Emotional and Behavioral Consequences of Bioterrorism: Planning a Public Health Response

BRADLEY D. STEIN, TERRI L. TANIELIAN, DAVID P. EISENMAN, DONNA J. KEYSER, M. AUDREY BURNAM, and HAROLD A. PINCUS

RAND Corporation; University of Southern California; University of California, Los Angeles; University of Pittsburgh

Millions of dollars have been spent improving the public health system's bioterrorism response capabilities. Yet relatively little attention has been paid to precisely how the public will respond to bioterrorism and how emotional and behavioral responses might complicate an otherwise successful response. This article synthesizes the available evidence about the likely emotional and behavioral consequences of bioterrorism to suggest what decision makers can do now to improve that response. It examines the emotional and behavioral impact of previous "bioterrorism-like" events and summarizes interviews with experts who have responded to such events or conducted research on the effects of communitywide disasters. The article concludes by reflecting on the evidence and experts' perspectives to suggest actions to be taken now and future policy and research priorities.

THE IMPORTANCE OF PREPARING OUR NATION TO counter and respond effectively to terrorist threats has been evident since the attacks of September 11, 2001. Of particular concern is the possibility of terrorist attacks involving chemical, biological, radiological, or nuclear weapons (CBRN) (Gilmore Commission 2002). Organized terrorist groups (such as al-Qaeda) have tried to obtain or develop CBRN weapons and have publicly proclaimed that they

Address correspondence to: Bradley D. Stein, RAND, 1700 Main Street, Santa Monica, CA 90407-2138 (e-mail: stein@rand.org).

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consider obtaining them to be a religious duty (Lumpkin 2001), but they have not yet demonstrated the capability to effectively acquire, create, or use them. Nonetheless, CBRN weapons remain a substantial concern because of their potential to cause widespread death and destruction.

Terrorism using biological weapons is of particular concern because small quantities of biological agents can kill or seriously injure large numbers of people. However, even if there are few casualties, these weapons can have serious and extensive psychological, economic, and political consequences (Gilmore Commission 2002). Recognizing the threat posed by bioterrorism, the federal government has allocated more than $4 billion to states and communities to improve the public health response to a bioterrorist attack (Gilmore Commission 2002).

Biological terrorism is likely to differ from conventional terrorism, such as a bombing or hijacking, on a number of dimensions, as illustrated in Table 1. Given these differences, we might also expect differences in the emotional and behavioral impact of bioterrorism compared with that of other types of terrorist events. For example, the unfamiliarity of biological weapons, the uncertainty in determining whether an attack has occurred and the scope of that attack, and the possibility of contagion and of being an unknowing victim of the attack may heighten the level of fear and anxiety associated with a bioterrorist attack (Alexander and Klein 2003; Demartino 2002; Holloway et al. 1997).

But precisely how the public will respond to a bioterrorist event is unclear. Some people are concerned that the demand for health care services by the "worried well"—individuals without an organic etiology of their symptoms (Bartholomew and Wessely 2002)—will overwhelm health resources, even in the event of a very small bioterrorist attack. Based on prior terrorist events such as the sarin gas attacks in Tokyo in 1995, the U.S. Department of Defense estimates that an attack from a CBRN weapon would produce five psychological casualties for every one physical casualty (Warwick 2001); other estimates of the ratio of psychological casualties to physical casualties range from 4 to 1 to as high as 50 to 1 (Demartino 2002). Some experts recommend planning for widespread public panic, whereas others believe that such expectations are misguided (Glass and Schoch-Spana 2002; Pastel 2001; Schoch-Spana 2000). We do not understand under what circumstances people's emotional reactions will differ. These emotional reactions can range from common distress responses such as fear and anxiety to full-blown psychiatric disorders (Institute of Medicine 2003). Nor can we now confidently predict how

TABLE 1
Differences between Bioterrorism and Other Forms of Terrorism

	Bioterrorism	Other Forms of Terrorism[a]
Speed at which attack results in effect	Delayed and/or prolonged	Immediate
Site of attack	Unknown[b]	Specific
Knowledge of attack boundaries or scope	Scope or boundaries unknown	Usually well understood
Distribution of affected patients	Geographically dispersed, particularly in event of human-to-human transmission of disease	Usually in a concentrated area
First responders	Physicians, nurses, public health officials	Police, fire, EMS
Decontamination of victims and environment	Geographically dispersed	Confined environment
Isolation/quarantine	Required for transmittable diseases	Not usually necessary
Medical interventions	Antibiotics, vaccines	Trauma, first aid, antidotes

[a]Other forms of terrorism include the use of explosives or other kinetic events, as well as chemical, radiological, and nuclear terrorism.
[b]Unless authorities are informed about the site of the attack.

individuals' behavioral reactions to a bioterrorist attack (e.g., seeking health care services) may complicate planned public health responses.

This article synthesizes the available evidence about the psychological consequences associated with a bioterrorist event to suggest steps that decision makers can take now to improve their response and to identify the research questions that must be addressed to better prepare the nation to cope with such events. We begin by examining a range of psychological consequences of previous bioterrorist-like events for various populations. We categorized these psychological consequences as emotional consequences and behavioral consequences. Emotional consequences include clinical psychiatric disorders like posttraumatic stress disorder (PTSD), in which individuals display the full constellation of

symptoms and impairment required by clinicians to make a diagnosis. Emotional consequences also include less severe generalized distress and anxiety as well as symptoms of psychiatric disorders that may not meet clinical diagnostic criteria. Behavioral consequences cover such actions as seeking medical services; increasing one's use of tobacco, alcohol, or illicit drugs; avoiding an area; or evacuating a community. Next, we summarize our interviews with experts who have conducted research on communitywide trauma and disaster victims or have designed and implemented psychological response strategies for such events. We conclude by reflecting on the evidence and the experts' perspectives to suggest actions to be taken now and to recommend future research and policy priorities.

Methods

We conducted a literature and Web site review from November 2001 to July 2002 to collect information about the psychological consequences of communitywide trauma from manmade, technological, or other terrorist disasters or incidents, such as large-scale terrorist events (e.g., the World Trade Center bombing, 1993; the Oklahoma City federal building bombing, 1995; and the September 11 attacks on the Pentagon and the World Trade Center, 2001). We also looked for information about feared and actual chemical attacks (e.g., Israel SCUD missile, 1994; Tokyo sarin gas, 1995). The intentional nature of many of these events is comparable to bioterrorism, although many are different in other respects, such as uncertainty of exposure, as highlighted in Table 1. Our key word search terms included *psychological consequences of trauma*, *terrorism*, *bioterrorism*, *biological warfare*, and *disasters*. We also list relevant references that have come to our attention since the original review.

We searched for studies of known events with one or more of the aspects of bioterrorism identified in Table 1 that were not associated with terrorism, such as outbreaks of infectious disease (e.g., the severe acute respiratory syndrome [SARS] epidemic in 2003 and the early days of HIV/AIDS) and industrial events (e.g., the nuclear meltdown at Three Mile Island, Pennsylvania, in 1979). These events differ from bioterrorism in that they were unintentional, but they are better analogues of bioterrorism in regard to their uncertainty of exposure than are

many communitywide disasters. Our team members also read articles and books from conference proceedings and reference lists. We reviewed the titles and abstracts of all relevant sources for articles, book chapters, and reports.

To complement the literature review, we interviewed (1) experts with clinical and research experience assessing and responding to the emotional and behavioral consequences of terrorism and disasters and (2) senior policy and operational decision makers with expertise and experience in devising and implementing disaster and terrorism response plans and strategies. We found the interviewees through the literature (e.g., if they had published widely on the topic) or on the basis of their position (e.g., if they were in a position charged with responding to a disaster). The RAND Human Subject Protection Committee reviewed and approved all our study procedures.

These semistructured interviews were designed to explore the challenges of managing emotional and behavioral issues resulting from bioterrorism and to examine how these might differ systematically from those of other types of terrorist events. We also asked about additional resources, tools, and strategies that might be needed at local and state levels to prepare for and respond adequately to bioterrorism.

We asked those interviewees with clinical and research experience to comment on (1) whether the psychological effects of bioterrorism might differ from the effects of other terrorist events, and what these differences might be; (2) to what extent the available data and earlier studies might allow experts to predict the emotional and behavioral consequences of a bioterrorist attack; (3) whether they believed the emotional or behavioral consequences of a bioterrorist attack might be different for populations not in close geographic proximity to the attack and what these differences might be; (4) whether preparedness strategies for bioterrorism needed to be different from strategies for other traumatic or terrorist events and, if so, how; and (5) what the most important advice they could give to senior operational decision makers would be regarding the capacities, preparation, acute response, and long-term response for managing the psychological aspects of bioterrorism.

We asked senior policy and operational decision makers to discuss (1) the current status of federal, state, and local plans to address the emotional and behavioral effects of terrorism; (2) any critical gaps in bioterrorism preparedness; (3) differences between the responses to terrorism and those to bioterrorism; and (4) the information that they would

need to respond adequately to bioterrorism, as well as the information most needed by the public.

Results

Literature Review

Our literature review yielded little empirical information about the emotional and behavioral consequences of bioterrorism. We found no empirical studies examining the emotional and behavioral consequences of actual bioterrorism events for directly exposed individuals, and few empirical studies of the emotional and behavioral consequences of bioterrorism for other populations.

Given the lack of terrorism-specific empirical data, we then looked at empirical studies of other events to help us understand and predict the emotional and behavioral consequences of bioterrorism. We organized our findings according to the different populations commonly identified in the trauma field (Norris 2001):

- Direct victims, who have suffered an injury, trauma, or other destructive result from an event (Frederick 1987).
- The general public, whose exposure to an event is most commonly through the media—TV, radio, newspapers, and the Internet—as well as through conversations with family and friends.
- First responders, such as police, firefighters, or emergency medical technicians, whose occupations require them to respond to the needs of those exposed to a disaster.
- Vulnerable populations, who may be more susceptible to the emotional and behavioral consequences of a disaster as a result of predisposing personal characteristics, such as children (Flynn and Nelson 1998), those with preexisting psychological problems (Kessler et al. 1999; North et al. 1999), and those with physical disabilities (Orr and Pitman 1999).

Some characteristics of bioterrorism may influence the composition of these groups. Uncertainty about exposure to a biological agent and whether one was directly exposed is likely to increase fear and anxiety among the general public. Similar to what may happen in some chemical

events, this uncertainty may occur even in situations with low levels of exposure and not only in the early phases of an attack but even for months or years after an attack (Hyams, Murphy, and Wessely 2002). The risk of emotional and behavioral consequences for these individuals may mirror those of victims for whom exposure is documented. Similarly, the first responders to a bioterrorist event are likely to encompass more than the traditional emergency response community (fire, emergency medical service [EMS] personnel, police, search and rescue), to include hospital emergency department personnel, primary care physicians, and others working in the public health care system (Benedek, Holloway, and Becker 2002). In fact, if a covert release of a biological agent does not immediately result in symptoms, the traditional first responders may not be called, and the first responders would be mainly health care workers (Gilmore Commission 1999, 2000, 2001, 2002). In a covert bioterrorist attack during which the first indication of the event is the increased presentation of affected individuals at health care facilities, health care workers may initially have the highest morbidity rates, as was observed in health care workers in China and other countries in Asia following the outbreak of SARS (Centers for Disease Control and Prevention 2003).

Much of the literature we reviewed provides a theoretical or conceptual discussion of the psychological consequences of disasters and terrorism, comments on the resources and strategies needed to prepare for the emotional and behavioral consequences of terrorism and disasters, or describes the emotional and behavioral sequelae in victim populations, with a heavy emphasis on assessing symptoms of PTSD in various victim populations. The assessment of disorders such as PTSD offers useful information for predicting the early and longer-term clinical mental health needs of affected populations. This literature does not, however, offer much information about other emotional and behavioral responses and their effect on functioning. Such information would be useful for planning early large-scale intervention strategies and predicting how the majority of people, who are unlikely to develop clinical psychiatric disorders such as PTSD, would respond to a bioterrorist event.

The following tables highlight our findings from empirical studies of the major emotional and behavioral consequences for each victim group associated with three types of large-scale trauma: mass violence/conventional terrorism, industrial events/chemical terrorism, and infectious disease outbreaks. The tables are organized by victim population and type of event. Table 2 lists examples of studies that examined

emotional and behavioral consequences for direct victims; Tables 3 and 4 describe these issues in the general population and first responders, respectively; and Table 5 focuses on two large vulnerable populations, children and individuals with drug and alcohol problems.

Emotional and Behavioral Consequences for Direct Victims. Research on disasters has found that mass violence is the most psychologically disturbing type of disaster. One review suggested that as many as two-thirds of those directly exposed are psychologically impaired to some degree (Beaton and Murphy 2002). As Table 2 explains, those directly exposed to mass violence and conventional terrorism experience a wide range of emotional and behavioral consequences, such as clinical PTSD, posttraumatic stress symptoms that do not meet the criteria for PTSD, other anxiety disorders, depression, and substance use problems. The documented prevalence of such problems varies widely for different events and may be attributed to differences in study methodologies (including screening methods and timing), as well as to differences in the populations studied and the traumatic events. Most studies screen victims to identify symptoms of posttraumatic stress and to determine whether the victims meet the criteria for PTSD. The severity of symptoms may not meet the criteria for some victims at the first screening, but if left untreated, these symptoms may become more severe in the following months and thus meet the criteria later.

Technological and industrial events and terrorism using chemical agents may also be important analogues of a bioterrorist event, but they differ from bioterrorism in important ways. Because these events are not intentional, they are likely to generate less fear and anxiety. Terrorist attacks using chemical agents do not present the same risk of contagion as many bioterrorist events do. In many cases, individuals in close geographic proximity to the event may also depend on the source of the disaster for jobs and for economic support of the region. Despite these differences, studies show that even several years after these events, many people continue to have emotional distress and physical (e.g., somatic) symptoms unrelated to the amount of exposure.

Reports of the emotional and behavioral reactions by persons affected by SARS and botulism may also inform expectations for likely reactions to bioterrorism, including the need for psychosocial interventions to relieve anxiety and depression. Before much is known about a novel infection, such as SARS or HIV/AIDS, those victims directly exposed and those thought to be potential vectors may also be stigmatized (Blendon

TABLE 2
Psychological Consequences of Events Measured in the Direct Victims

Event	Direct Victims	Source
Intentional Mass Violence/Conventional Terrorism		
Militant guerrilla hostage situation involving 100 high school students in Ma'alot, Israel, May 1974.	An examination of the long-term effect of terrorism attack on adolescents found that 17 years later the majority of survivors continued to experience some traumatic stress symptoms, with 39% of survivors experiencing up to four posttraumatic stress symptoms.	Desivilya, Gal, and Ayalon 1996
Terrorist attacks in France between 1982 and 1987.	Of 254 survivors of terrorist attacks assessed one to five years after the attack, 18% continued to have posttraumatic stress disorder (PTSD). Uninjured victims were least likely to have PTSD; the most severely injured individuals were the most likely to have PTSD.	Abenhaim, Dab, and Salmi 1992
Bombing in Enniskillen, Northern Ireland, November 1987.	Of 26 victims referred for medicolegal assessment six months after the event, 13 met criteria for PTSD. At 12 months, 12 of the 13 met criteria for PTSD. Females were more likely to have PTSD.	Curran et al. 1990
Cafeteria shooting spree in Killeen, Texas, 24 killed, October 1991.	Among the civilian population exposed to the shooting spree, the most common postdisaster reactions were alcohol abuse in men and major depression for women. Six to eight weeks after the disaster, 26% of survivors met diagnostic criteria for PTSD; at one year, 14%; and at a three-year follow-up, 18%. One-third of the women with PTSD also met diagnostic criteria for major depression, as did one-fourth of the men who had PTSD.	North, McCutcheon, et al. 2002

TABLE 2—*Continued*

Event	Direct Victims	Source
Shooting at Brooklyn Bridge, New York, March 1994.	Four of 11 survivors interviewed eight weeks after the shooting had emotional distress symptoms consistent with PTSD.	Trappler and Friedman 1996
Bombing of Murrah Federal Building, Oklahoma City, April 1995.	Approximately six months after the bombing, 34% of individuals directly exposed to the federal building bombing met criteria for PTSD. Symptom onset was sudden; few victims developed PTSD at six months if they did not have symptoms in the month following the bombing.	North et al. 1999
	Forty-five percent of survivors experienced a postevent psychiatric disorder. Up to three years later, one-third of survivors reported anxiety and depression.	Maningas, Robison, and Mallonee 1997
Terrorist attacks on World Trade Center and Pentagon, September 2001.	Seven months following the attack, 14% of respondents in one of the Pentagon commands displayed symptoms consistent with probable PTSD, and 13% reported using more alcohol than intended.	Grieger et al. 2003
Industrial Events/Chemical Terrorism		
Radiation event in Goiania, Brazil, with unintentional exposure to radioactive cesium isotope, September 1987.	More than three years after the event, individuals in the affected community with anticipatory stress about radiation exposure had performance decrements and neuroendocrine alterations indicative of stress-related concentration deficit comparable to that of individuals with exposure to radioactive cesium isotope. Both groups were significantly different from community controls.	Collins and Banderia de Carvalho 1993

Unintentional release of hazardous chemicals, Texas City, Texas, October–November 1987.	Two years after the unintentional release, 20% to 30% of people highly exposed to the unintentional release had somatic complaints, including dizziness, chest pain, nausea, and weakness, numbness, or tingling of body parts. Those with the highest level of exposure had a high dose-response relationship between exposure and severe individual symptoms for organ/function systems that were more likely to be directly related to exposure (e.g., throat, skin, inhalation). In the highly exposed group, those with emotional distress were significantly more likely to have physical symptoms that did not appear to be caused by exposure to the chemical. Emotional distress was also significantly related to all somatic symptoms in individuals who had only intermediate levels of exposure to the chemical.	Dayal et al. 1994
Sarin gas attack in Tokyo subway, March 1995.	More than 1,000 individuals experienced some degree of acute or chronic gas exposure, and 13 people died. Approximately 4,500 individuals who sought medical services but could not be determined to suffer from nerve gas exposure were considered psychological casualties. Many of those involved in this attack suffered some physical symptoms or emotional reactions for at least one year following the attack.	Okumura et al. 1998
	Approximately 60% of individuals who presented at St. Luke's International Hospital following the sarin attack suffered from posttraumatic stress symptoms that persisted longer than six months.	Ohbu et al. 1997
	Victims of the sarin attack continued to suffer from physical symptoms and emotional reactions five years after the terrorist incidents, most commonly eye problems and depressed mood.	Kawana, Ishimatsu, and Kanda 2001

TABLE 2—*Continued*

Event	Direct Victims	Source
Infectious or Food- or Water-Borne Disease Outbreaks		
Botulism outbreak in Peoria, Illinois, October 1983.	During small-group discussions (intended for information sharing) following the outbreak, family members of patients expressed several emotional reactions, including concern, worry, fear, and pressure to be with the patient at all times. Data on affective responses were gathered from the patient and family members during week 1 and week 2 of the illness outbreak (before and after the initial informational group meetings for families). Participants rated, on a 10-point scale, their level of anxiety, fear, helplessness, depression, and anger. Levels of anxiety, fear, helplessness, and depression decreased over the two-week period for family members. Levels of anger remained the same in both patients and family members. For patients, while levels of anxiety, fear, and helplessness decreased over the two weeks, the level of self-reported depression significantly increased.	Cohen and Anderson 1986
SARS outbreak in Toronto, March–April 2003.	Patients deprived of family visits experienced insomnia, anxiety, and interpersonal friction with staff. Pharmacological and behavioral interventions to treat insomnia were used extensively.	Maunder et al. 2003
Biological Terrorism		
Suspected anthrax package in South Wales, 13 people exposed, October 2002.	Using the Hospital Anxiety and Depression (HAD) scale one week following the event, the authors documented anxiety (HAD anxiety score > 10) in 45% of those exposed. Anxiety score was significantly higher in persons exposed to the hoax anthrax package compared with unexposed matched controls. Depression scores were not different between the groups.	Mason and Lyons 2003

and Donelan 1988; Gostin, Bayer, and Fairchild 2003), which in turn may intensify the emotional consequences of the disorder.

To date, there have been few bioterrorist events, and no empirically based articles documenting the emotional and behavioral reactions of direct victims of bioterrorist events, including the populations exposed and treated during the anthrax attacks in the fall of 2001 in the United States. One study did report on emotional reactions following a hoax event in South Wales and found that individuals had significantly more symptoms of anxiety immediately following the hoax (Mason and Lyons 2003).

Emotional and Behavioral Consequences for the General Population. Table 3 shows how large catastrophic events, similar to a bioterrorist event, affect the general population.

Before September 11, 2001, the only study of how intentional mass violence or conventional terrorism affected the public examined the effects of the bombing of the federal building in Oklahoma City in April 1995. It documented posttraumatic stress symptoms among residents who did not hear, see, or feel the explosion.

Studies conducted in the immediate aftermath of the September 11 terrorist attacks discovered a range of emotional and behavioral reactions, both in the cities where the attacks occurred and across the country. Subsequent surveys found a decrease in the prevalence of more severe emotional distress reactions in the general public (Silver et al. 2002; Stein et al. 2004) but also noted changes in health-related behaviors, such as a persistent increase in the use of cigarettes, alcohol, and marijuana in New York (Vlahov et al. 2004) and an increase in missed doses and suboptimal doses of antiretroviral therapies in HIV-positive men in New York City (Halkitis et al. 2003).

Several studies have followed community members in surrounding areas after industrial events (e.g., unintentional releases of hazardous chemical or radioactive substances) and could be helpful in understanding the emotional and behavioral consequences for persons geographically distant from an event. These studies found that at the time of an event, many individuals may be fearful, anxious, and present for screening related to the noxious agent. In at least one event (e.g., the Chernobyl nuclear disaster in the Soviet Union in 1986), the emotional impact may persist for years, manifested as a higher rate of depression and mood disorders (Havenaar et al. 1997).

TABLE 3
Psychological Consequences of Events Measured in the General Population

Type of Event	General Population	Source
Intentional Mass Violence/Conventional Terrorism		
Bombing of Murrah Federal Building, Oklahoma City, April 1995.	Eight percent of Oklahoma City residents interviewed six months after the bombing who did not hear, see, or feel the explosion reported emotional symptoms consistent with posttraumatic stress disorder (PTSD).	Sprang 1999
Terrorist attacks on World Trade Center (WTC) and Pentagon, September 2001.	Forty-four percent of national sample reported experiencing substantial emotional stress three to five days following the attacks. Individuals experiencing substantial emotional stress engaged in coping strategies (e.g., talking to others, turning to religion, checking on family members and friends) more often than did those without such reactions.	Schuster et al. 2001
	One to two months after the attacks, estimates of probable PTSD in areas close to the attack ranged from 3% (for the Washington, D.C., metro area) to 11% (for the NYC metro area). Estimate of probable PTSD in rest of country was 4%.	Schlenger et al. 2002
	One to two months following the attacks, 8% of Manhattan residents reported symptoms consistent with PTSD and 10% consistent with depression. Among Manhattan residents in closest geographic proximity (south of Canal Street near the WTC), the prevalence was as high as 20%.	Galea et al. 2002
	Seventeen percent of the U.S. population outside New York City had posttraumatic stress symptoms two months after the attack; 6% at six months. Prior depression or anxiety was associated with higher levels of posttraumatic stress symptoms.	Silver et al. 2002

	Five to eight weeks after the attacks, increased use of cigarettes, alcohol, and marijuana was found among New York City residents living closest to the affected area and was associated with higher prevalence of current PTSD or current depression.	Vlahov et al. 2002
	Three to six months after the attacks, 18% of 1,009 individuals interviewed in Manhattan had symptoms severe enough to put them at risk for PTSD. Only 27% of these individuals were receiving counseling or psychiatric treatment.	DeLisi et al. 2003
	One to three months following the attacks, the three states in closest proximity to the WTC (N.Y., N.J., and Conn.) added a terrorism module to their ongoing Behavioral Risk Factors Surveillance System. In this survey of noninstitutionalized U.S. adults, they found that 3% reported being direct victims of the attack (7% had relatives and 14% had friends who were victims), and 75% reported having problems that they attributed to the attack.	Centers for Disease Control and Prevention 2002
Industrial Events/Chemical Terrorism		
Unintentional release of radiation at Three Mile Island, Pennsylvania, March 1979.	More individuals in the surrounding community evacuated than were actually advised to do so.	Houts, Cleary, and Hu 1988
	Almost 18 months after the event, chronic stress syndromes, anxiety, somatic complaints, feelings of alienation, and physiological markers of stress were higher in the surrounding community than in comparison communities.	Baum, Fleming, and Singer 1983; Baum, Gatchel, and Schaeffer 1983

TABLE 3—*Continued*

Type of Event	General Population	Source
Chernobyl nuclear power plant disaster, Soviet Union, April–May 1986.	In a small study of the long-term effects of the Chernobyl disaster, higher rates of mood disorder were found in local residents ten years after the nuclear catastrophe; mothers with children under the age of 18 had the highest levels of psychopathology. Children in the affected area had higher rates of thyroid cancer, which may have contributed to the mothers' psychopathology. This study highlighted the long-term emotional consequences associated with a radiological disaster that produced major health consequences for the individuals exposed.	Havenaar et al. 1997
Radiological incident in Goiania, Brazil, September 1987.	Only 250 persons were actually exposed to the radioactive substance: 125,000 people (13% of population) requested screening. Five thousand (8%) of the first 60,000 seeking medical care when the incident became public had physical symptoms that mimicked actual symptoms of exposure.	Collins and Banderia de Carvalho 1993
Unintentional release of 19,000 gallons of metam sodium, northern California, July 1991.	Residents living near an unintentional release of 19,000 gallons of metam sodium, a toxic pesticide, experienced significant emotional and physical complications three to four months after the event. They had more depression, anxiety, and adverse health symptoms than did matched control subjects.	Bowler et al. 1994
SCUD missile attacks in Israel during Gulf War, 1992.	At the time of the attacks, 773 civilians were taken to 12 different hospitals: 43% were identified as "psychological casualties," and 27% had mistakenly used the antidote for chemical exposure.	Bleich et al. 1992

	During the period of the attacks, a 250% increase was reported in the risk of clinical depression among the Israeli population.	Lomranz et al. 1994
Sarin gas attack in Tokyo subway, March 1995.	More than 4,500 individuals from the Tokyo population were labeled "psychological casualties" because they presented with physical symptoms unrelated to direct exposure to the sarin gas. It is not known how many were at the subway at the time of the attack, how many were responders, and how many were in general population.	Kawana, Ishimatsu, and Kanda 2001
Biological Terrorism		
Anthrax letters mailed through U.S. Postal Service in New York, District of Columbia, New Jersey, and Florida, October 2001.	More than 30,000 people were offered prophylactic antibiotics, despite the relatively narrow scope of the attack.	Gerberding, Hughes, and Koplan 2002
	Two months following the first confirmed case, more than 75% of Americans surveyed believed they would survive if they contracted inhalational anthrax.	Blendon et al. 2001
	Less than 25% of Americans surveyed within two to four weeks of the anthrax attacks reported taking emergency precautions because of concerns of bioterrorism; there was no difference between areas with and without anthrax cases. Less than 10% of Americans reported avoiding public events owing to concerns of bioterrorism; there was no difference between areas with and without anthrax cases.	Blendon et al. 2001
	There was no large-scale increase in the demand on the health care system following the anthrax attacks. "His/her own doctor" was viewed as most trustworthy source of reliable information in the event of bioterrorism in a community.	Blendon et al. 2001

TABLE 3—*Continued*

Type of Event	General Population	Source
	In the month following the first reported anthrax case, there was a widespread increase of prescriptions for ciprofloxacin (40% increase) and doxycycline (30% increase) compared with the same time a year earlier, more than was warranted based on confirmed or suspected anthrax exposure alone.	Shaffer et al. 2003
Infectious or Food- or Water-Borne Disease Outbreaks		
Plague outbreak in Surat, India, with 53 deaths, 167 confirmed cases, and more than 5,000 suspected cases, January 1994.	Mass exodus with 600,000 fleeing the area. Investigators believe that much of this behavior is likely associated with widespread anxiety about infection, low confidence in the health care system's ability to effectively treat and manage the outbreak, and people's belief that they could escape the illness.	Ramalingaswami 2001
E. coli outbreak in Walkerton, Ontario, seven deaths, 2,300 ill, May 2000.	Forty-five percent of 3,908 Walkerton area residents who participated in a health assessment follow-up study reported health concerns conducted after the outbreak. Most common concerns reported included stress, headache, and fatigue.	Walkerton Health Study, personal communication, December 17, 2002
	Anecdotal reports of anxiety and depression in the weeks and months following the outbreak were noted in the formal inquiry from this outbreak.	O'Connor 2002

SARS outbreak in Singapore, 2002/2003.	During the first three months of the SARS outbreak, 3% of Singapore residents reported high levels of anxiety; 42% reported moderate levels of anxiety. Anxiety was unrelated to perceived likelihood of contracting SARS. Individuals with high or moderate levels of anxiety, women, and those over 35 years old were more likely than others to take preventive measures.	Quah and Hin-Peng 2004
SARS outbreak in Hong Kong, 2003.	Thirteen percent of Hong Kong residents surveyed during the SARS outbreak were quite or very anxious about SARS. Anxiety and perception of risk from SARS was associated with precautionary measures against SARS but was unrelated to recent use of health services.	Leung et al. 2003
SARS outbreak in Toronto, 2003.	Ninety-seven percent of Toronto residents and 93% of U.S. residents surveyed during the SARS outbreak reported they would agree to be quarantined if exposed to SARS. Twenty-four percent of Toronto residents who were quarantined or had a family member or friend quarantined for SARS reported it was a major problem; 51% said it was a minor problem. Emotional difficulty from being confined was the most common major problem.	Blendon et al. 2004

Several studies examined the impact on the general population of the SARS outbreak in 2003. These studies found higher levels of anxiety in much of the general population. This anxiety was often related to the increased use of precautionary measures against SARS but was not associated with a greater use of health services (Blendon et al. 2004; Leung et al. 2003; Quah and Hin-Peng 2004).

Until the anthrax attacks, our nation had not yet experienced a deadly bioterrorist event. Several years ago, some salad bars in Oregon were intentionally poisoned in order to influence a local election, but no empirical data were collected on the emotional and behavioral consequences of this event. At the time of our literature review, no studies had been published that assessed the emotional reactions of those people exposed to anthrax in the fall of 2001. Reports of the public health response and surveys of attitudes toward and opinions about the anthrax attacks and the risk of bioterrorism are informative, however. Despite the relatively narrow scope of the attack, more than 30,000 individuals were offered prophylactic antibiotics by public health officials (Gerberding, Hughes, and Koplan 2002), and many more appear to have sought antibiotics on their own (Shaffer et al. 2003). But the majority of Americans reported that they did not take emergency precautions or visit their doctor, with no difference in behavior in those living in areas either with or without anthrax cases (Blendon et al. 2001).

Emotional and Behavioral Consequences for First Responders. First responders—those who respond to disasters and terrorist events and care for both survivors and those lost—must enter dangerous environments where their own health and well-being may be harmed and where they may witness mass carnage and destruction. A fair amount of literature discusses the emotional repercussions of such experiences in the first responder communities, traditionally thought of as police, fire, and EMS personnel, particularly in those who responded to the Oklahoma City bombing and the World Trade Center attacks (Table 4). These studies suggest that the experience of responding to these events placed these individuals at a significantly higher risk for symptoms of PTSD.

The emotional and behavioral reactions of health care workers responding to the SARS epidemic were examined in medical personnel in Hong Kong and Toronto. Their emotional distress was higher than that of the general population, and while most continued to care for their patients, a number of hospital staff were reported to have refused work

TABLE 4
Psychological Consequences of Events Measured in First Responders

Type of Event	First Responders	Source
Intentional Mass Violence/Conventional Terrorism		
Bombing of Murrah Federal Building, Oklahoma City, April 1995.	Thirteen percent of 181 male firefighters and rescue workers who responded to the bombing met criteria for PTSD three years following the disaster. High rates of alcohol disorders (24% following disaster; 47% lifetime prevalence) were observed in male firefighters and rescue workers who responded to the bombing, but virtually no new cases occurred after the bombing.	North, Tivis, et al. 2002
Terrorist attacks on World Trade Center and Pentagon, September 2001.	In reports discussing the mental health response to the Pentagon attacks, authors cited anecdotal reports of the emotional consequences of recovering bodies, pulling victims from the scene, and going through the rubble and remains. The authors also noted that workers reported sleeping difficulty, stress, and anxiety during their mission as well as in the aftermath. Although these symptoms were not clinically assessed and empirically documented, they were widely cited in reports and articles.	Ritchie and Hoge 2002
	In a mental health needs assessment for New York State conducted one month following the attacks, researchers estimated that approximately 24% of rescue workers would meet criteria for PTSD and require treatment.	Herman, Felton, and Susser 2002

TABLE 4—*Continued*

Type of Event	First Responders	Source
Infectious or Food- or Water-Borne Disease Outbreaks		
HIV/AIDS, Los Angeles, 1985.	Many physicians reported concerns about contagion was a deterrent to treating patients with AIDS and that more knowledge and experience regarding AIDS would likely increase the number of physicians willing to care for AIDS patients.	Richardson et al. 1987
HIV/AIDS, Chicago, 1987.	Nearly 90% of the nurses and more than half of the physicians surveyed reported worries about treating persons with AIDS. Seventy-two percent of nurses and 57% of physicians worried about their own health; 56% of nurses and 41% of physicians worried about being infected by treating these patients; and 37% of nurses and 25% of physicians worried about infecting their families. Nurses were also less likely than physicians or social workers to report always being comfortable talking with AIDS patients.	Dworkin, Albrecht, and Cooksey 1991
SARS outbreak in Toronto, 2003.	One month following the first SARS case, retrospective analyses indicated that the prominent reactions among hospital staff were fear, anxiety, anger, frustration, fatigue, insomnia, irritability, and decreased appetite. Anxiety worsened when isolation procedures changed, staff entered quarantine/ treatment, staff developed fevers, or staff were admitted with an unclear source of infection. Many staff were conflicted between their professional responsibility as health care providers and feeling fearful and guilty about potentially transmitting illness to their loved ones. Nurses on the SARS unit did not refuse work	Maunder et al. 2003

	assignments, but some professional and nonprofessional staff on general medical floors refused to care for patients with SARS.	
	Twenty-nine percent of respondents in a hospital survey during the SARS outbreak experienced emotional distress, more than double that seen in a general population survey. Nurses and allied health care professionals had significantly greater emotional distress than did doctors and staff not working in patient care. Part-time employees were also more likely to have significant emotional distress.	Nickell et al. 2004
SARS outbreak in Hong Kong, 2003.	Sixteen percent of family physicians surveyed during and immediately after the SARS outbreak reported spending less time with patients; 7% avoided physical examinations. Physicians in private clinics were more likely than those in public clinics to quarantine themselves for a ten-day period after contacting a SARS patient (58% versus 31%). Physicians in private clinics were less likely than those in public clinics to report staying away from home to protect their family (5% versus 19%).	Wong et al. 2004
Industrial Events/Chemical Terrorism		
Sarin gas attack in Tokyo subway, March 1995.	Secondary contamination was found in 10% of firefighters and emergency medical service workers, and 20% of hospital staff because of lack of decontamination procedures.	Okumura et al. 1998
Eighty-seven hazardous materials incidents in Washington State, December 1997–October 1999.	Somatization was the only psychological score statistically elevated above the normative population within 40 days of exposure; prior treatment for a psychological condition was associated with an increased risk of somatization.	Kovalchick et al. 2002

assignments, and a few family physicians avoided physically examining patients or stayed away from home to protect their family (Maunder et al. 2003; Nickell et al. 2004; Wong et al. 2004). Many of the emotional and behavioral reactions and fears of contagion reported by health care workers in response to SARS are similar to those documented more than a decade ago in the early phases of the HIV/AIDS epidemic (Dworkin, Albrecht, and Cooksey 1991; Gallop et al. 1992; Richardson et al. 1987; Searle 1987; Treiber, Shaw, and Malcolm 1987).

Less has been written about first responders, emergency workers, and health care professionals responding to industrial events or chemical exposures, but what is available indicates that these groups are at risk for secondary contamination as well as primary contamination and are also at a higher risk of emotional distress.

Emotional and Behavioral Consequences for Vulnerable Populations. Many studies have identified factors that put individuals at risk for more serious emotional and behavioral consequences following a disaster; fewer studies have specifically examined the emotional and behavioral impact of mass violence and terrorism in vulnerable populations. Table 5 focuses on two particularly vulnerable populations: children and those with a history of psychiatric disorders or psychological problems.

Studies of children suggest that they may warrant special attention and may be at greater risk than adults are of developing emotional distress and other adverse behavioral consequences of terrorism. The data on individuals with current and previous psychiatric disorders are mixed. Many studies found that individuals with a previous psychiatric illness were more likely to develop posttraumatic stress symptoms. However, studies that specifically looked at persons who currently had clinical disorders (substance abuse, PTSD, etc.) had differing results regarding how the disaster affected health care service use, increase in illness severity, or return to substance use.

General Lessons from the Literature Review. The studies just summarized defined the populations of interest in slightly different ways and used different methods to assess emotional and behavioral reactions. Therefore, comparisons across studies must be made with care. Nevertheless, our literature review of the emotional and behavioral consequences of earlier terrorist events, communitywide disasters, and potentially analogous events offered several lessons that can help us prepare for future bioterrorist events.

TABLE 5
Psychological Consequences Measured in Vulnerable Populations

Event	Vulnerable Populations	Source
Intentional Mass Violence/Conventional Terrorism		
Bombing of Murrah Federal Building, Oklahoma City, April 1995.	Almost 20% of sixth-grade students in a town approximately 100 miles from Oklahoma City reported bomb-related difficulty functioning two years after the attack.	Pfefferbaum et al. 2000
	Clinical needs assessment conducted with sixth-to-twelfth-grade students seven weeks after the bombing found that posttraumatic stress symptoms were significantly higher in females, children who knew someone injured or killed, and children who reported watching more bombing-related television news coverage.	Pfefferbaum et al. 1999
	Seven weeks following the attack, a majority of children in the Oklahoma City area reported fear that a friend or someone in their family would be hurt and reported being nervous or afraid; 40% felt helpless. Fear, arousal, and dissociation at the time of the bombing was the strongest predictor of posttraumatic stress symptoms, more important than physical exposure, relationship to direct victims, bomb-related television viewing, and continued safety concerns.	Pfefferbaum et al. 2002
Terrorist attacks on World Trade Center (WTC) and Pentagon, September 2001.	Three to five days after the attack, almost one-third of children ages five to 18 in households in a national survey had emotional stress symptoms, and 42% discussed safety fears with their parents.	Schuster et al. 2001

TABLE 5—*Continued*

Event	Vulnerable Populations	Source
	One to two months after the attacks, parents in 48% of households with children reported that at least one child in the household was upset by the attacks on Sept. 11. Twenty percent of these children had trouble sleeping; 30% were irritable, grouchy, or easily upset; and 27% were described as fearing separation from their parents.	Schlenger et al. 2002
	Twenty-two percent of parents living in lower Manhattan surveyed five to eight weeks after the attacks reported that their children had received some form of counseling related to their experiences after the WTC attack. More than half of the counseling was delivered in schools.	Stuber et al. 2002
	Within two months following the attacks, an increased demand for drug and alcohol treatment was found among individuals with preexisting psychological problems in 13 states and four major cities.	Center on Addiction and Substance Abuse 2002
	Significant increase was reported in children's visits to behavioral health clinics for acute and posttraumatic stress reactions and other anxiety disorders at military treatment facilities within 50 miles of Washington, D.C., for five months after Sept. 11, compared with same period in the previous two years.	Hoge, Pavlin, and Milliken 2002
	Survey of drug users conducted between one and four months following the attacks found significant anxiety, anger, and sadness; increase in drug use was as common as reductions in drug use.	Weiss et al. 2002

- A broad range of emotional and behavioral reactions are likely after an event.
- Widespread emotional reactions such as fear and anxiety are the most common. Less common is the development of clinical disorders such as PTSD. Many reports, however, do not clearly differentiate the level of emotional reactions (e.g., clinical levels of PTSD versus subclinical levels of symptoms of posttraumatic stress versus more general anxiety), thereby making a comparison of the studies difficult.
- Events in which the perceived threat is greater than the tangible exposure (e.g., biological events, radiological exposure, many chemical events) are likely to stimulate more sustained emotional and behavioral consequences.
- When the perceived threat is greater than the tangible exposure, a relatively large number of people in the nearby population may change their behavior with respect to seeking medical care. This effect should not be equated with panic. Rather, these people often present with physical (e.g., somatic) complaints or for screening. Little empirical research, however, has systematically examined the relationship between emotional reactions and behavioral reactions after such events.

Observations from the Experts

The experts we interviewed generally agreed on the important differences between bioterrorism and other events, but they offered a variety of opinions about what these differences implied for planning and research.

Several interviewees noted that the plans and preparation for bioterrorism must go well beyond what is currently in place for other types of communitywide disasters. For example, uncertainty about exposure means that individuals across broad geographic areas are likely to perceive themselves as being at risk following a bioterrorist event, even if all confirmed cases are confined to a single state or geographic region. Accordingly, a response plan should extend beyond those areas in which there have been documented infections. Commenting on the experience of the anthrax attacks, one expert observed that a bioterrorist attack anywhere in the country would require public health officials in all 50 states to activate some components (e.g., heightened surveillance) of their response plan. As was noted, "A new model [will be needed] for responding in a situation with cross-jurisdictional issues."

All the experts agreed that effective communication will be critical to addressing the public's fear and anxiety in the event of a bioterrorist attack and reducing the likelihood that unaffected individuals will flood the public health triage system. Several experts emphasized the importance of local risk communication strategies to complement the information likely to be provided by national authorities. As one interviewee remarked, "National messages just aren't very personal." But several experts maintained that we lacked empirical data to modify the communication strategies necessary for bioterrorism. According to one expert, "We really don't understand the psychological context in which we are delivering our messages, nor whether they are really addressing the needs of the community. We need to better understand {it} so we can modify our messages and target our outreach."

Another interviewee added, "Communities are not made up of homogenous groups. In order to respond effectively, we must strive to understand how different subgroups will respond differently." According to several others, "We need a new model of how to deliver mental health support and services for bioterrorism." Many felt that organizations like schools, churches, employee assistance programs, and employers who already have relationships with large and specific segments of the community would be an important part of such a response. Such organizations can help educate the public, offering basic knowledge of biological agents and likely public health response plans and thereby enhancing the public's understanding and preparedness. These organizations are also well positioned to give information and support to individuals with particular concerns or needs, thus greatly increasing the effectiveness of the overall response. But several interviewees observed that "we probably need organized efforts to train ministers, teachers, and others about their potential roles in psychological management" after a bioterrorist attack. An additional benefit of a broad-based community response noted by several experts is that it would concentrate more on individual and community resiliency and less on emotional reactions and clinical psychiatric disorders.

Many interviewees pointed out that while we have effective treatment for individuals with PTSD from a variety of traumatic events, we currently know little about what helps those traumatized by mass violence, in which many in a community are traumatized by a single event. Many echoed the consensus panel of the National Institute of Mental Health (NIMH), which called for a larger base of evidence regarding effective

early interventions for specific populations across different settings. The interviewees also recognized the importance of determining how to treat effectively those persons who do develop psychiatric disorders, such as PTSD and major depression, as a result of bioterrorism. However, the experts also felt that relatively few would develop psychiatric disorders such as PTSD and major depression *solely* as a result of a bioterrorist attack and suggested that efforts to improve services to such individuals should not distract policymakers from the more global issues of managing changes in behavior (e.g., staying home, becoming hypervigilant, demanding more health care information, avoiding community involvement) that could be associated with bioterrorism. Several experts also noted that bioterrorism presents the additional challenge of devising plans to support health care workers, first responders, and others important to an effective public health response to a bioterrorist event, a response that is likely to be characterized by greater uncertainty about the level of risk for longer periods than in most other disasters.

Discussion

As highlighted in our review of the literature and interviews with experts, policymakers making bioterrorism prevention and response plans face many critical gaps in knowledge, such as the following:

1. What are the range and severity of the expected emotional and behavioral consequences?
2. To what extent will these emotional and behavioral consequences affect the public health response?
3. How can our preparation and response to bioterrorism capitalize on and enhance the effectiveness of natural supports in our society?
4. What aspects of risk communication are most useful for and appropriate to a response to bioterrorism?
5. What interventions should be used to reduce the emotional and behavioral consequences of a bioterrorism event?

The Uncertain Nature of the Threat

The increased psychological effect that results from uncertain exposure to an invisible agent has previously been recognized (Holloway et al.

1997). Many experts noted that this uncertainty requires the modification of many existing disaster response plans. These concerns also were supported by our literature review, which found high rates of emotional distress and behavioral changes stemming from those events that included uncertainty about exposure. Furthermore, in a bioterrorist event, the lag between exposure and the development of symptoms may exacerbate this uncertainty. Inaccurate knowledge about the organism involved may also hamper response plans and should be addressed by public health education programs. For example, for months after the anthrax attacks, many Americans were still not sure whether anthrax was contagious, despite media announcements that it was not (Blendon et al. 2002; Lisa Meredith, personal communication, February 13, 2003). The public and the health care community should be given basic knowledge of the organisms likely to be used in a bioterrorist event and the planned public health response (Ferguson et al. 2003). Such efforts would remove some of the uncertainty among the public and first responders and would begin to define some of the risk/benefit issues with regard to a response.

One component of response plans about which we know very little is how the behavior of those responsible for coordinating and conducting an effective public health response would be affected by uncertainty about exposure. Not only could these persons be at risk as a result of their professional activities, but in a number of scenarios their families also might be at risk. The actions of the first responders and health care professionals cannot be taken for granted. One survey of physicians reported that more than half would not be willing to put themselves at risk of contracting a deadly illness in order to save the lives of others in the event of a bioterrorist attack (Alexander and Wynla 2003), and fewer than half of emergency department physicians surveyed were willing to get the smallpox vaccine (Kwon et al. 2003). Such attitudes and behaviors on the part of health care professionals are not unique to bioterrorism and were expressed during both the SARS outbreak of 2003 and the early years of the HIV/AIDS epidemic.

Providing rapid and accurate information to the public in the event of a bioterrorist event is, therefore, critical to reducing uncertainty (U.S. Department of Health and Human Services 2002) and should be joined by the efforts of local, state, and federal governments to enhance surveillance for a bioterrorist attack and increase lab capacity to rapidly identify a bioterrorist agent. By its very nature, however, bioterrorism will always carry with it a high level of uncertainty, particularly during the early

stages of an attack. Accordingly, response and mitigation plans must be designed with this inherent uncertainty in mind. Robust strategies are needed to address the needs of communities that are unsure of their level of risk and recognize that this uncertainty may also affect the behavior of first responders and health care professionals.

Currently, however, we have little empirical information about how uncertainty regarding the threat or level of risk affects an individual's emotional and behavioral reaction. Studies of those persons exposed to anthrax will increase our understanding of these reactions related to bioterrorism. In addition, we should study events that, while not bioterrorism, are sufficiently similar that they can help us understand the public's emotional and behavioral reactions when facing an event with an unknown level of risk. Recent examples include the spread of West Nile virus and the SARS infection, as well as the HIV/AIDS epidemic (Nicholas, Tredoux, and Daniels 1994). In such cases, in which exposure to the threat is not apparent, how do people determine their own risk of exposure (and that of their families), and how does this perceived risk affect behavior of the general public, first responders, and health care workers?

The Role of Natural Support Systems

In the past, planners and policymakers were often able to assume that the duration of the actual disaster would be relatively brief. Therefore, their plans to address the psychological impact of disasters often relied on the deployment of mental health professionals after the event. A bioterrorist attack, however, may require the public to shelter-in-place for an extended period or to observe social distance practice and contact management (e.g., isolation, quarantine, and other restrictions on movement) in order to control the risk of contagion, thus needing emotional and behavioral supports during the event and perhaps complicating the deployment of mental health professionals.

One way to address these issues is to include natural support systems, such as schools, family physicians, and clergy and other faith-based organizations, in communitywide emotional and behavioral response preparation and planning. These natural supports are often not formally integrated into a community's disaster response plan, even though their importance in helping individuals deal with disasters and other traumatic events has been widely demonstrated (Schuster et al. 2001; Silver

et al. 2002; Stein et al. 2004). Support systems also provide a natural avenue through which to educate the public as part of preparing for and responding to a bioterrorist event.

The extent to which people can draw on natural support systems over time is limited (Pennebaker and Harber 1993), and little is known about how more formal mental health response systems will function under conditions of continuing and uncertain risk. We therefore should look at how people use the natural emotional supports in their community to help them cope over time when a threat does not pass quickly (e.g., SARS; the Washington, D.C., snipers; West Nile virus). There is little doubt that the support of family, friends, the clergy, and others to whom people naturally turn will be vital after a bioterrorist event. Policymakers and planners will be able to make better-informed decisions about the best use of such resources in preparing for and responding to a bioterrorist event by examining the following issues:

- How should schools, faith-based organizations, and the health care system prepare for such events, particularly with respect to educating the public and first responders?
- How should schools, faith-based organizations, and the health care system mitigate and manage the emotional and behavioral issues associated with such events?
- How can we best use natural support systems to provide emotional support following a bioterrorist event?
- How can the educational materials commonly distributed by professional organizations and experts to help people cope be more useful during these more sustained events, or how can they be improved?

The Role of Risk Communication

Numerous efforts are now under way to help local, state, and national public officials refine their risk communication strategies, particularly those involving the media (U.S. Department of Health and Human Services 2002). These efforts are based on well-developed theories and their application after events such as exposure to industrial hazards and contaminated drinking supplies (Commission on Risk Perception and Communication 1989; Fischhoff 1995; Johnson and Slovic 1995; Rowan 1994; Sandman 1991, 1993). The applicability of such events to

bioterrorism, however, may be limited because of bioterrorism's intentional nature and the relative unfamiliarity of both the public and medical community with the likely agents.

It is important to understand how risk communication strategies can best address sociocultural differences. As was apparent in the aftermath of both the anthrax attacks and the smallpox inoculation efforts, different groups in our society have very different life experiences and beliefs through which they view official communications regarding bioterrorism and related health behaviors. The collaborative and multigroup approach that the Institute of Medicine recommends is essential to a public health approach to these issues (Institute of Medicine 2003). Better understanding these issues must be a priority, especially considering the importance of risk communication to mediating, mitigating, or promulgating emotional and behavioral responses in the event of a bioterrorist attack, and given the reality that an effective public health response will likely require communitywide action.

Events other than bioterrorism, in which the certainty about the level of risk to a community is not known, may provide an opportunity to evaluate the impact of different risk communication strategies. Collaboration among researchers, decision makers, and funding agencies before such an event would allow the development of a research design that could be used to test the effectiveness of different risk communication strategies. This planning would allow an investigation to be fielded quite rapidly, thus beginning to build an evidence base on which future risk communication strategies could be built.

Knowing When, Where, and How to Intervene in the Event of a Bioterrorism Attack

The NIMH's consensus report on early intervention after mass trauma acknowledges that the current evidence from randomized, well-controlled trials cannot definitively confirm or refute the effectiveness of such early interventions. But even this limited evidence does permit several conclusions: (1) any early intervention should consider the hierarchy of a victim's needs, including safety, food, and shelter; and (2) the important elements of early intervention activities are an assessment of needs, the dissemination of information and the education of directly affected individuals and the general public, and the facilitation of natural support networks (National Institute of Mental Health 2002).

We do have effective treatments for adults and children with clinical disorders such as PTSD and depression that commonly occur after trauma. Several experts underscored the importance of ensuring that individuals with such disorders have access to these evidence-based treatments in both traditional mental health treatment settings and other less traditional settings, such as primary care for adults and schools for children. Few studies, however, have examined the effectiveness of such interventions delivered in such settings (Stein et al. 2003). Treating these disorders after a bioterrorist event may also be complicated by reminders of the trauma, as well as the continuing stress associated with the possibility of future attacks and any related economic disruption.

Additional research on the emotional and behavioral consequences of terrorism and terrorist-like events will also lead to the continued development and evaluation of interventions. We still need to understand how interventions and response strategies might differ according to the type of event or agent (chemical versus biological, etc.). We need to know whether different populations would require different types of interventions, how interventions should be modified to be culturally relevant and responsive to local conditions, and whether these interventions need to change over time to meet different demands. In addition, we must determine to what extent interventions are appropriate and effective in the different settings (e.g., primary care clinics, schools) in which they are likely to be delivered.

Conclusion

Faced with continued threats from weapons of mass destruction and mounting concerns about bioterrorism, our nation urgently needs to consider how best to meet the challenges associated with managing the emotional and behavioral consequences of these acts of violence. If the anthrax attacks and the sniper attacks in Washington, D.C., taught us anything, it is that events like bioterrorism, in which the level of risk is uncertain for a prolonged period, create emotional distress responses and behavioral changes in far more individuals than are physically at risk. Substantial efforts and funding are still needed to understand and prepare for the emotional and behavioral consequences likely to be associated with bioterrorism. At the same time, many of those efforts directed

at improving our response to bioterrorism will allow us to be better prepared to face a range of current public health problems.

We already know about the emotional and behavioral effects of terrorism and of nonterrorist events that contain some of the components of bioterrorism. Our preparations and response planning must draw from all these sources. But only by examining how people respond to such events and by learning how these responses can be modified by community-wide responses can we develop evidence-based assumptions about how people within and across communities will react to bioterrorist events. This new knowledge will be essential to improving our response strategies, including the use of natural support systems, risk communication techniques, and effective treatment interventions.

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