A Model Curriculum for Public Health Bioterrorism Education

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SYNOPSIS

Beginning with the spring semester of 2001, a course designed to prepare future public health leaders for potential bioterrorism events has been offered by the University of Connecticut Graduate Program in Public Health. Entitled "The Public Health Response to Bioterrorism," this popular course was one of the few developed by academic programs in the United States prior to the attack of September 11, 2001. The course utilizes innovative teaching methods and presentations by distinguished guest speakers to educate public health personnel, public health and medical students, and physicians and nurses about the complex issues involved in the public health response to bioterrorism. The instructional methods and curriculum can serve as prototypes for similar efforts.

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Biological agents were used as weapons in North America as early as the 18th century, when British forces distributed smallpox-tainted blankets to indigenous people during the French and Indian War.¹ The potential for modern-day use of biological agents as weapons was made evident during the fall of 2001, when letters containing anthrax were disseminated by use of the automated distribution system of the U.S. Postal Service.² As a consequence of these events and the World Trade Center disaster, billions of dollars have been spent to reduce the threat of terrorism in the United States.

The U.S. public health workforce is ill prepared to meet the challenges posed by bioterrorism, as Senator Joseph Lieberman pointed out in a letter to Health and Human Services Secretary Tommy Thompson cited by NewsMax.com.³ The bioterrorism preparedness knowledge gap is partly due to a general lack of availability of scientifically and medically relevant curriculum material developed for practicing public health and medical professionals, groups that are in greatest need of this information. Since 1998, federal initiatives have resulted in the establishment of Public Health Training Centers across the country,⁴ as well as Academic Centers for Public Health Preparedness (A-CPHP),⁵ as partnerships among academic institutions, public health agencies, and community organizations. There is no longer any doubt that the public health workforce and infrastructure are among the most important components of the earliest phases of response to bioterrorism.⁶

Prior to the events of September 2001, only a few graduate programs had introduced courses to teach medical, public health, and government professionals about the comprehensive defense required against biological weapons and bioterrorism. These included full-semester courses offered by the F. Edward Hébert School of Medicine of the Uniformed Services University of the Health Sciences (since 1996)⁷; the University of California, Los Angeles, School of Public Health (since 2000)⁸; and the University of Connecticut Graduate Program in Public Health (UConn MPH Program), located at the University of Connecticut Health Center (UCHC) (since 2001).

UConn's BIOTERRORISM PREPAREDNESS COURSE

Since 2001, the UConn MPH Program, which is structured as an evening program for working professionals, has offered a comprehensive semester course in bioterrorism preparedness to the Connecticut public health workforce. The course uses curriculum and teaching methods that have been highly popular with students, and have stimulated a high degree of scholarship on their part. The overall course goal is to train future public health leaders to cope with the multiple crises likely in a bioterrorism event. A range of instructors, including representatives of the Centers for Disease Control and Prevention (CDC) and the U.S. Army Medical Research Institute of Infectious Diseases (USAMRIID), present basic concepts of bioterrorism preparedness.

Distance learning

Use of distance learning methods has been a hallmark of this course since its inception. Class size at the primary class

location at UCHC (an auditorium with seating for 60) has ranged from 20 to 30 students, supplemented by live telecasts to as many as three additional class locations throughout Connecticut. Total graduate student enrollment for the first three years consisted of 20 students in 2001, 40 in 2002, and 25 in 2003. Guest lectures are regularly videotaped, with the videotapes placed in the main campus library for viewing and additional copies available for borrowing by students. The ability to telecast guest speakers has proved invaluable due to the prominence of some of the speakers and the uncertainty of New England weather during the winter months, which can interfere with travel to this evening class. Class lecture materials are made available through a UCHC website that students enrolled in the course can access. Final examinations have also been offered on the Internet via a university website.

Interdisciplinary learning

An elective course in the UConn MPH curriculum, the course is open to others as well, and class size is not limited. Attendees have included municipal health directors and their staff members, epidemiologists, physicians, sanitarians, hospital and public health nurses, pharmacists, medical residency program directors, laboratory directors, and military Reserve and National Guard personnel. Full-time medical, public health, and other biomedical science graduate students have enrolled as well. This diverse student group promotes interdisciplinary learning. Individual lectures, especially those by visiting lecturers, are publicized in advance, and are attended by university faculty and staff and members of the local community. Local municipal and district health directors and their staff have been encouraged to attend, and some have done so. The UConn MPH Program currently offers no other bioterrorism-specific courses, but pertinent seminars and lectures are presented frequently at UCHC and announced to the university and public health communities.

Local resources

Locally available resources are heavily utilized in the curriculum of this course. Personnel from the regional office of the Federal Bureau of Investigation and the Connecticut State Police lecture about law enforcement and public health interactions, including the similarities and differences between law enforcement and epidemiologic investigations. Infectious disease, toxicology, and emergency medicine experts from nearby Hartford and Stamford hospitals teach infectious disease, toxin and chemical agent detection, patient diagnosis and treatment, and triage methods. Experts from the Connecticut Department of Public Health (CDPH) and CDC's pharmaceutical Strategic National Stockpile (SNS) have presented up-to-date information on pharmaceutical stockpile deployment and use. The knowledge and experiences gained in the Connecticut anthrax case and the subsequent discovery and mitigation of anthrax spores in a Connecticut postal facility in 2001–2002 were described by an occupational physician working for the U.S. Postal Service and the State Epidemiologist. Representatives of the state public health laboratory and the nearby federal Plum Island Animal Disease Center have discussed their roles in bioterrorism preparedness and detection. Personnel from

the local Metropolitan Medical Response System, the U.S. Public Health Service (USPHS), the state's Disaster Medical Assistance Team, and the Connecticut and Massachusetts National Guard Weapons of Mass Destruction Civil Support teams have presented the responsibilities and functions of their organizations.

Guest speakers

We have been able to attract national subject-matter experts as course contributors, including Ken Alibek, former deputy director of the Soviet Union's biological weapons program and co-author of *Biohazard*; Giandomenico Picco, former Under Secretary General of the United Nations, international hostage negotiator, and author of *A Man Without a Gun*; U.S. Representative Christopher Shays; John Marr of the Virginia Department of Health, author of *The Eleventh Plague*; Laurie Garrett, author of *The Coming Plague* and *Betrayal of Trust*; David Huxsoll, then Director of the Plum Island Animal Disease Center; Ronald Berger, Arnold Kaufmann, Martin Meltzer, Stephen Reissman, Timothy Uyeki, and Mitchell Wolfe from CDC; David Jarrett (now Director of the U.S. Armed Forces Radiobiological Research Institute), Mark Kortepeter, and Ross Pastel from USAMRIID; and Mohamed Mughal from the U.S. Army Soldier and Biological Chemical Command (SBCCOM).

Enhanced learning modules

This course was designed two years prior to the development of bioterrorism core competencies for the A-CPHP.⁹ However, our course anticipated most of the A-CPHP core competencies. Our lecture modules may also suggest some potential future additions to the core competency list, such as health economics, distribution of the SNS, agricultural and zoonotic pathogens, and interactions between law enforcement and public health workers.

As subject matter experts, guest lecturers have been asked by the course instructors to assist in determining course content and related learning objectives. Many innovative lectures have subsequently been delivered in this course. For example, the lecture on principles of medical management of biological casualties is one designed for military clinicians by USAMRIID physicians.¹⁰ Students were introduced to concepts of treatment for nonspecific initial symptoms resulting from exposure to Class A biological agents by the infectious disease division chair of the Department of Medicine at Hartford Hospital. This was then reinforced by a lecture presenting the algorithm for empirical patient care in the absence of a definitive diagnosis developed by USAMRIID physicians.¹⁰

The lecture on the epidemiology of diseases of bioterrorism was made pertinent to Connecticut clinicians and public health officials through the use of Connecticut examples, including the human inhalational anthrax case of 2001¹¹ and the tularemia index case of the Martha's Vineyard outbreak of 2000.¹² Similarly, occupational health perspectives on processing and distribution of the U.S. mail were discussed in connection with the Connecticut anthrax mailing case by occupational health and postal service officials involved in the protection of U.S. postal workers in Connecticut.¹³ The health risks and economics of preparing for a bioterrorism event were introduced by a CDC health

economist and then reinforced through the students' use of CDC software and mathematical models for influenza and smallpox outbreak simulations, available on the Internet.^{14,15} Lectures on the development and use of biological weapons have been updated with new information, e.g., recent research on the spread of smallpox in colonial America¹⁶ and information on various state-sponsored biological weapons programs, including the extensive Japanese effort during World War II.¹⁷ Lectures by former bioweapons scientist Ken Alibek brought these topics to life.¹⁸

An example of emerging crosscutting challenges now facing public health officials and clinicians is the composition and deployment of the SNS. This was explored and demonstrated in our course by federal and state participants who have actually utilized this resource.¹⁹ New research areas related to bioterrorism have been regularly folded into the course curriculum. One example is the potential psychological impact of the use of biological weapons and bioterrorism, as examined by a research psychologist, Ross Pastel, convener of an international conference on this topic.²⁰ Finally, greatly adding to the students' enthusiasm for this course are book signings at the conclusion of classes offered by authors (e.g., Ken Alibek, Laurie Garrett, John Marr, and Giandomenico Picco). These classes have proved to be especially popular, and have often been standing room only.

Tabletop modeling as an instructional tool

Students learn to integrate the new material in a real-world context midway through the course with an assignment using a tabletop exercise. A tabletop bioterrorism response scenario was conducted at the Connecticut Fire Academy in Windsor Locks, CT, in 2001 and 2003.²¹ This facility includes a ping-pong table-size model of a hypothetical city, "Peterboro," with 1:87 scale-size model buildings, vehicles, and associated equipment. In the hypothetical scenario, Peterboro's population of 14,593 is spread over 43 square miles, with two fire stations (three fire engines and ladder, command, utility, rescue, and ambulance vehicles, all staffed by fire and EMS personnel); a police department (three cars available per shift, with off-duty officers subject to call); and a small community hospital with a 10-bed emergency department. Altogether, 40 buildings are represented on the tabletop, located on six main highways. A railroad spur is located in the northern section of the town.

Students with appropriate experience participated in the tabletop exercise, while others acted as observers. Participants included first responders at the federal level (representatives of the USPHS, the FBI, the Federal Emergency Management Agency, Connecticut and Massachusetts National Guard Weapons of Mass Destruction Civil Support Teams, and the U.S. Army SBCCOM); the state level (the State Police bomb squad, the Department of Environmental Protection hazardous materials [hazmat] team, and staff of the Office of Emergency Management); and the local level (police, fire, and EMS personnel; local health officers; physicians; nurses). Players participating in the tabletop exercise at the Fire Academy were identified by reflective vests clearly marking their role, e.g., Fire Department, Police Department, EMS. The exercise assessed the participants' ability to create and adhere to an Incident Command System

The bioterrorism course offered by the University of Connecticut's MPH program includes tabletop modeling of hypothetical bioterrorism scenarios.

(ICS) or Hospital Emergency Incident Command System (HEICS) disaster response model within the context of a fire or hazmat incident combined with a bioterrorism event involving a level A biological agent.

The exercise commenced with the participants introducing themselves, followed by a general situation briefing to set the groundwork for the scenario. This briefing explained the layout and logistics of the community of Peterboro and the resources available to fire, police, EMS, hospital, and associated personnel. During the course of the exercise, participants were handed timed situation cards, which were read aloud. Each participant then decided upon an appropriate response to the situation, and whether other participants needed to be included in the decision-making process. The exercise lasted about 60 to 90 minutes, and was followed by at least 60 minutes of group discussion and analysis of the response by participants. The tabletop exercise served as a training tool to promote a coordinated community and state response to a bioterrorism event. The students wrote a brief synopsis of their interpretation of the

tabletop exercise's events, aiding integration of knowledge gained in the course.

Redesign of examinations and term papers

Additional course requirements have included in-class and take-home comprehensive examinations, as well as a term paper on a subject dealing with biodefense. Guest lecturers are asked to contribute to examinations by providing essay questions. The term paper requirement has proved to be a popular tool for enhancing students' writing skills, with the offer that superior papers are forwarded to the appropriate course lecturer for review. One term paper requirement has been to design a bioterrorism attack or defense scenario. These theoretical exercises have contributed to the development of novel bioterrorism security planning. For example, one student with knowledge of the building maintenance industry described how a terrorist attack could be carried out by someone culturing a category A biological agent and then placing it in automatic deodorant sprayers commonly found in restrooms in public buildings. Another student

described how certain events present opportune targets when appropriate security precautions are lacking, e.g., the annual maritime Fleet Week held in New York City, San Diego, and San Francisco. Convincing term papers addressing novel threats, scenarios, or biodefense measures are forwarded with the permission of the student to interested parties at universities or federal or state biodefense agencies.

Another term paper requirement has been for students to work with a local health agency to assist in developing a framework for a comprehensive local bioterrorism plan based on four core elements: surveillance, disease control, communication, and coordination. This requirement forces the students to confront many of the real-world issues involved in such planning, including scale of response, local vs. regional control over resources, inter-agency rivalries, and all-hazards vs. biological agent-specific planning. This requires multiple interactions between students and local health directors or their representatives and various stakeholder agencies involved in a community disaster plan. Several of the plans thus developed have become models for bioterrorism planning for local communities throughout the state.

STUDENT EVALUATIONS

The course instructors review the end-of-semester student evaluations provided by the UConn MPH Program as a tool to improve the course curriculum and teaching methods. Table 1 presents information from course evaluations received from 66 of the 85 students (both matriculated and non-matriculated) enrolled in this course over the three-year period from 2001 to 2003. The course evaluation form uses a five-point scale ("very high," "high," "average," "low," and "very low"). Ninety-two percent of the raters checked "very high" or "high" for course topics, as did 94% of the raters for the educational content of the lectures. Class discussions (69%) and exercises (68%) did not fare as well, but during those two years in which a tabletop exercise was included (2001 and 2003), the latter score rose appreciably (to 84%). Examinations were less well rated (54%), but

take-home finals in 2001 and 2003 were rated higher (70%) than the in-class final in 2002 (33%). The course term paper appeared to be well received; 80% of the ratings were "very high" or "high." The level of scholarship of instruction (87%) and level of interest/stimulation (84%) were also rated favorably.

Students also provide written course comments to the UConn MPH Program. These comments have been highly favorable, praising the instructors and guest lecturers as well as the nature and amount of material learned in this course and requesting that the UConn MPH Program continue to offer this course. Comments on the class tabletop exercise have been very favorable. On the other hand, since this course has a final examination (either in-class or take-home) and the term paper is due at the end of the semester, students have complained about the timing of these requirements. Suggestions to alleviate this problem have included the use of a mid-semester examination or earlier graded assignments. The tabletop exercise offered in 2001 and 2003 was held midway through the semester, and students were graded on a two-page written description of their interpretation of the events.

There have also been complaints about technical problems with the quality of two-way video links between the main site at UCHC and the satellite campus sites. Students have stated that they would prefer to have the instructor and lecturer with them at the main campus site whenever possible. The presence of a teaching assistant at all sites greatly assisted with student participation and with technical difficulties during telecasts. Student comments have also pointed to the need to avoid repetitive information as much as possible. This unavoidably occurred during 2002, in the aftermath of the intense focus on anthrax cases during the fall of 2001, including a Connecticut case, and the subsequent discovery of anthrax spore contamination of a Connecticut postal facility. We have also learned from student comments that it is especially useful when course instructors elucidate the connections between aspects of the public health response to bioterrorism, such as the SNS, public

Table 1. Registered student course evaluations, 2001–2003

Category	Number of students responding	Number of students who gave "very high" or "high" ratings	Percentage of students who gave "very high" or "high" ratings
Educational value of course content			
Course topics	65	60	92
Lectures	65	61	94
Class discussions	62	43	69
Exercises			
Without tabletop exercise	65	44	68
With tabletop exercise	38	32	84
Examinations	54	29	54
Take-home	30	21	70
In-class	24	8	33
Term paper	61	49	80
Quality of instruction			
Level of scholarship	63	55	87
Interest/stimulation	64	54	84

health laboratories, the psychology and epidemiology of bioterrorism, and law enforcement initiatives. The use of tabletop modeling has proved invaluable in this regard, as have lectures by the course instructors integrating these aspects of bioterrorism preparedness.

DEVELOPMENT OF ENHANCED PUBLIC HEALTH COMPETENCIES

The A-CPHP is a network of 21 accredited schools of public health partnering with state and local health departments.⁵ The key bioterrorism core content areas initially developed for training public health professionals by A-CPHP in 2002 included characteristics of biological agents classes A, B, and C associated with bioterrorism; clinical manifestations; surveillance and epidemiology; laboratory systems; health risk communication and media relations; the psychosocial impact of bioterrorism; worker safety issues; information technology; and public health law.⁹ Many of these core content areas are covered in our course curriculum, as shown in Table 2.

The Institute of Medicine (IOM) has recently delineated needed improvements in academia to meet the requirements of educating public health professionals.²² This IOM report also recommends that academic institutions increase integrated learning opportunities for students in public health and other related health science professions, including multidisciplinary and interdisciplinary education. Many of the education and training needs for the public health workforce identified in the IOM report from an earlier study funded by the Health Resources and Services Administration (HRSA)²³ are also addressed in our course curriculum (Table 2). The IOM/HRSA core public health training needs, as identified in the report, are information systems and computer skills, technical writing and presentation skills, research and policy development skills, management and administrative skills, grantsmanship, public relations, transition skills, and leadership skills.²³ The UConn MPH Program course has also met many of the curriculum goals of the HRSA requirements for funding Public Health Training Centers, including: (1) use distance learning technology and other new educational approaches to provide basic and

Table 2. Course sessions and relationship to Academic Centers for Public Health Preparedness (A-CPHP) bioterrorism core competencies and IOM/HRSA core public health training needs

<i>Topic</i>	<i>Presenting agency</i>	<i>Learning objectives</i>	<i>A-CPHP bioterrorism core competencies</i>	<i>IOM/HRSA core public health training needs</i>
Medical management of biological casualties	Hartford Hospital; USAMRIID	Identification, triage, treatment of patients exposed to biological agents	Surveillance and epidemiology; characteristics of biological agents classes A, B, and C associated with bioterrorism; clinical manifestations	Management and administrative skills
Occupational health in Postal Service anthrax investigations	U.S. Postal Service; CDPH	Anthrax distribution, exposure, and remediation in an occupational environment	Worker safety issues; health risk communication and media relations	Leadership skills; public relations; research and policy development skills
Health economics	CDC	Disease model prediction of infectious disease epidemic effects	Surveillance and epidemiology	—
History and use of biological weapons	George Mason University; CDC; Virginia Department of Health	Historical biological events; state-sponsored biological weapons program; modeling of biological agent dispersal	Surveillance and epidemiology; characteristics of biological agents classes A, B, and C associated with bioterrorism	—
Strategic National Stockpile	CDC; CDPH	Composition, deployment, and distribution of Strategic National Stockpile	—	Management and administrative skills; leadership skills
Psychology of bioterrorism	USAMRIID	Psychological effects of the threat and use of biological agents	Psychosocial impact of bioterrorism	—

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Table 2 (continued). Course sessions and relationship to Academic Centers for Public Health Preparedness (A-CPHP) bioterrorism core competencies and IOM/HRSA core public health training needs

<i>Topic</i>	<i>Presenting agency</i>	<i>Learning objectives</i>	<i>A-CPHP bioterrorism core competencies</i>	<i>IOM/HRSA core public health training needs</i>
Epidemiology of bioterrorism diseases	USAMRIID; CDC	Characteristics of transmission and control of bioterrorism diseases; Connecticut-specific cases	Surveillance and epidemiology	—
Agricultural bioterrorism	Plum Island Animal Disease Center	Potential animal and crop bioterrorism diseases; food and agriculture biosecurity	Surveillance and epidemiology	Management and administrative skills
Law enforcement	FBI; Connecticut State Police	Law enforcement investigations: similarities and differences between law enforcement and public health approaches and partnerships with public health agencies; forensic epidemiology	Surveillance and epidemiology	Management and administrative skills
Public health laboratory bioterrorism response	CDPH	Laboratory identification of bioterrorism organisms and toxins; laboratory tabletop exercise	Laboratory systems	—
Tabletop exercise	CDC	Operational integration and coordination of a response to a bioterrorism event	—	Technical writing and presentation skills; leadership skills
Public health law and bioterrorism	UCHC	—	Public health law	—
Responding to the threat of bioterrorism: federal initiatives	U.S. House of Representatives	—	Health risk communication and media relations	Public relations; leadership skills
Agent-specific lectures	Various	—	Surveillance and epidemiology; characteristics of biological agents classes A, B, and C associated with bioterrorism; clinical manifestations	—
Term paper and examinations	—	—	—	Technical writing and presentation skills; research and policy

A-CPHP = Academic Centers for Public Health Preparedness

CDC = Centers for Disease Control and Prevention

CDPH = Connecticut Department of Public Health

FBI = Federal Bureau of Investigation

HRSA = Health Resources and Services Administration

IOM = Institute of Medicine

UCHC = University of Connecticut Health Center

USAMRIID = U.S. Army Medical Research Institute of Infectious Diseases

specialized public health education; (2) improve public health providers' ability to make improved and informed public health decisions based on relevant data and information; (3) develop field-based educational opportunities for students in traditional on-campus graduate public health programs; (4) develop new curricula for public health practitioners on emerging public health issues; and (5) train lay workers from local boards of health and community health offices.²⁴

Students have been taught by example the successful methods used for planning and management of state and national bioterrorism programs. Students have been able to develop their competencies through case studies presented in class and through written assignments and exams. The ability to interact with state and national policy makers has helped to raise the level of the students' comprehension and utilization of the material presented in lectures. Promotion of creative problem-solving by students through work in interdisciplinary teams has occurred during the tabletop exercise. The overall course goal to advance the ability of future public health leaders to deal with the multiple crises involved in a bioterrorism event has been met in a manner that has helped the students become enthusiastic about their place in the public health partnership for defense against bioterrorism.

CONCLUSION

We have developed a comprehensive curriculum using innovative materials and methods designed to engage public health professionals in a didactic experience. This approach has proven itself. It involves the successful integration of academic contributions from local leaders who will be potential responders in the emerging preparedness community with the experiences of national policy makers. Training the public health workforce to standards of competency for bioterrorism preparedness requires extensive and constantly changing efforts to reflect the evolving responsibilities of public health practice.

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