir/section2/LCME\\_Hot.xls](http://services.aamc.org/currdir/section2/LCME_Hot.xls)
4. Training of clinicians for public health events relevant to bioterrorism preparedness. Evidence Report/Technology Assessment: Number 51. Rockville (MD): Agency for Healthcare Research and Quality. AHRQ Publication No. 02-E011; 2002. Also available from: URL: <http://www.ahrq.gov/clinic/epcsums/biotrsum.htm>
5. Rose MA, Larrimore KL. Knowledge and awareness concerning chemical and biological terrorism: continuing education implications. *J Contin Educ Nurs* 2002;33:253-8.
6. Pesik N, Keim M, Sampson TR. Do U.S. emergency medicine residency programs provide adequate training for bioterrorism? *Ann Emerg Med* 1999;34:173-6.
7. Blendon RJ, DesRoches CM, Benson JM, Herrmann MJ, Taylor-Clark K, Weldon KJ. The public and the smallpox threat. *N Engl J Med* 2003;348:426-32.