

## EXPOSURE TO BIOTERRORISM AND MENTAL HEALTH RESPONSE AMONG STAFF ON CAPITOL HILL

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The October 2001 anthrax attacks heralded a new era of bioterrorism threat in the U.S. At the time, little systematic data on mental health effects were available to guide authorities' response. For this study, which was conducted 7 months after the anthrax attacks, structured diagnostic interviews were conducted with 137 Capitol Hill staff workers, including 56 who had been directly exposed to areas independently determined to have been contaminated. Postdisaster psychopathology was associated with exposure; of those with positive nasal swab tests, PTSD was diagnosed in 27% and any post-anthrax psychiatric disorder in 55%. Fewer than half of those who were prescribed antibiotics completed the entire course, and only one-fourth had flawless antibiotic adherence. Thirty percent of those not exposed believed they had been exposed; 18% of all study participants had symptoms they suspected were symptoms of anthrax infection, and most of them sought medical care. Extrapolation of raw numbers to large future disasters from proportions with incorrect belief in exposure in this limited study indicates a potential for important public health consequences, to the degree that people alter their healthcare behavior based on incorrect exposure beliefs. Incorrect belief in exposure was associated with being very upset, losing trust in health authorities, having concerns about mortality, taking antibiotics, and being male. Those who incorrectly believe they were exposed may warrant concern and potential interventions as well as those exposed. Treatment adherence and maintenance of trust for public health authorities may be areas of special concern, warranting further study to inform authorities in future disasters involving biological, chemical, and radiological agents.

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IN THE WEEKS FOLLOWING THE 9/11 terrorist attacks, a series of anthrax-filled letters were mailed to various locations in Florida, New York, and Washington, DC. Five deaths among 11 confirmed cases of inhalational anthrax plus 11 cutaneous anthrax cases resulted.<sup>1</sup> This constituted the first U.S. incident of bioterrorism involving anthrax. Authorities responding to the attacks did not have the benefit of prior experience with bioterrorist attacks with anthrax to guide them in determining the scope of the incident, establishing public safety measures, and conducting mass antibiotic prophylaxis.<sup>2-4</sup> Officials responding to the attacks were criticized for their management of the anthrax exposures, for not responding soon enough, and for risk communication errors such as offering early reassurances of safety that later proved incorrect.<sup>5-7</sup>

The anthrax letter delivered to Capitol Hill was opened the morning of October 15, 2001, by an office worker in Senate Majority Leader Tom Daschle's sixth-floor office in the Hart Senate Office Building. In short order, the office was closed; its staffers were quarantined, tested for anthrax exposure, and treated prophylactically with antibiotics. The House of Representatives, whose offices were not a target of any of the anthrax letters, quickly initiated a historically unprecedented and controversial 3-day shutdown to inspect for anthrax.<sup>8</sup> The Senate, however, remained open for 2 more days until October 17, when its offices were closed for environmental testing. The Hart Building was closed for months after discovery of anthrax contamination there. Many congressional staff from Hart Senate offices initially worked from home until relocating to other temporary spaces, often doubling up in other offices on Capitol Hill (sometimes with their political rivals).

The fifth- and sixth-floor Daschle offices and the adjacent offices of Senator Russ Feingold were the most highly exposed, with all 28 anthrax-positive nasal swab tests coming from these areas (25 in Daschle's offices, 2 in Feingold's offices, and 1 from a hallway adjacent to the Daschle offices).<sup>3</sup> Eleven offices in the Hart Building were subsequently found to have traces of anthrax.<sup>9</sup> Capitol Hill health officials tested thousands of workers for anthrax and started them on antibiotic prophylaxis. No individuals on Capitol Hill developed anthrax-induced illness.

In the first days and weeks after the attacks, individual workers did not know whether they had been personally exposed or their level of risk. This difficult situation provided a research opportunity to examine associations between mental health effects and exposure among those who were within the exposure areas versus those who were not, and among those who believed they were exposed compared to those who considered themselves unexposed, independent of actual exposure status.

Psychological and behavioral responses to bioterrorism differ from those to natural disasters and conventional terrorism with explosives. In contrast to the immediate and unmistakable physical impact of other types of disasters,

bioterrorism's effects may be invisible, delayed, and uncertain,<sup>10</sup> earning this type of disaster the label "stealth terrorism."<sup>11</sup> Ambiguities surrounding personal exposure may instill pervasive fear. Behavioral responses to bioterrorism may, therefore, arise from *belief* in exposure independent of *actual* exposure and may thus be unpredictable and disproportionate to the actual degree of physical exposure.<sup>12-14</sup> The novelty of the agent used, the public's lack of familiarity with it, and health authorities' inexperience with it are factors that may incite fear.<sup>10,15</sup> Bioterrorists seek not just to injure selected individuals, but to create widespread panic, generate chaos, and disrupt the broader society.<sup>16,17</sup>

The concept of "belief in exposure" has been examined in combat veterans potentially exposed to chemical and biological weapons. In these studies, belief in exposure correlates with mental illness and psychological stress.<sup>18,19</sup> Similarly, studies of infectious epidemics and toxic contamination accidents, for which the boundaries of exposure may also be uncertain,<sup>20-24</sup> suggest that emotional and behavioral responses of populations exposed to epidemics and toxic contamination accidents may relate even more to concerns about possible exposure than to actual exposure.<sup>21,25,26</sup> Individuals' beliefs about their exposures may predict health and mental health status apart from actual exposure status.<sup>19</sup>

Uncertainty about exposure and associated risk communication issues were evident in the 2001 anthrax attacks. Reports of increasingly sophisticated vehicles for anthrax dissemination in later anthrax-containing letters necessitated redetermination of safety response strategies. Revised messages to potentially exposed groups conflicted with earlier communications and other sources of information, generating confusion and apparent misinformation.<sup>2,8,27,28</sup> Further, the communications were not always clearly understood: many did not realize that the nasal swab testing procedure was not a clinical test of anthrax infection for individual use, but rather an epidemiologic tool for determining zones and perimeters of exposure,<sup>7</sup> a situation that created unintended worry and concern.

Published research into this unique series of anthrax attacks has provided new knowledge about epidemiologic surveillance of anthrax dissemination and exposure, epidemiologic risk assessment, mass prophylaxis, antibiotic adherence, and risk communication to inform authorities facing future bioterrorist attacks.<sup>2-4,27</sup> Relatively little, however, has been learned about the mental health effects. Previous assessment of 15 of all 16 surviving adults with documented inhalational or cutaneous infection from the 2001 anthrax mailings (none from Capitol Hill) revealed abundant psychological distress, significant health problems, and poor life adjustment 1 year postinfection.<sup>1</sup> Qualitative studies of focus groups comprised largely of postal workers with a few Capitol Hill workers identified concerns about effectiveness of communication during public emergencies, perceived unfairness in medical treat-

ment, loss of trust in authorities, antibiotic prophylaxis nonadherence, and reactions to the anthrax vaccine.<sup>27,29,30</sup> Qualitative focus group studies of congressional staff identified concerns about authorities' actions, safety issues, work disruption, potential exposure, social support, and medical procedures.<sup>7,31</sup> A semistructured interview study of Brentwood postal workers and Capitol Hill staff described workers' experiences of antibiotic prophylaxis for anthrax and perceptions of public health recommendations.<sup>28</sup>

No mental health data have been published from systematically assessed groups who were exposed to the anthrax attacks but who did not become ill, and no quantitative studies have specifically focused on congressional staff, despite the existence of a large population of surviving exposed congressional workers. Although no congressional personnel developed an infection with anthrax, many had clear evidence of exposure (28 with anthrax-positive nasal swabs), and many more were considered at significant risk (occupants of 11 Capitol Hill offices where anthrax spores were discovered; prolonged antibiotic prophylaxis to 625 and briefer prophylaxis to >2,000).<sup>3,32</sup> Potential exposures, therefore, clearly go beyond those who succumbed to anthrax infection, or even those positive for anthrax spores on nasal swab testing, to encompass a far wider exposure perimeter. No studies of groups exposed to these anthrax attacks have assessed psychiatric disorders such as posttraumatic stress disorder (PTSD).

This article describes findings from a study of 137 congressional workers who were systematically assessed for psychiatric, emotional, and behavioral responses to the anthrax attacks. Information obtained from these study participants regarding their physical presence in areas documented by independent environmental sampling procedures as being anthrax-contaminated allowed comparison of psychosocial variables with exposure to anthrax contamination. Data obtained from separate inquiry about participants' stated beliefs about their own personal exposure to anthrax spores allowed comparison of psychosocial variables with belief in personal exposure. Workers' beliefs that they were exposed to anthrax were not necessarily concordant with their actual exposure to anthrax-contaminated areas. Therefore, stratification of the sample by exposure status and belief in exposure permitted investigation of emotional and behavioral responses to belief in personal exposure among those not exposed to anthrax-contaminated areas.

## METHODS

### *Sampling*

Office workers were recruited from the congressional offices where exposure was highest, and other Capitol Hill workers were recruited for comparison. Participating congressional

offices approved the conduct of this study in their offices. The Washington University School of Medicine Institutional Review Board (sponsoring institution at the time) approved the project in advance, and a federal Certificate of Confidentiality provided further protection of participant privacy. All study participants provided written informed consent before participating.

Information about the study was disseminated directly to administrative staff of the most highly exposed Senate offices and to various other offices through a notice posted in a Capitol Hill newsletter and word-of-mouth.\* Participants ( $N=137$ ) from 43 Capitol Hill offices volunteered (29 Senate offices, 12 House offices, and 2 non-Senate, non-House Capitol offices). Of 70 staff workers in the 2 most highly exposed offices, 37 (53%) participated in the study; 6 of those 37 were not in the contaminated areas after the anthrax letter was opened. Additionally, 100 participant volunteers were recruited from other Senate offices ( $n=69$ ), other House offices ( $n=15$ ), and other Capitol offices ( $n=16$ ).

### *Assessment Procedures*

Interviews using the Diagnostic Interview Schedule/Disaster Supplement<sup>34</sup> were completed a median of 7 months (range, 4-20 months) after the Capitol Hill anthrax letter was opened. The Diagnostic Interview Schedule examined selected psychiatric disorders—PTSD assessed not only in relation to the anthrax incident but also to the 9/11 attacks, because Capitol Hill was a 9/11 terrorist target and it was evacuated on 9/11; depressive, panic, and generalized anxiety disorders; and alcohol abuse/dependence—providing both postdisaster and retrospective predisaster lifetime diagnoses using Diagnostic and Statistical Manual of Mental Disorders (*DSM-IV*) criteria.<sup>35</sup> The Disaster Supplement obtained information on disaster-related variables such as physical location after the anthrax attack, perception of exposure, emotional responses, secondary sequelae, and level of functioning. This instrument has been used in numerous studies to collect systematic data from various populations exposed to major disasters, such as the Oklahoma City bombing.<sup>36,37</sup>

Two operational definitions were established for the present study. *Actual physical exposure* was defined as physical presence in any of the 11 offices and adjoining and other areas where anthrax spores were identified by

\*A volunteer sample was recruited because direct contact with Capitol Hill staff to invite their study participation was not possible. Federal Office for Human Research Protections rules disallowed direct contact with potential study participants who had not provided written consent to be contacted for the purposes of research study recruitment from recruitment sources not holding a Federalwide Assurance of Compliance with HHS regulations (45 CFR 46.103).<sup>33</sup>

environmental sampling.<sup>3,9</sup> Determination of the exposure status of individual participants was established by comparing their self-reported physical locations after the anthrax attacks with areas separately identified as anthrax-contaminated, to identify those who had been in the contaminated areas (“exposed”) and differentiate them from those who had not (“unexposed”). *Belief in exposure* was defined as the participant’s stated belief, in response to interview query, of having had direct personal contact with anthrax-contaminated material or air. Therefore, belief in exposure might not necessarily always coincide with actual physical exposure to areas later found positive for the presence of anthrax spores. Some individuals who did spend time in contaminated areas may have maintained the belief that they were not really exposed, while others who did not enter these areas may have harbored a belief that they were exposed in spite of not having had direct contact with contaminated areas. Comparison of these 2 variables allowed stratification of the sample by exposure status and belief in exposure: of 56 exposed, 52 (92.9%) believed they had been exposed, and of 81 not exposed, 24 (29.6%) believed they had been exposed.

**Data Analysis**

Descriptive statistics include frequencies, means with standard deviations, and percentages. Chi-squared tests were used to compare 2 dichotomous variables (substituting 2-sided Fisher’s exact tests for expected cell sizes <5), and Student’s *t*-tests were used to compare dichotomous with numerical variables. Testing repeated measures for

dichotomous dependent variables was accomplished with McNemar tests for dichotomous and paired *t*-tests for numerical independent variables, using 2-tailed calculations. Multiple logistic regression models were constructed to identify dependent variables associated with belief in exposure (independent variable) controlling for effects of gender (covariate independent variable) in the same model. Alpha level was set at  $p \leq .05$ .

**RESULTS**

**Sample Characteristics and Exposure Status**

The sample was 56.2% female and relatively young (mean = 32.6, SD = 10.3, median = 29, range = 21-61 years), 87.7% Caucasian, 57.4% single, and highly educated (mean = 16.9, SD = 2.2, median = 16, range = 12-25 years). Three-fourths (77.4%) were Senate staff. Most (79.3%) were from offices with Democratic political affiliation, reflecting the composition of the office targeted by the anthrax letter and other offices where traces of anthrax were found; 6.7% were from Republican offices; and 14.1% were not with either Democratic or Republican offices (eg, Senate post office, Veterans Affairs office, Supreme Court).

More than one-third of the study sample (40.9%, 56 of 137) had been exposed to contaminated areas as determined by this study’s methods (ie, presence in offices or areas later found to have physical evidence of anthrax). Table 1 lists findings of variables with significant differences between the exposed and unexposed subgroups. The

Table 1. Subgroup Differences by Exposure and Belief in Exposure

	All (N = 137) n (%)	Exposed (n = 56) n (%)	Unexposed (n = 81) n (%)	Unexposed with Belief (n = 24) n (%)	Unexposed without Belief (n = 57) n (%)
Male gender	60 (43.8)	23 (41.1)	37 (45.7)	*16 (66.7)	21 (36.8)
“Very upset” in immediate aftermath	65 (47.8)	***37 (67.3)	28 (34.6)	12 (50.0)	16 (28.1)
Change in job satisfaction	72 (54.1)	**38 (67.9)	34 (44.2)	8 (36.4)	26 (47.3)
Positive change	16 (12.0)	10 (17.9)	6 (7.8)	0 (0.0)	6 (10.9)
Negative change	56 (42.1)	28 (50.0)	28 (36.4)	8 (36.4)	20 (36.4)
Lost trust in health authorities	61 (44.9)	**34 (60.7)	27 (33.8)	7 (30.4)	20 (35.1)
Considered own mortality	23 (16.8)	**16 (28.6)	7 (8.6)	*5 (20.8)	2 (3.5)
Received antibiotics	101 (73.7)	***56 (100.0)	45 (55.6)	***20 (83.3)	25 (43.9)
≥60-day course	66 (50.0)	***49 (92.5)	17 (21.5)	***12 (52.2)	5 (8.9)

Statistical significance of subgroup comparisons (exposed/unexposed groups; unexposed with/without belief groups): \* $p \leq .05$ ; \*\* $p \leq .01$ ; \*\*\* $p \leq .001$ .

exposed and unexposed groups did not differ on demographic characteristics. Eleven (19.6%) of the exposed participants and none of the others indicated that they had an anthrax-positive nasal swab test. These 11 anthrax-positive cases represented 39.3% of all 28 individuals with known anthrax-positive nasal swab tests.<sup>3</sup>

### *Subjective Responses*

Nearly one-half (47.8%) of the study participants reported feeling “very upset” about the anthrax attacks in the immediate aftermath, significantly higher than the proportion (17.9%) who were still feeling “very upset” about it at the time of the interview (McNemar  $\chi^2 = 39.0$ ,  $df = 1$ ,  $p < .001$ ). More of those exposed than others reported feeling “very upset” about it afterward (67.3% vs. 34.6%;  $\chi^2 = 14.04$ ,  $df = 1$ ,  $p < .001$ ). Nearly one-half (47.5%) of the total sample acknowledged having a great deal of stress since the incident; 32.1% reported moderate stress and 20.4% low stress. Stress levels did not differ by exposure group. Among those reporting moderate-to-great stress since the anthrax incident, only 22.2% said the main stressor was the anthrax attacks; 17.6% cited the 9/11 terrorist attacks as their major stressor. Another 24.1% of this stress-acknowledging group cited something related to terrorism (eg, difficult working environment after anthrax attacks, concerns about future terrorist attacks) as their major source of stress. The largest proportion (36.1%), however, said the main source of their stress was unrelated to terrorism (eg, planning a wedding, professional exam, recent move).

Three-fourths (75.4%) of the participants, exposed and unexposed alike, reported having lost time from work as a result of the anthrax incident. Most (68.7%) described the anthrax incident as severely disruptive to their work, especially those physically exposed (82.1% vs. 59.0% of others;  $\chi^2 = 8.13$ ,  $df = 1$ ,  $p = .004$ ). Nearly one-half (42.1%) of the sample reported persistent negative effects on their job satisfaction; a few (12.0%) reported an increase in job satisfaction, and about one-half (54.1%) reported no change. More of the exposed (67.9%) than others (44.2%) reported a change in job satisfaction ( $\chi^2 = 7.34$ ,  $df = 1$ ,  $p = .007$ ). Positive change in job satisfaction was described by nearly 1 in 5 (17.9%) of those exposed and only 7.8% of others, a difference falling short of statistical significance ( $\chi^2 = 3.10$ ,  $df = 1$ ,  $p = .078$ ).

Nearly one-half of the sample (44.9%) said they lost trust in health authorities, their elected officials (43.7%), the government (41.6%), the media (40.2%), and any of these entities (44.9%) after the anthrax incident. Those physically exposed were more likely to report having lost trust in health authorities (60.7% vs. 33.8%;  $\chi^2 = 9.68$ ,  $df = 1$ ,  $p = .002$ ) but were no different from others in change in trust for their elected officials, the government, or the media.

More Senate staff than others (51.0% vs. 20.7%;  $\chi^2 = 8.33$ ,  $df = 1$ ,  $p = .004$ ) felt at the time that the Senate

closure did not occur soon enough. Few participants (4.8%) felt that closing the Senate was an overreaction. Few (8.4%) thought the House closure was not soon enough. More Senate staff than other staff considered the House closure to be an overreaction (44.9% vs. 16.7%;  $\chi^2 = 7.63$ ,  $df = 1$ ,  $p = .006$ ).

### *Concerns about Infection*

Because no individuals on Capitol Hill became ill with anthrax, no physical symptoms reported by participants in this study represented anthrax infection. Inhalational anthrax disease presents as a flulike syndrome (respiratory and gastrointestinal symptoms) and cutaneous anthrax disease as a bump evolving into a painless ulcer with a black center, typically on the face or arms.

Nearly 1 in 5 (18.4%,  $n = 25$ ) participants recalled having symptoms they attributed at the time to possible anthrax infection, most commonly upper ( $n = 13$ ) and lower ( $n = 3$ ) respiratory symptoms and dermatologic ( $n = 4$ ) symptoms. Reported symptoms were independent of exposure group. The majority (68.2%) of those with symptoms sought medical advice for the symptoms, consistent with directions to them from Capitol Hill physicians.

Nearly one-third (30.9%) of the sample entertained the notion that they might become ill with anthrax, an idea that was statistically unrelated to exposure status. The possibility of dying from anthrax was considered by 28.6% of those exposed but only 8.6% of others ( $\chi^2 = 9.41$ ,  $df = 1$ ,  $p = .002$ ).

### *Antibiotic Prophylaxis*

More than one-half (55.6%) of the unexposed and all (100.0%) of those exposed to the places where anthrax was detected received antibiotics for prophylaxis of anthrax infection. Overall, 57% were prescribed ciprofloxacin only, 7% received another antibiotic only, and 10% received both ciprofloxacin and another antibiotic. Among the unexposed, more of those who took antibiotics than those who did not described themselves as “very upset” about the anthrax (46.7% vs. 9.4%;  $\chi^2 = 6.55$ ,  $df = 1$ ,  $p = .011$ ). Most (68.8%) of those who received antibiotics were prescribed a course of  $\geq 60$  days, including the vast majority (92.5%) of those exposed. All prescriptions for  $< 60$  days of antibiotics were for  $\leq 10$  days.

Only 26.2% of those prescribed antibiotics took the medication flawlessly (ie, missing no prescribed doses), and more than half (51.7%) of those prescribed antibiotics said they discontinued them prematurely. The most common reasons for stopping antibiotics were side effects (48.9%) and feeling the antibiotics weren’t needed (37.8%). “Major side effects or problems” were described by more of those prescribed antibiotics for  $\geq 60$  days than

of those prescribed for a shorter period (88.1% vs. 32.1%;  $\chi^2 = 28.41$ ,  $df = 1$ ,  $p < .001$ ). The most commonly reported side effects were problems with joints or tendons (42.0%) and abdominal complaints (37.0%). More of those prescribed antibiotics for  $\geq 60$  days than those prescribed shorter courses reported abdominal symptoms (48.5% vs. 20.0%;  $\chi^2 = 7.00$ ,  $df = 1$ ,  $p = .008$ ), joint or tendon problems (56.1% vs. 6.7%;  $\chi^2 = 20.86$ ,  $df = 1$ ,  $p < .001$ ), and "swelling or anaphylaxis" (16.7% vs. 0.0%;  $df = 1$ , Fisher's exact  $p = .016$ ). Among those who did not prematurely stop their  $\geq 60$ -day course of antibiotics, however, the median percentage of prescribed doses missed was only 5%.

Those prescribed  $\geq 60$  days of antibiotics were not more likely than those prescribed shorter courses to stop the medication prematurely, but among those who completed their antibiotic course, flawless antibiotic adherence was far less often achieved by those taking a course of  $\geq 60$  days compared to those completing a shorter course (31.0% vs. 91.7%;  $\chi^2 = 12.49$ ,  $df = 1$ ,  $p < .001$ ). Stopping antibiotics prematurely was not associated with exposure group or a positive nasal swab test.

### *Psychiatric Disorders*

Overall, 24.9% of the sample had a postdisaster diagnosis. The most common diagnoses were major depression (12.4%) and anthrax-related PTSD (6.6%), and there were a few cases of panic disorder (1.5%), generalized anxiety disorder (1.5%), and alcohol use disorder (2.9%). Before the disaster, 37.2% had a psychiatric disorder, including major depression (24.8%), PTSD (11.0%), panic disorder (2.9%), generalized anxiety disorder (5.1%), and alcohol use disorder (10.2%). For incident diagnoses, only 5.1% of the sample had a disorder that occurred for the first time after the disaster (6 cases of PTSD and 1 case of major depression).

The prevalence of anthrax-related PTSD among those exposed was 14.3% (27.3% among those with and 11.1% of those without a positive nasal swab test, a nonsignificant difference). Of 15 individuals with PTSD after the anthrax attacks, PTSD was related to both anthrax and the 9/11 attacks in 2, to only anthrax in 7, and to only the 9/11 attacks in 6. Post-anthrax major depression was diagnosed in 27.3% of those with a positive nasal swab test, 11.1% of those exposed without a positive nasal swab test, and 11.1% of those not exposed (nonsignificant differences). Any post-anthrax psychiatric disorder was diagnosed in 54.6% of those with a positive nasal swab test compared to 24.4% of those physically exposed without a positive nasal swab test and 19.8% of those not physically exposed (comparing those physically exposed with and without a positive nasal swab test, Fisher's exact  $p = .072$ ; comparing those exposed with a positive nasal swab test to those not exposed, Fisher's exact  $p = .020$ ).

Among those exposed to anthrax-contaminated areas, a predisaster diagnosis was identified in more of those with than without a postdisaster diagnosis (82.4% vs. 25.6%;  $\chi^2 = 15.85$ ,  $df = 1$ ,  $p < .001$ ). Psychiatric diagnoses were not associated with variables reflecting antibiotic adherence.

### *Belief in Exposure*

Several noteworthy associations with belief in exposure were found among the 81 unexposed participants. Table 1 lists findings of variables with significant differences between those who believed and those who did not believe they had been exposed among the unexposed subgroups. Nearly one-half (43.2%) of unexposed men but only about 1 in 5 (18.2%) unexposed women stated they believed they had been exposed ( $\chi^2 = 6.05$ ,  $df = 1$ ,  $p = .014$ ). Half (50.0%) of those believing they had been exposed reported feeling "very upset" about the anthrax attack initially, nearly twice the rate (28.1%) of those believing they were unexposed, a difference falling just short of statistical significance (controlling for gender,  $\beta = 1.01$ ,  $SE = 0.53$ , Wald  $\chi^2 = 3.64$ ,  $p = .056$ ). Likelihood of dying from anthrax was considered by a significantly higher proportion of the unexposed who believed they had been exposed compared with other unexposed individuals (20.8% vs. 3.5%; controlling for gender,  $\beta = 2.24$ ,  $SE = 0.94$ , Wald  $\chi^2 = 5.76$ ,  $p = .016$ ). Among the unexposed, belief in exposure was associated with being prescribed antibiotics (83.3% of those who believed vs. 43.9% of those who did not; controlling for gender,  $\beta = 1.71$ ,  $SE = 0.63$ , Wald  $\chi^2 = 7.55$ ,  $p = .006$ ) and specifically with prescription of antibiotics for  $\geq 60$  days (52.2% vs. 8.9%; controlling for gender,  $\beta = 2.31$ ,  $SE = 0.65$ , Wald  $\chi^2 = 12.65$ ,  $p < .001$ ). No individuals who were not exposed to contaminated areas but believed they had been exposed met symptom criteria for anthrax-related PTSD.

## DISCUSSION

Lacking systematic research on mental health effects of bioterrorism to guide them, authorities were not sufficiently prepared to respond to the anthrax attacks in the weeks following the September 11, 2001, terrorist attacks. Complementary findings from systematic observations on survivors of anthrax infection in previous research<sup>1</sup> together with the current study of a broader exposure group constitute a new empirically based literature on mental health effects of bioterrorism. This work may inform responses to future incidents including not only bioterrorist attacks but also chemical or radiological accidents, emerging infectious diseases, and pandemics such as the severe acute respiratory syndrome (SARS) outbreak and the more recent 2009 H1N1 epidemic.<sup>38</sup> All of these events are associated with fear and uncertainty about exposure and/or contagion and

raise public health concerns. In mass emergencies involving large populations with uncertain exposures, small fractions of the populace becoming convinced they were exposed and rushing to seek medical care could translate into massive numbers of patients overwhelming the surge capacity of acute care systems.<sup>10,39</sup>

Extrapolating the proportions of people in this limited study who incorrectly believed they had been personally exposed in order to anticipate in future disasters the raw numbers of people who believe they have been exposed indicates a potentially important public health consequence, if people alter their healthcare behavior based on misunderstanding. In this Capitol Hill anthrax attack study, a sizeable proportion of those unexposed, especially men, believed they had been exposed. To our knowledge the finding that, among those who were not exposed, men were more likely than women to believe that they had been exposed has not been previously reported. This result is not consistent with previous studies that demonstrate greater perception of threat and threat-related anxiety among female exposure groups compared to males,<sup>40,41</sup> with the well-known preponderance of PTSD among female trauma-exposure groups,<sup>42</sup> or with general symptom-reporting patterns among women compared to men.<sup>43</sup> The false belief in exposure among men in this sample could well represent a false-positive artifact of this particular dataset, or it could reflect unique psychological characteristics of the men and women who work for Congress.

Even though no congressional workers became ill with anthrax infection, many had symptoms that they suspected represented anthrax infection and they sought medical care. Among those in this study who were not exposed, belief in exposure was also associated with emotional upset, concern about mortality, and taking antibiotics (despite being told antibiotics were not needed for their exposure category). Therefore, those who incorrectly believe they were exposed may warrant attention and potential interventions as well as those actually exposed, although reaching them may be complicated by loss of trust in authorities.

Despite the risk of contracting a serious, potentially fatal disease from anthrax, antibiotic adherence was far from perfect. Fewer than half of those who were prescribed antibiotic prophylaxis completed the entire antibiotic course (most often stopping it due to side effects), and only one-fourth took their antibiotics flawlessly. The incidence of side effects for the  $\geq 60$ -day regimens observed here differed from typically brief ( $\leq 10$ -day) courses of these commonly used antibiotics for ordinary infections in community settings; joint and tendon problems constituted the biggest side effect, along with gastrointestinal side effects.

The treatment adherence findings of this study parallel research reported by the Centers for Disease Control and Prevention (CDC) that just over one-half of congressional workers completed their 60-day course of antibiotics.<sup>4</sup> Gulf War veterans participating in a 6-month doxycycline prophylaxis study also exhibited problems with side effects and

poor medication adherence.<sup>44</sup> Adherence to protracted antibiotic regimens for individuals who feel healthy might be expected to be less than for short-term acute antibiotic treatment of infectious illness<sup>45-47</sup> and more similar to long-term medication for chronic diseases such as tuberculosis, hypertension, or diabetes.<sup>48,49</sup> Providers of extended prophylaxis following bioterrorism or other mass exposures may thus anticipate the discontinuation of antibiotics and other antidotes with treatment courses of 2 months or longer, potentially leading to negative medical outcomes.

The sample for the current study represented a relatively young and educated group with an almost ideal access to medical care and public health authorities. Unlike the thousands of postal employees who were potentially exposed during the same period, congressional staff (especially those known to be highly exposed) had numerous onsite physicians, ready access to authorities from the military and CDC, and nearly daily briefings from healthcare providers regarding anthrax; questions regarding their individual symptoms or concerns were addressed by physicians within hours. It is likely that the abundant personal communication of medical information from Capitol Hill physicians to staff reduced distress and inappropriate responses, which otherwise might have been far worse.

Yet, despite this level of access and their high educational level, the staff's unfounded fears and nonadherence with prophylaxis were quite prevalent. Such responses might be anticipated to be even more evident in general populations without these advantages. The Hart and Brentwood postal employees, who were not afforded this level of targeted risk communication, demonstrated greater mistrust of health authorities, although trust issues also may have sorted across racial lines among the predominantly African-American postal employees.<sup>27-30</sup> In a mass exposure event, such as an aerosol exposure over a city or a packed sports stadium, it would be impossible to provide the level of personal contact with all exposed individuals that the Capitol Hill staff was afforded. This further suggests a considerable challenge for public health authorities in any future bioterrorism event, especially one on a large scale.

The causal pathways of the associations with belief in exposure found in this study are not certain. Possibly, because people believed they were exposed they became more upset, thought they might die, and sought out antibiotics. Alternatively, being upset or receiving antibiotics might have contributed to their belief that they had been exposed, or other factors associated with belief in exposure, being upset, and receiving antibiotics may indirectly link these findings. To the degree that belief in exposure generates emotional distress and seeking of unnecessary treatment, targeted risk communication to help align exposure beliefs with actual exposure status could reduce levels of emotional distress and unnecessary healthcare use. If, however, belief in exposure is generated by individuals' interpretation of healthcare measures ("I was prescribed antibiotics—that must mean

I was exposed”), then risk communication can be targeted to better inform people of the significance of medical treatments in order to reduce erroneous conclusions about personal exposure. Clarification of the mechanisms of these associations may help direct future public health and occupational interventions: screening, public education about what constitutes exposure and worrisome symptoms, reassurance, and workplace preparation for these types of disasters.

Psychopathology in these congressional workers after the anthrax attacks was associated with exposure. Among the most highly exposed individuals (those with positive nasal swab tests), rates of psychiatric disorders (anthrax-related PTSD in 27%, any postdisaster disorder in 55%) were not unlike those identified in directly exposed survivors of the Oklahoma City bombing (PTSD in 34%, any disorder in 45%).<sup>37</sup> This is somewhat surprising given the absence of violence and abject horror in the exposure experiences of these anthrax victims compared to the survivors of the Oklahoma City bombing. The invisible nature of the bioterrorism attack, however, as discussed earlier in this article, may have yielded less apparent psychological effects compared to the more evident response to the example of a terrorist attack using conventional weapons in the Oklahoma City bombing. Further contributors to psychological reactions to the anthrax attacks among Congressional staff may relate to the high-profile and national nature of the anthrax attacks as well as the fact that the anthrax attacks followed soon after the September 11 terrorist attacks (in which Capitol Hill was a target), almost blending the attacks in the perception of the public and of those directly exposed. Regardless, the amount of psychopathology found in the most directly exposed survivors of the anthrax attacks on Capitol Hill underscores the importance of addressing mental health service needs. Mental health assessment and treatment might best be delivered if integrated with the medical services for those actually exposed or infected.

Although psychological stress was prevalent, with 48% of the sample acknowledging a great deal of stress, the source of the stress was more often unrelated to terrorism or to circumstances indirectly related to terrorism than focused on exposure to terrorism. Thus, it should not be assumed, without inquiry, that mental health problems following terrorism are necessarily direct consequences of the incident.

Although inclusion of exposed and unexposed groups and systematic interviews with structured diagnostic assessment were strengths of this research, the sample may not be representative of the potentially exposed Capitol Hill population, given the 47% nonparticipation rate among those most highly exposed and the volunteer sampling. This sample may be overly inclusive of highly exposed people with an interest in discussing their experience yet lacking individuals who are so upset that they would avoid participation in a study reminding them of the incident and

individuals unmotivated to participate because they feel they were little affected by the incident. The extreme tails of the normal curve—that is, those most and least upset—may thus be underrepresented. This population of young, educated, conscientious, motivated, and largely nonminority congressional workers may also be unrepresentative of other workplace populations. The postdisaster time window was relatively brief (several months); previous work, however, has shown that most disaster-related PTSD begins within a few months,<sup>37,50-53</sup> allowing identification of cases in this study. Recall bias may have modified participants’ retrospective recollection of predisaster and early postdisaster symptoms.

While some findings of the current study are specific to the population studied, others may represent more general responses to bioterrorism. Further research is needed with more representative populations to confirm the findings and determine generalizability. To the degree that the findings of this study are representative of other incidents and other populations exposed to bioterrorism, potentially important implications for public disaster health policy and intervention may follow. The possibility remains, however, that this could be a massively larger problem in a general population event in which the kind of personal intervention provided by public health authorities on Capitol Hill may not be feasible.

Despite methodological limitations of this study, the findings suggest important public health, mental health, and social implications. Mental health service needs associated with bioterrorism range from public education and outreach, commonly provided after disasters, to traditional services for those with psychiatric disorders. Confusion about health status requires clear communication for those needing treatment or prophylaxis and for the public at large. This communication must be delivered in an environment of diminished trust at a time when such trust is critically important to thwart an enemy, maintain public order, and focus social action. Thus, careful thought must be given to the content of messages, the modalities for disseminating messages, and the selection of credible spokespersons.

These research findings suggest that treatment adherence and trust in public health authorities represent areas of special concern in disasters involving biological, chemical, and radiological agents, warranting further study. A mental health research agenda for bioterrorism and related mass emergencies should be established to identify priorities to guide public health and mental health prevention and intervention strategies for these types of incidents.

## ACKNOWLEDGMENTS

This research was supported by National Institute of Mental Health Grant #MH66628 to Dr. North and by Award #MIPT106-113-2000-020 from the National



Memorial Institute for the Prevention of Terrorism (MIPT) and the Office of State and Local Government Coordination and Preparedness, U.S. Department of Homeland Security, to Dr. Pfefferbaum. Points of view in this document are those of the authors and do not necessarily represent the official position of NIMH, MIPT, the Department of Veterans Affairs, or the U.S. government. The authors gratefully acknowledge the assistance of Pam Lokken, the participants in this study, and employees of the Capitol Hill offices involved.

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Manuscript received July 14, 2009;  
accepted for publication October 2, 2009.

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