On November 19, 2001, a case of inhalational anthrax was identified in a 94-year-old Connecticut woman, who later died. We conducted intensive surveillance for additional anthrax cases, which included collecting data from hospitals, emergency departments, private practitioners, death certificates, postal facilities, veterinarians, and the state medical examiner. No additional cases of anthrax were identified.

The absence of additional anthrax cases argued against an intentional environmental release of *Bacillus anthracis* in Connecticut and suggested that, if the source of anthrax had been cross-contaminated mail, the risk for anthrax in this setting was very low. This surveillance system provides a model that can be adapted for use in similar emergency settings.
Because of the paucity of clinical information on deaths occurring outside hospitals, the review focused on in-hospital deaths. Deaths were further classified by place of occurrence: hospital, nursing home, residence, or other setting. Contacted by telephone to identify patients for whom a definitive cause of death could be determined. For the remaining deaths in which cause of death could not be ascertained, medical record reviews by a team of four physician epidemiologists using a standardized abstraction form were conducted at the hospitals where the deaths occurred.

Laboratory Data

Hospital-associated laboratories statewide were contacted to obtain information on any gram-positive rods or Bacillus species isolated from sterile sites (e.g., blood, cerebrospinal fluid, or pleural fluid). A standardized reporting form was provided to laboratories to be completed and sent to a 24-hour-accessible fax machine. For Bacillus species isolates, we contacted laboratories by phone to gather information about motility and hemolysis tests when this information was not provided on the report. For all other reports of gram-positive bacilli, laboratories were contacted to obtain speciation information if available, when this information was not provided. All available isolates suspicious for B. anthracis were sent to the Connecticut Department of Public Health (CDPH) laboratory for final identification.

Medical Examiner’s Records

Connecticut’s state medical examiner is notified of deaths that occur outside hospitals or within 24 hours of hospitalization. Data on deaths referred to the medical examiner and reported from September 1 to November 26 were reviewed. After November 26, ongoing prospective surveillance for deaths referred to the medical examiner was assumed by CDPH, with a particular focus on deaths in the town where the index patient resided and the eight surrounding towns. The medical examiner’s office and CDPH made the decision about whether an autopsy was necessary to exclude anthrax as the cause of death, based on the symptoms of the deceased patient and the clinical circumstances surrounding death.

Postal Worker Absenteeism

Work attendance records were obtained from both the local postal and main processing distribution facilities serving the index patient’s town of residence and the eight surrounding towns (Seymour and Wallingford postal facilities). To obtain information about reasons for absence, either postal management or CDPH personnel interviewed postal workers with absences for ≥3 consecutive days from September 11 to November 25, 2001. When workers were not available to be interviewed, information was obtained by interviewing management personnel, who also were questioned about recent deaths in postal workers.

Surveillance for Postal Worker

Influenzalike Illness and Cutaneous Conditions

The U.S. Postal Service had been conducting surveillance for influenzalike illness or cutaneous conditions compatible with anthrax among postal workers nationwide since October 25, 2001. In Connecticut, postal service management collected
BIOTERRORISM-RELATED ANTHRAX

Prospective Surveillance

Hospital, Emergency Departments, and Physician Reports

The statewide hospital-based surveillance for bioterrorism-related agents that began after September 11, 2001, was enhanced from November 27 to December 15. All acute-care hospitals in Connecticut designated a surveillance officer (e.g., infection control practitioner, nurse, or physician) who would be responsible for surveillance of conditions potentially related to anthrax and other bioterrorism-related agents at their institution. Each day, the surveillance officer contacted the clinical microbiology laboratory to request a list of any suspect Gram stain results or bacterial isolates from sterile sites. Suspect results were defined as gram-positive rods that had not been further identified or Bacillus species that had not been further typed or for which speciation as B. anthracis had not been excluded. Additionally, the surveillance officer reviewed admissions for the previous 24 h and reported patients having any one of five clinical syndromes (acute respiratory failure with pleural effusion; hemorrhagic enteritis with fever; a skin lesion characterized by vesicles, ulcer, or eschar; meningitis, encephalitis, or unexplained acute encephalopathy; or anthrax or suspected anthrax infection) and a widened mediastinum on chest radiograph or laboratory findings of a gram-positive bacillus on Gram stain, Bacillus species from culture of a sterile site specimen, or hemorrhagic cerebrospinal fluid, pleural, or peritoneal fluid in patients without a traumatic tap or event.

Using a standardized form, the surveillance officer reported findings daily to CDPH. Upon identifying patients with the surveillance criteria for a suspect anthrax case, hospital surveillance officers contacted a designated member of the surveillance team by telephone and faxed the report. These patients were then referred to a clinical team for further evaluation. In addition, physicians and infection control practitioners statewide (in particular those in the nine towns including and surrounding the town of the index patient) were asked to report immediately to CDPH any patient with symptoms that suggested anthrax.

Other Anthrax Surveillance Activities

Survey of Veterinary Practices

To ascertain undiagnosed animal anthrax cases, a one-page questionnaire was distributed to the members of the Connecticut Veterinary Medical Association (CVMA) on November 28. CVMA has a total of 620 members, accounting for 82% of the 768 CDPH-licensed veterinarians in Connecticut. Information collected included the number of veterinarians associated with the practice, type of practice, number of undiagnosed deaths by animal species, animal deaths accompanied by clinical signs consistent with anthrax, and knowledge of confirmed cases of animal anthrax in Connecticut. Questionnaires were sent by the CVMA rapid fax system to the approximately 325 members who requested faxed updates from CDPH. We requested a single completed questionnaire from each practice. Since some practices included veterinarians who are not CVMA members, the survey likely reached more veterinarians than actual members who had requested faxed updates.

Results

Data were entered and analyzed in an Epi Info database (5). Hospital, emergency department, and physician reports were evaluated at least twice a day.

Among the 487 deaths reported from the nine towns in September, October, and November 2001, a total of 131 (26.9%) had one of the six conditions under surveillance. Of these, 66 (50.3%) occurred in hospitals; the rest occurred in residences, nursing homes, and other settings. No postmortem examinations were performed. By contacting physicians, infection control practitioners, and laboratories, a likely cause of death other than anthrax was identified for 7 (10.6%) patients. For the remaining 59 (89.4%) patients, medical record review was necessary. In 33 (55.9%), a cause of death other than anthrax was identified. For 12 (20.3%) patients, the cause of death was not apparent, but available information on the clinical features and clinical course (such as absence of fever and respiratory symptoms) of the patients did not suggest a diagnosis of anthrax. Insufficient data were available to assess the cause of death for 14 (23.7%) patients because death occurred before or shortly after arrival to the hospital. None of these patients had been autopsied, and because of the lack of a clear indication and the limited availability of resources, no further measures (e.g., exhuming the body to conduct autopsy) were taken to ascertain the cause of death.

Laboratory Data

Thirty (96.7%) of 31 clinical laboratories provided data. Twenty-two (73.3%) laboratories reported at least one patient with a gram-positive bacillus or Bacillus species isolate. Gram-positive bacilli were identified in 71 specimens from 70 patients (one patient had more than one specimen submitted), including blood (59 specimens), tissue (6 specimens), perito-
Prospective Surveillance

All 140 questionnaires were returned from 140 practices; 79 were from Connecticut veterinarians. Completed questionnaires were received from practices distributed throughout eight counties of the state. Of these, 113 (81%) were small animal practices; 14 (10%) a mixture of small animals, equine, and food animal practices; and 12 (9%) equine practices. Of the respondents, 69 practices with 180 veterinarians, including nine practices and 20 livestock veterinarians, were located in the two counties representing the nine towns of interest during surveillance. Of the 140 practices, 18 (13%) reported that they were aware of undiagnosed animal deaths since September 15, 2001. None of the respondents indicated that they or anyone in their practice knew of a confirmed case of animal anthrax in Connecticut.

Discussion

Despite intensive, active prospective and retrospective surveillance, we did not identify any patients other than the index case with features compatible with anthrax. This finding indicates that the index patient was probably not exposed through intentional local environmental release of B. anthracis; therefore, the concurrent epidemiologic investigation focused on the personal activities and contacts of the patient. Our findings, in conjunction with the B. anthracis contamination of the regional postal distribution facility, suggest that the index patient was likely exposed through cross-contaminated mail. If so, the lack of additional anthrax cases among persons who received mail from the same postal facility as the index patient also suggests that the risk from cross-contaminated mail in this setting was very low.

The scope of this epidemiologic investigation did not include a formal evaluation of the surveillance system. Although a standard for evaluating the performance of a system to detect covert acts of bioterrorism has not yet been described, we have some general comments about the traditional criteria (6) used in assessing the attributes of surveillance systems. Our system was complex and labor-intensive, requiring an estimated 1,500 person-hours for state and federal public health officials alone during the most intense 3-week period of the investigation. However, the system operated effectively. The acceptance of the system and compliance in reporting were likely enhanced by both national and local events—the World Trade Center and Pentagon attacks, the subsequent anthrax–tainted mailings, and the death of the Connecticut resident from anthrax. The staff at the public health department were highly motivated, and training requirements were minimal because of their knowledge of the preexisting system for syndromic surveillance. Use of existing resources provided a foundation for successfully implementing enhanced surveillance in less than 12 hours. Because of standardized and relatively simple reporting forms and data abstraction by trained investigators, quality of the data was excellent. The system was by design flexible and met evolving needs, including adding new syndromes to the surveillance system and moving staff from one activity to another as needed. Centralized reporting by fax or telephone assisted us
in identifying early any problems in implementation of the surveillance system.

The true frequency of reportable syndromes was not known before we implemented this surveillance system for bioterrorism-related agents. Furthermore, with no prior knowledge of bioterrorism events, adequate numerator for the occurrence of any bioterrorism-related syndrome, or denominator for the population susceptible to the event, calculating the sensitivity and predictive value positive for the system was difficult. However, this system likely reflected accurately the lack of additional anthrax cases in both animal and human populations in Connecticut. Approximately 80% of Connecticut-licensed veterinarians in the state were successfully surveyed, including veterinarians who treat livestock most susceptible to anthrax infection, and none reported any animal illness consistent with anthrax. Similarly, an exhaustive search for human anthrax cases based on review of clinical and laboratory data yielded no additional cases.

In general, we received timely data that ensured quick and appropriate public health responses and allowed modifications to the system as needed. For hospital reporting, most reports were transmitted to a designated fax by noon each day for events during the preceding day. This plan was not problematic except on weekends, when hospitals were often operating with minimal staff. Without exception, all hospitals submitted data no later than 4 p.m. on the day of required reporting. Frequently, hospital, laboratory, medical examiner, and postal service personnel contacted a member of the team by telephone or pager with concerns about potential patients with suspect symptoms. The Connecticut Vital Records Department directed the daily transmission of all death certificates from the towns of interest, which allowed for continual monitoring of suspected deaths that required further investigation. The surveillance system operated 24 hours a day, 7 days a week; this constant accessibility was helpful with data turnaround and evaluation of suspect cases but difficult to sustain and resource intensive. Although surveillance instruments evolved over time, these changes did not detract from the ability to collect, manage, and disseminate the data, attesting to the stability of the system.

Our surveillance activities met the objectives of providing information about the source of exposure for the index case and guiding the course of the accompanying epidemiologic investigation. Although we were able to approach “real-time” reporting, permanent sustainability of these activities is unrealistic because they require too many resources. While the costs of sustaining this system were not directly evaluated, such an analysis would be useful. Explicit discussion of costs and benefits may help both in terms of protecting and increasing funding levels and assuring that existing surveillance systems are necessary and make the best possible use of limited resources. In situations requiring surveillance, an approach similar to ours could be applied after suitable modifications to meet the need for short periods of time. Clearly, the approaches to detecting sentinel bioterrorism events require further evaluation, standardization, and improvements to allow a timely, efficient, and effective public health response.

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Dr. Williams is an Epidemic Intelligence Service officer assigned to the New Hampshire Department of Health and Human Services. She was a member of the Connecticut Anthrax Investigation Team.

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