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# Clinicians' Knowledge, Attitudes, and Concerns Regarding Bioterrorism After a Brief Educational Program

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*We conducted this study to determine the knowledge, attitudes, and intended behaviors of New York City clinicians regarding bioterrorism-related diseases after a brief educational program. Data on clinicians' knowledge and attitudes toward bioterrorism and related diseases were collected using a self-administered questionnaire following a 3.5-hour educational program. Participants (n = 310, 82% response rate) reported increased confidence in recognizing symptoms of bioterrorism-related diseases (89%), in addressing patients' bioterrorism concerns (83%), and ability to treat bioterrorism victims (75%). Despite a high level of confidence in the efficacy of infection control precautions, participants' knowledge scores regarding safe work practices suggest that additional education is warranted. Educational programs are useful in enhancing the public health response to bioterrorism and its consequences. (J Occup Environ Med. 2004;46:77-83)*

History is replete with examples of biologic warfare, but the use of these unconventional weapons in the United States has been extremely limited, and the capability of the public health system to respond to a bioterrorist event is largely unknown.<sup>1-11</sup> In the Fall of 2001, the readiness of the U.S. public health system to respond to a significant public health emergency was tested after the intentional dissemination of *Bacillus anthracis* spores through the U.S. postal system.<sup>12</sup> This act of bioterrorism, which resulted in 22 anthrax infections and 5 deaths, underscored the importance of the public health system's readiness to deal with the threat of bioterrorism and highlighted gaps to be addressed.<sup>13-16</sup>

Following so closely on the World Trade Center Disaster on September 11, 2001, the anthrax attacks placed enormous burdens on already strained public health systems, especially in the tristate area (New York, New Jersey, and Connecticut). Public health responsibilities after the anthrax attacks included providing expert consultative advice regarding the appropriate care to anthrax patients, investigating possible contamination sites, testing of numerous materials suspected of anthrax contamination (the New York City Department of Health and Mental Hygiene tested over 2000 such specimens in a 2-month period alone), hospital surveillance for new cases, administration of antibiotic prophylaxis to tens of thousands of at-risk individuals, and providing risk communication information to

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the general public.<sup>17,18</sup> These responsibilities were in addition to the routine delivery of essential services and affected nearly every sector of the public health infrastructure, including hospitals, clinics, pharmacies, and medical practices, all of whom reported a significant rise in the number of patients with psychosomatic complaints and antibiotic requests. Yet, despite these many challenges, all sectors of the public health infrastructure responded rapidly and, in hindsight, with remarkable effectiveness.<sup>19</sup> Nevertheless, it became clear in the Fall of 2001, that there was a pressing need to rapidly educate clinicians on the signs and symptoms and reporting mechanisms of bioterrorism-related diseases, including cutaneous and pulmonary anthrax. Although few studies have examined the bioterrorism readiness of the clinical segment of the public health sector, several published reports provide evidence of both knowledge gaps and the high levels of interest in bioterrorism related training.<sup>21-23</sup>

For example, an October 2001 survey of family physicians ( $n = 614$ ) conducted by Chen et al. found that only 18% of respondents had any prior bioterrorism training, 93% reported that they needed such training, and 75% considered themselves unprepared to recognize bioterrorism-related illnesses.<sup>24</sup> Most of the participants felt more competent to deal with natural disasters and natural infectious disease outbreaks than with bioterrorism. Of special concern was the finding that only 57% of these family physicians knew how to report a suspected bioterrorism case.

In 2002, Rico et al. surveyed licensed physicians ( $n = 134$ ) and nurses ( $n = 121$ ) in Miami-Dade County. The investigators found that 97% of physicians and 92% of nurses were interested in receiving bioterrorism training.<sup>25</sup> Interest was especially high for training on the recognition of potential bioterrorism events and on the overall public health response to these emergen-

cies. Only 21% of physicians and 7% of nurses in that sample believed they had updated knowledge on the signs, symptoms, treatment, modes of transmission, and communicability of class A agents (eg, smallpox, anthrax, tularemia, plague, botulism, and hemorrhagic fevers).

A large-scale survey mailed to the medical and nursing professionals living and working in Hawaii, conducted in the Summer of 2001 by Lanzilotti et al., examined the availability and capability of medical professionals to respond to casualties caused by weapons of mass destruction.<sup>26</sup> Although the response rate was low (23%,  $n = 3386$  for physicians; and 22.4%,  $n = 2775$  for nurses), their findings are of interest. As in other studies exploring these issues, the investigators found that both physicians and nurses reported having low knowledge levels regarding class A agents and a perceived inability to recognize and treat patients with diseases of bioterrorism. Less than 10% of physicians in that sample reported that they considered themselves able to treat victims of bioterrorism incidents. In contrast, respondents reported generally high levels of willingness to report to duty during a bioterrorism incident, with a positive correlation seen between high levels of self-reported knowledge and willingness to respond. Therefore, it may be possible to increase clinicians' willingness to respond to a bioterrorism event through physician education and training.

Finally, a 2003 survey supported by the National Network for Immunization Enforcement found that nurses ( $n = 2627$ ) who were under the age of 50, were trained within the past 10 years or who had little or no experience with smallpox vaccinations were less likely to consent to receive the smallpox vaccine.<sup>27</sup> Knowledge regarding the effectiveness of the vaccine was highest in nurses with higher levels of education and in those who had received a prior smallpox vaccination. Nearly

one third of the nurses thought that they were *unlikely* to contract smallpox even if they were exposed through close contact with an infected patient.

The ability to respond quickly to the public health emergency resulting from the anthrax attacks was dependent in part on the preplanning efforts of the Centers for Disease Control and Prevention (CDC) and other governmental agencies and institutions. One of CDC's planning initiatives included the development of Centers for Public Health Preparedness (the Centers).<sup>28</sup> The purpose of the Centers is to ensure the capability of the public health workforce to meet the challenges presented by bioterrorism and other weapons of mass destruction. The Columbia University, Mailman School of Public Health Center, one of 21 such Centers nationwide, responded to both the World Trade Center attacks and the subsequent anthrax attacks in a number of ways.<sup>29</sup> In response to requests from community-based clinicians (including physicians, nurse practitioners, and physician assistants) for more information on bioterrorism, the Columbia Center developed, implemented, and evaluated an educational program designed specifically for these providers. These front-line clinicians are especially important to target for this type of education because front-line medical providers, they frequently have a number of barriers, such as time constraint to obtaining up-to-date continuing education information. To augment our educational program, we administered a brief questionnaire designed to increase our understanding of community-based clinicians knowledge, attitudes, and behavioral intentions toward diseases of bioterrorism. Finally, for planning purposes, we asked clinicians what additional public health emergency-related training they felt they needed, as well as the preferred format for this training.

## Methods

### Educational Program

In concert with the New York City Department of Health and Mental Hygiene, the Columbia Center's collaborating partner, and in consultation with leading primary care practitioners, infectious disease specialists, virologists, and dermatologists, a 3.5-hour educational program was developed to address the following topics related to bioterrorism:

1. Microbiology, pathophysiology, epidemiology, diagnosis, differential diagnosis, treatment, prevention, infection control, and reporting requirements for specific category A diseases of bioterrorism, including anthrax, smallpox, tularemia, plague and botulism<sup>12</sup>
2. Psychosocial aspects of bioterrorist attacks
3. The public health response

The program was presented 5 times over a 2-month period and was offered either in the evening at the end of the workday or on weekend mornings to facilitate clinicians availability to attend. At the time of the training, frequent updates regarding recommendations for diagnosis, treatment, and prevention were provided by local, state, and federal agencies, and every effort was made to incorporate the most up-to-date information available into each presentation of the program. The program took place in lecture facilities at the New York Academy of Medicine in New York City.

Once the program was developed, it was advertised through a variety of methods, including notification to various professional societies, web announcements, group faxing, and mass e-mails. The program was presented in a lecture/slide format followed by a lengthy question-and-answer period. A team-teaching methodology was followed with various experts from the New York City Department of Health and Mental Hygiene (NYC DOHMH) and infec-

tious disease specialists from leading New York City medical centers presenting the lectures. A public health physician from the New York City Department of Health and Mental Hygiene was present at all sessions to discuss the Department's response to the anthrax attacks in New York City and to present up-to-date case information as well as information on the Department's bioterrorism preparedness procedures. The lectures were supplemented with printed literature and handouts, including a copy of the slide presentation, rolodex card with New York State and New York City Health Department contact/reporting numbers, seminal journal review articles on diseases of bioterrorism, and other materials chosen for their use to the general practitioner. (Copies of the training packet, including a set of the training slides, are available by contacting the corresponding author. The training program is also available on the Columbia Center's web site.)<sup>29</sup>

### Measures

In the interest of maximizing program time, we chose to administer a single retrospective pretest at the conclusion of the program.<sup>30</sup> The testing procedure was submitted for Columbia University IRB approval before the program and was granted an IRB exemption. The test procedure was explained to those in attendance, and participants were asked to voluntarily complete a self-administered 37-item questionnaire designed to evaluate their knowledge, beliefs, and confidence regarding their ability to diagnose, treat, and report certain class A diseases of bioterrorism (eg, anthrax, smallpox, tularemia, plague, and botulism) as well as their own concerns and fears regarding contagion. We also asked 2 questions related to the clinicians' degree of exposure to the World Trade Center Disaster (eg, witnessing the event at the time it happened either in person or on television or having reexposure through television

broadcasts) to determine the impact, if any, this had on their bioterrorism attitudes and behavioral intentions. Items related to the clinicians' emergency response educational needs were also included on the questionnaire. Copies of the questionnaire, along with coding information, are available from the corresponding author.

Participants were also asked to complete an 11-item course evaluation designed to assess the quality of the program (ie, of overall content, success in meeting learning objectives, program organization, and so on).

Statistical analyses were conducted using descriptive statistics to measure demographic data, as well as knowledge, confidence, concerns, infection control intentions, and educational needs. Odds ratios were calculated to determine correlates of intentions and willingness to respond to smallpox vaccination and other variables.

## Results

### Response Rate

A total of 377 practitioners attended the program; of these, 310 completed the posttraining questionnaire (82% response rate). Seventy-five percent ( $n = 292$ ) of the participants completed the course evaluation.

### Demographics

Most of the survey respondents were middle-aged, male physicians. The specialty with the most representation was internal medicine (36%), followed by dentistry (26%), and pediatrics (8%). Table 1 displays the participants demographic data.

### Knowledge

On a set of 5 basic knowledge questions, participants generally had high scores, especially on items related to reporting requirements. Lower scores were noted for items dealing with the differential diagnoses of anthrax (eg, flu-like illness

**TABLE 1**  
Demographics

	No.	Percent
Gender		
Male	171	55.2
Female	125	40.3
No response	14	4.5
Age		
Mean years	52.9	
Range	25–85	
Profession		
MD	227	73.2
DDS/RDH	27	8.7
PA/NP	22	7.1
RN	9	2.9
Other	10	3.1
No response	15	4.8
No. years practicing		
Mean years	23.3	
Range	25–85	
Primary practice		
Internal medicine/ family	111	35.8
Dentistry	35	11.3
Pediatrics	24	7.7
PA/NP	22	7.1
RN	10	3.2
Surgery	15	4.8
Dermatology	11	3.5
Psychiatry	7	2.3
Infectious disease	5	1.6
Pathology	2	0.6
No response	19	6.1
Other	49	15.8

vs. anthrax), effectiveness of screening tests for anthrax, and smallpox vaccination efficacy. Knowledge scores did not correlate with clinical specialty, educational degree, or number of years of practice. Clinicians with high knowledge scores were less likely to report recommending the smallpox vaccine for their patients ( $P < 0.05$ ). Attendees were asked about their prior experience with treating patients deemed to be at risk for exposure to anthrax. Interestingly, clinicians who had treated such patients ( $n = 59$ ) were no more likely to have a higher level of knowledge about diseases of bioterrorism or be knowledgeable about appropriate infection control procedures for class A agents than clinicians without such experience.

## Confidence

Most participants felt that the program increased their overall confidence in their ability to: 1) recognize bioterrorist diseases (88.6%), 2) address their patients' concerns about bioterrorism diseases (83.2%), 3) treat suspected cases (74.6%), and 4) report suspected cases to the New York City Department of Health and Mental Hygiene (73%).

## Concerns

Clinicians reported overall concern about future bioterrorism attacks (77.4%), and specifically concern about anthrax (58.4%) and smallpox (61%). Only 37.7% felt that the U.S. government was able to protect the public's health during a bioterrorist attack. They also reported high levels of concern about bioterrorism among their patients; 90.5% of clinicians reported that they provided care to patients with complaints related to fears of bioterrorism during the 2-month period before the training program. No significant correlation was found between clinicians' media exposure to the World Trade Center Disaster (WTC) and their bioterrorism-related concerns. However, clinicians who reported high degrees of television exposure to the WTC disaster were 2.4 times more likely to volunteer in the disaster relief efforts (eg, assist in rescue centers, emergency rooms, or outpatient settings, or donate money or supplies) (odds ratio [OR], 2.45; 95% confidence interval [CI] = 1.12–5.35) than those who had limited exposure.

## Infection Control Practices and Contagion Concerns

Although nearly 69% of clinicians were more confident in their ability to use appropriate infection control practices after the training program, their responses to several items demonstrated that important knowledge gaps remain in this area. For example, 40.3% reported that they *would* institute respiratory precautions

when treating patients with cutaneous anthrax, whereas 14% reported that they *would not* institute such precautions when treating suspected smallpox cases. Ten percent of respondents were concerned about contagion regarding patients with cutaneous anthrax. Clinicians with prior experience in treating known or suspected anthrax cases were approximately half as likely to be concerned about contracting anthrax than those without such experience (OR, 0.40; 95% CI = 0.18–.91). Clinicians' degree of confidence in their clinical assessment skills was directly associated with appropriate infection control intentions (OR, 1.9; 95% CI = 1.05–3.72). High levels of general knowledge regarding class A agents, however, did not correlate with appropriate infection control intentions. In addition, experience with actually providing clinical care to known or suspected cases of anthrax did not correlate with infection control behavioral intentions. Table 2 summarizes these results.

## Needs Assessment—Further Educational Needs

The clinicians expressed interest in additional training on: chemical terrorism (89.0%), clinical diagnosis of bioterrorism diseases (84.2%), infection control aspects of bioterrorism (81.9%), treatment of bioterrorism diseases (81.6%), and psychologic aspects of bioterrorism (74.5%). Training needs did not differ based on direct experience in treating patients at risk for exposure to anthrax.

The preferred training methods for emergency preparedness programs were: traditional lecture formats (86.5%), written materials (79%), videoconferencing and computerized distance education (59.4%), and training through audios or videos (44%). Several clinicians said they would like to receive information by e-mail.

TABLE 2

## Questionnaire Results

Knowledge, confidence, concerns &amp; infection control intentions of clinicians regarding to diseases of bioterrorism

	No.	(%)
Knowledge, correct responses		
Reporting requirements for <i>Bacillus anthracis</i> infections	298	(96.1)
Use of nasal swabbing for Anthrax	278	(89.7)
Post exposure prophylaxis for smallpox	242	(78.1)
Reporting requirements for class A agents	195	(69.6)
Appropriate diagnostic testing for Anthrax	202	(65.2)
Differential diagnosis of Anthrax	129	(41.6)
Increased confidence		
In recognizing diseases of bioterrorism	265	(88.6)
The ability to address patients' concerns related to bioterrorism	244	(83.2)
The ability to treat diseases of bioterrorism	215	(74.6)
The ability to report diseases of bioterrorism	225	(72.6)
The ability to adopt appropriate infection control precautions	213	(68.7)
In the US government's ability to protect the public's health during a bioterrorist attack	117	(37.7)
In the US government's preparedness for a bioterrorist attack	43	(13.9)
Concerns		
Treated patients who were concerned about bioterrorism	266	(90.5)
Concerned that the US is likely to experience another bioterrorist incident	240	(77.4)
Personally concerned about the risk of contracting smallpox	189	(61.0)
Personally concerned about contracting anthrax as a result of bioterrorism	181	(58.4)
Personally concerned about the risk of contracting cutaneous anthrax from patients	31	(10.1)
Prevention/interventions		
Would follow established infection control precautions for smallpox	267	(86.1)
Would consult with the Department of Health before prescribing prophylaxis for class A agents	195	(62.9)
Would recommend smallpox vaccine to own patients	151	(53.3)
Would follow established infection control precautions for cutaneous Anthrax	125	(40.3)

## Evaluation of the Training Program

The participants overwhelmingly reported high levels of satisfaction with the educational program. The positive aspects of the program that were noted included: 1) advanced level of the program, 2) clarity in the presentations, 3) effectiveness of the instructors, 4) program organization, and 5) helpfulness of the supplemental materials. Several of the participants also noted that the convenient schedule and location as well as the availability of no-cost continuing medical education credits (3 per session) encouraged their attendance. Overall, 98% felt that attending the training program was an extremely valuable experience.

## Discussion

Our results suggest that bioterrorism training programs are effective in improving community-based clinicians' confidence regarding bioter-

rorism-related disasters. Because data on baseline knowledge of clinicians was not obtained, it is difficult to document gains in knowledge. However, the retrospective pretest design has been shown to be an effective measure of training impact.<sup>31</sup> In the retrospective pretest design, training program participants self-report their perceptions of competence after the training compared with their perceptions before the training. This approach (compared with the more traditional pretest-posttest design) for evaluating training has not only been shown to be an effective alternative but also has the additional benefit of minimizing the burden on participants and maximizing time spent on training.<sup>32</sup> However, objective measures are also needed to determine the impact of such training, and we are currently developing several models of assessment of clinician response using methods such as tabletop and coun-

tywide drills. We are also preparing assessment tools to gauge the response of the community-based clinicians to naturally occurring outbreaks, eg, SARS.

Our results support other research findings and further document the need and importance of clinical education on the topic of bioterrorism. Since the anthrax attacks, several educational initiatives have begun, including programs developed by federal and state agencies, public health departments, as well as medical, dental, nursing, and public health schools, with many curricula incorporating the recently published CDC emergency competencies.<sup>33</sup> The recently enacted Public Health Security and Bioterrorism Response Act helps to provide funding in support of these efforts.<sup>34</sup> Other initiatives directed toward this goal include improving the communications infrastructure, e.g. the Internet-based Clinicians' Biodefense Network created

by The Johns Hopkins University's Bloomberg School of Public Health.<sup>35</sup> In addition, the CDC Centers for Public Health Preparedness have developed web-based training programs, seminars, conferences for the public health workforce, public safety employees seminars, graduate-level public health courses, and medical and dental educational curricula.<sup>28</sup> The Columbia Center is in the process of developing long-term and sustainable strategies for emergency preparedness training of all sectors of the public health infrastructure, including the use of distance-based learning programs.

### Limitations

Although our findings suggest that clinicians were relatively knowledgeable on various aspects of category A agents of bioterrorism, the use of a single questionnaire, as mentioned, precludes our ability to evaluate the effectiveness of this program in terms of its impact on the baseline knowledge and attitudes of clinicians. Another potential limitation is that the sample of participants was limited to the greater New York City area, and, as such, it is difficult to generalize these findings to clinicians from other parts of the country or the rest of New York State. It also would have been helpful if we had determined who the clinicians thought should provide future preparedness training programs.

### Implications

Unfortunately, the occurrence of a bioterrorist event in the United States can no longer be considered unlikely. The lessons we learned from the 2001–2002 attacks have strengthened our capabilities, and we are clearly better equipped to respond to future emergencies.<sup>36,37</sup> Although strong efforts have been made to address the obvious need for bioterrorism education for all sectors of the public health community, many challenges remain and public health training on bioterrorism among the various sectors of the healthcare sys-

tem reportedly remains sporadic and uneven.<sup>38–40</sup> In particular, anecdotal reports regarding the paucity and unevenness of bioterrorism training for the public safety sector indicate that this is an especially important group to target for specialized training. Uniformed services employees (eg, emergency medical services, transportation, fire, and police) should participate in basic emergency preparedness training as well as training on their roles and responsibilities during any future bioterrorist attacks. The process of developing, implementing, and evaluating educational programs on this complex topic for the many thousands of individuals who need them is daunting. These and other issues will undoubtedly be of considerable interest in the months and years to come as the public health system continues to improve its overall emergency preparedness and response capabilities.

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