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Enhanced Drop-in Syndromic Surveillance in New York City Following September 11, 2001

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ABSTRACT *After the 2001 World Trade Center disaster, the New York City Department of Health was under heightened alert for bioterrorist attacks in the city. An emergency department (ED) syndromic surveillance system was implemented with the assistance of the Centers for Disease Control and Prevention to ensure early recognition of an increase or clustering of disease syndromes that might represent a disease outbreak, whether natural or intentional. The surveillance system was based on data collected 7 days a week at area EDs. Data collected were translated into syndromes, entered into an electronic database, and analyzed for aberrations in space and time within 24 hours. From September 14–27, personnel were stationed at 15 EDs on a 24-hour basis (first staffing period); from September 29–October 12, due to resource limitations, personnel were stationed at 12 EDs on an 18-hour basis (second staffing period). A standardized form was used to obtain demographic information and classify each patient visit into 12 syndrome categories. Seven of these represented early manifestations of bioterrorist agents. Data transfer and analysis for time and space clustering (alarms) by syndrome and age occurred daily. Retrospective analyses examined syndrome trends, differences in reporting between staffing periods, and the staff's experience during the project. A total of 67,536 reports were received. The system captured 83.9% of patient visits during the first staffing period, and 60.8% during the second staffing period (*$P < .01$*). Five syndromes each accounted for more than 1% of visits: trauma, asthma, gastrointestinal illness, upper/lower respiratory infection with fever, and anxiety. Citywide temporal alarms occurred eight times for three of the major bioterrorism-related syndromes. Spatial clustering alarms occurred 16 times by hospital location and 9 times by ZIP code for the same three syndromes. No outbreaks were detected. On-site staffing to facilitate data collection and entry, supported by daily analysis of ED visits, is a feasible short-term approach to syndromic surveillance during high-profile events. The resources required to operate such a system, however, cannot be sustained for the long term. This system was changed to an electronic-based ED syndromic system using triage log data that remains in operation.*

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INTRODUCTION

Within 24 hours of the terrorist attacks of September 11, 2001, the New York City Department of Health became concerned about the possibility of additional terrorist events and implemented heightened surveillance for bioterrorism.[1] Passive reporting was enhanced through medical alerts that asked health care providers to maintain awareness for unusual disease clusters or manifestations that might represent a bioterrorist event. These alerts were sent to all city hospitals and laboratories by broadcast facsimile and electronic mail.

In addition, with assistance from the Centers for Disease Control and Prevention (CDC), the New York City Department of Health implemented an active emergency department (ED) syndromic surveillance system based at sentinel New York City hospitals to improve its capacity for detecting disease clusters that might represent bioterrorism. This system categorized 24-hour ED patient visits into clinical syndromes associated with the primary bioterrorism agents. The primary objective of the ED syndromic surveillance system was to ensure early recognition of an increase or clustering of disease syndromes that might represent a disease outbreak, whether natural or intentional.

METHODS

Sites

Syndromic surveillance was implemented at 15 sentinel EDs in New York City. Hospitals were selected based on their volume of ED patient visits, geographic distribution, and available resources. Hospital personnel were oriented to the system on September 13, when New York City Department of Health staff visited the 15 sentinel sites.

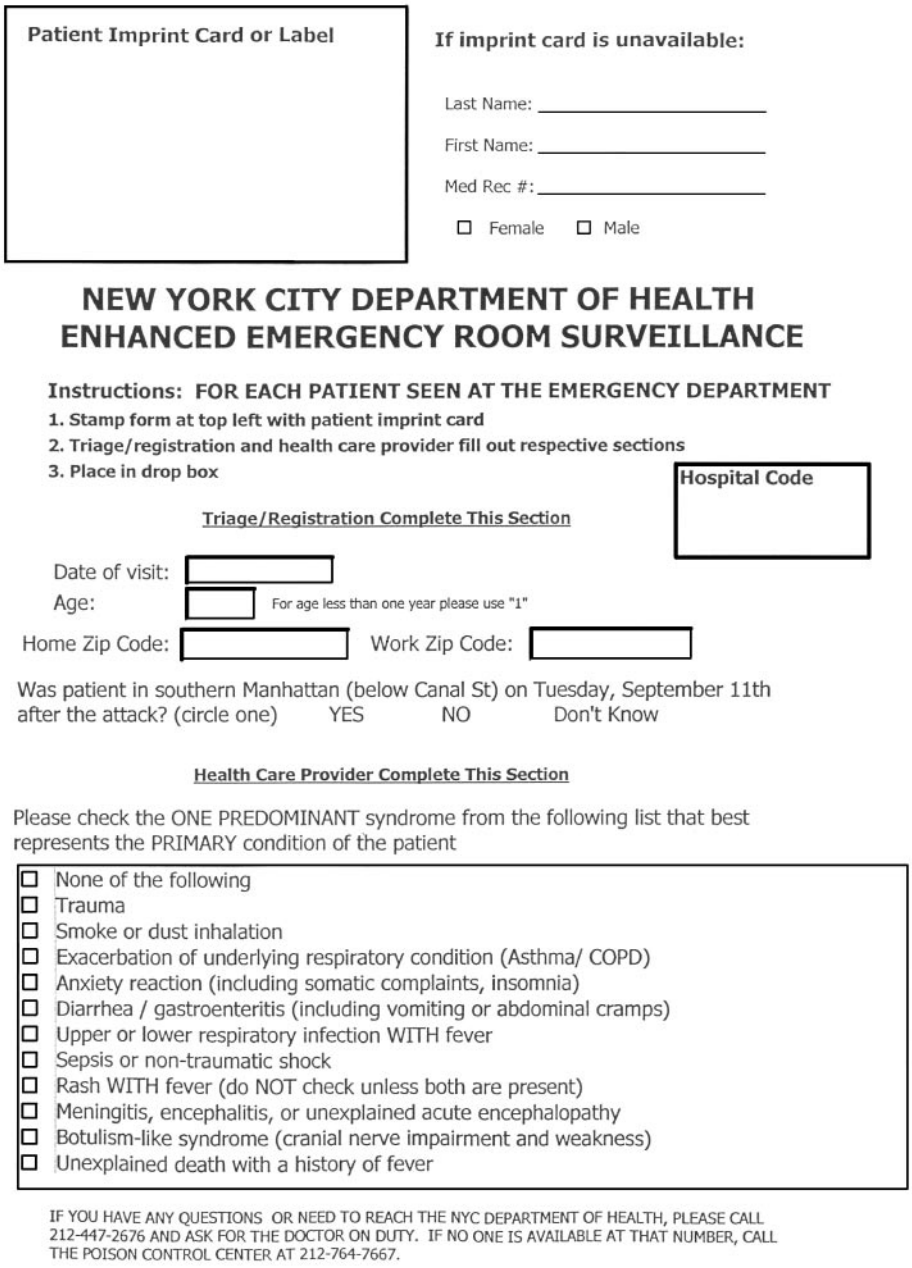
Staffing

To ensure data completeness, epidemic intelligence officers (EISOs) from the CDC were stationed at the sentinel hospital sites beginning on September 14. From then until September 27 (first staffing period), 15 hospitals had 24-hour staffing by EISOs. From September 29 to October 12, 2001 (second staffing period), 12 hospitals had 18-hour staffing by EISOs. There was a 1-day lapse in surveillance while replacement teams were put in place for the second staffing period.

Data Collection

For each ED patient visit, a one-page form was used to collect patient data on age, time of visit, date of visit, hospital, work and home ZIP codes, and the primary syndrome that characterized the patient's illness (Fig. 1). EISOs facilitated data collection and performed data entry on site.

Emphasis was placed on syndromes that might be associated with illness due to bioterrorism agents, including diarrhea/gastroenteritis, botulismlike syndrome, upper/lower respiratory infection with fever, unexplained death with fever, sepsis/nontraumatic shock, meningitis/encephalitis, and rash with fever. Trauma, smoke/dust inhalation, exacerbation/underlying respiratory condition, and anxiety reaction were included on the form to capture environmental and psychologic illness related to the World Trade Center attacks. The physician could also indicate (by selecting "none of the following") if the patient's illness was not characterized by any of these choices.



Patient Imprint Card or Label

If imprint card is unavailable:

Last Name: _____

First Name: _____

Med Rec #: _____

☐ Female ☐ Male

NEW YORK CITY DEPARTMENT OF HEALTH
ENHANCED EMERGENCY ROOM SURVEILLANCE

Instructions: FOR EACH PATIENT SEEN AT THE EMERGENCY DEPARTMENT

1. Stamp form at top left with patient imprint card
2. Triage/registration and health care provider fill out respective sections
3. Place in drop box

Hospital Code

Triage/Registration Complete This Section

Date of visit:

Age: For age less than one year please use "1"

Home Zip Code: Work Zip Code:

Was patient in southern Manhattan (below Canal St) on Tuesday, September 11th after the attack? (circle one) YES NO Don't Know

Health Care Provider Complete This Section

Please check the ONE PREDOMINANT syndrome from the following list that best represents the PRIMARY condition of the patient

- ☐ None of the following
- ☐ Trauma
- ☐ Smoke or dust inhalation
- ☐ Exacerbation of underlying respiratory condition (Asthma/ COPD)
- ☐ Anxiety reaction (including somatic complaints, insomnia)
- ☐ Diarrhea / gastroenteritis (including vomiting or abdominal cramps)
- ☐ Upper or lower respiratory infection WITH fever
- ☐ Sepsis or non-traumatic shock
- ☐ Rash WITH fever (do NOT check unless both are present)
- ☐ Meningitis, encephalitis, or unexplained acute encephalopathy
- ☐ Botulism-like syndrome (cranial nerve impairment and weakness)
- ☐ Unexplained death with a history of fever

IF YOU HAVE ANY QUESTIONS OR NEED TO REACH THE NYC DEPARTMENT OF HEALTH, PLEASE CALL 212-447-2676 AND ASK FOR THE DOCTOR ON DUTY. IF NO ONE IS AVAILABLE AT THAT NUMBER, CALL THE POISON CONTROL CENTER AT 212-764-7667.

FIGURE 1. Emergency department visit surveillance form.

Each day, EISOs were transported either by New York City Department of Health transportation or by mass transit to hospital sites. EISOs were provided with laptop computers and two-way radios to communicate with central Department of Health staff. At each site, EISOs were stationed within the ED admission area, in private rooms near the ED, or within the ED. EISOs worked with staff to ensure data completion. This included providing education, verbal encouragement,

and in some cases, incentives such as food and candy. In many cases, EISOs completed the one-page form themselves or helped fill in incomplete forms based on the patient's chart.

Data were entered onsite into Microsoft Access databases, transferred daily to the interim New York City Department of Health office, and merged into one data set within 24 hours. To evaluate completeness, the number of ED visits reported through the surveillance system was compared to the daily census of ED patients. The percentage completeness was calculated for each hospital separately for the first and second staffing periods. The mean percentage completeness was compared for the first and second staffing periods using a paired Student *t* test. The mean number of visits for the first and second staffing periods for each hospital was also compared.

Statistical Analysis

Daily data management and statistical analyses were carried out using SAS software (version 8.02, SAS Institute, Inc., Cary, NC). Syndrome frequencies were calculated by date and hospital, and data were transferred to CDC via Leaders, a secure Internet networking tool.

Temporal Aberration Detection

Temporal trend analyses were carried out at CDC using two aberration detection methods. The first, P Chart, was applied during the first 4 days because it can be implemented with as little as 1 day of baseline. The P-chart method assumes that ED visits are binomially distributed; a patient has a syndrome or not. The probability of having a syndrome on the most recent day is compared to the probability during baseline. Alarms were defined as two standard deviations from baseline data. From day 5 onward, the cumulative sums (CUSUM) method was used.[2] CUSUM compared the proportion of syndrome to total visits on each of the most recent 3 days to the mean proportion plus one standard deviation during a 7-day moving baseline. If the sum of positive differences over the 3 days exceeds two standard deviations, an alarm occurs.

Spatial Scan Statistic

For detection of spatial clusters of increased ED visits, we used the spatial scan statistic.[3] The scan statistic uses a circular window to represent potential geographic clusters. By continuously changing the circle center and radius, the window scans the geographic area for potential clusters without prior assumptions about their size or location. For each circle evaluated, the numbers of recently observed ED visits within and outside the circle are noted and compared with the expected.

Even in the absence of an outbreak, some areas will have more ED visits than others. To adjust the analysis for such background geographic variability, we used a modification of the spatial scanning approach first used in West Nile virus dead bird cluster detection.[4] In this approach, the expected number of visits for a given syndrome is derived from the ratio of that syndrome compared to total visits during a 7-day baseline period, multiplied by the total number of visits from that area during the recent period. A Poisson-based likelihood is calculated based on the observed and expected visits for each circle. The circle with the maximum likelihood is defined as the most likely cluster. A statistical significance (*P* value) is estimated based on a distribution of likelihood ratios calculated from 999 random Monte Carlo data sets. Cluster analyses were carried out using the SaTScan soft-

ware (version 2.1, National Cancer Institute, Bethesda, MD; free software available at www.satscan.org.

The focus of concern was on the population that presumably would be exposed in the event of a bioterrorist attack (i.e., those older than 12 years of age). ZIP code analyses were based on New York City metropolitan area ZIP codes only. If a patient had a New York City ZIP code of residence, then the residential ZIP code was used. If the patient had a New York City work ZIP code and did not have a New York City residential ZIP code, then the patient was classified by work ZIP code. If the patient had neither a New York City residential nor work ZIP code, then the patient was classified by hospital location. Alarms were defined as any cluster/aberration with a *P* value of .02 or less.

Investigation

Office staff conducted follow-up investigations for alarms and cases of interest with the assistance of hospital-based EISOs. Due to the low number of cases of meningitis/encephalitis, botulismlike syndrome, unexplained death with fever, and sepsis in persons older than 2 years and younger than 55 years, we followed up on each individual case for these syndromes with a more detailed case investigation form. For other bioterrorism-related syndromes, chart reviews were done only if a statistically significant cluster was noted; this was to verify whether patients in the cluster were experiencing the same illness, or if patients were exhibiting symptoms suggestive of disease due to a potential bioterrorist agent.

Line lists of individuals requiring further investigation were sent to the EISO by fax the same day of the analysis. Charts were reviewed using a standardized three-page form to confirm syndrome coding and to rule out illness related to a bioterrorism-related agent. Information abstracted included vital signs, presenting symptoms, pertinent findings on physical exam, underlying illnesses, neurological findings, laboratory/radiology test results, and final disposition and diagnoses. Chart review information was relayed by fax and phone to the New York City Department of Health central surveillance unit usually within 1 day after the analysis. Senior Department of Health medical epidemiology staff reviewed the case investigation forms and conducted follow-up phone calls to hospital-based clinicians and patient's homes when warranted.

Validation Study

A validation study was conducted at about the midpoint of the surveillance period. EISOs compared the primary syndrome noted by the ED physician on the New York City Department of Health surveillance form to the admitting or discharge diagnosis written in the patient's chart. The EISO noted whether he or she agreed or disagreed with the syndrome category assigned based on the information in the patient's chart.

Follow-up Survey

At the conclusion of the study period, a 34-question self-administered survey was developed and administered to the 80 EISOs who participated in this surveillance project. The survey inquired about the experience of each EISO with transportation, work environment, equipment resources on site, and hospital involvement issues. Descriptive analyses identified key issues from the EISO follow-up survey.

RESULTS

A total of 67,536 ED visits were reported from September 14 to October 12, 2001, from the sentinel hospitals participating in this syndromic surveillance system. Figure 2 shows the location of participating hospitals and the distribution of reported ED visits per ZIP code population. During the 28 surveillance days, syndrome coding was complete for 66,249 of 67,536 (98.1%) reports. Of these coded visits, 26.5% were categorized into a syndrome category, while 73.5% were categorized into the none category. Syndromes of respiratory infection with fever and sepsis had mean daily frequencies of 71.6 and 6.3 visits, respectively (standard deviations of 17.3 and 3.0, respectively), while the mean number of daily visits for all syndromes was 2,395 (standard deviation of 382). Meningitis/encephalitis, botulism-like illness, and unexplained death occurred too infrequently for meaningful statistical analyses.

To assess data completeness, the total number of visits recorded by the system was compared to the daily ED census data obtained from each hospital. Overall, the system captured 77% of ED visits, and completeness ranged from 31% to 97% at individual hospitals. Completeness was higher during the 24-hour staffing period (83.9%) compared to the 18-hour staffing period (60.8%) (paired t test, $P < .01$). During the 24-hour validation period, the EISO reviewer agreed with the syndrome coding of hospital staff in 87% of 1,415 ED visits.

Daily analyses focused on the syndromes that might be associated with illness due to agents of bioterrorism: sepsis, meningitis/encephalitis, rash with fever, upper/

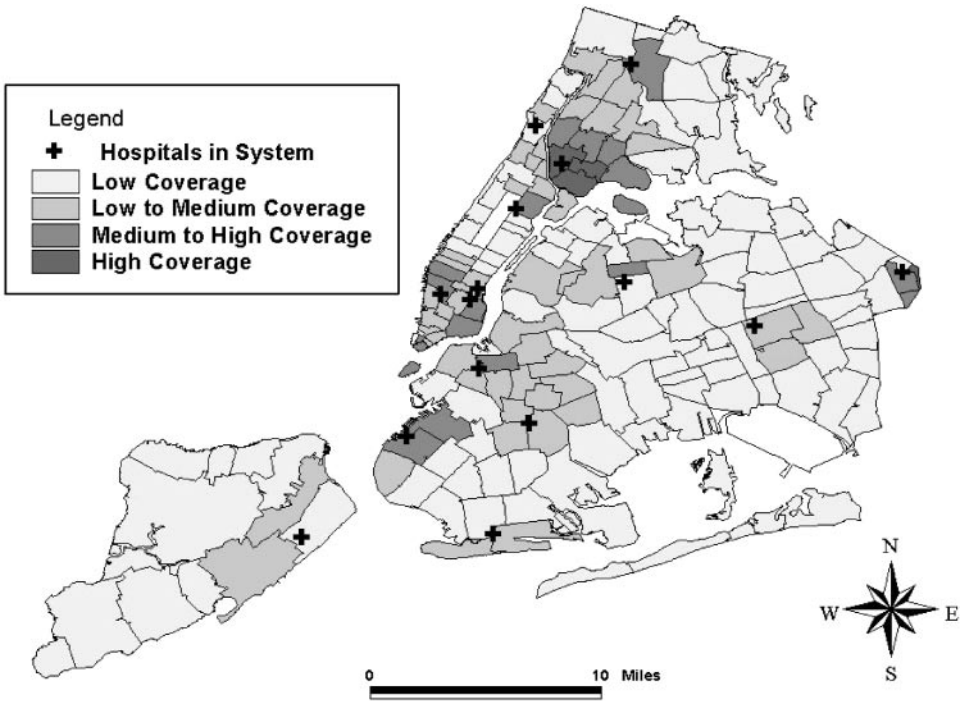


FIGURE 2. New York City Emergency Department visit distribution map. Emergency department visits from September 12, 2001, to October 12, 2001, normalized by residential ZIP code per 1,000 population.

lower respiratory infection with fever, gastrointestinal illness, botulismlike illness, and unexplained death with fever. In the first 5 days of surveillance, there were a total of six P Chart alarms associated with these syndromes: one for unexplained death, one for sepsis, two for meningitis/encephalitis, and two for gastrointestinal illness. Because the CUSUM method requires at least 4 days of data, CUSUM method was used from surveillance day 5 onward. Of 24 analyzable surveillance days, the CUSUM method detected eight citywide temporal alarms: one alarm for rash with fever (Fig. 3), two alarms for upper/lower respiratory infection with fever (Fig. 4), and five alarms for gastrointestinal illness (see Fig. 5). Overall signals by day are summarized in Fig. 6. No P Chart or CUSUM alarms occurred for botulismlike illness; however, four individual reports of botulismlike illness were investigated. None was found to be due to botulism.

Spatial analyses were carried out to assess geographic clustering by hospital and patient's home ZIP code for the three most common syndromes: rash with fever, upper/lower respiratory infection with fever, and gastrointestinal illness. Among patients aged 13 years and older, 10 spatial alarms by hospital and 2 spatial alarms by ZIP code were observed. Among all ages, 16 spatial alarms by hospital and 9 spatial alarms by ZIP code were observed (Fig. 6). No spatial alarms occurred for the same syndrome in the same area of the city for 2 or more consecutive days during the study period. The smallest spatial alarm detected included 4 visits. On October 1 and again on the October 2, spatial alarms for upper/lower respiratory infection with fever (in different geographic areas) coincided with citywide temporal CUSUM alarms.

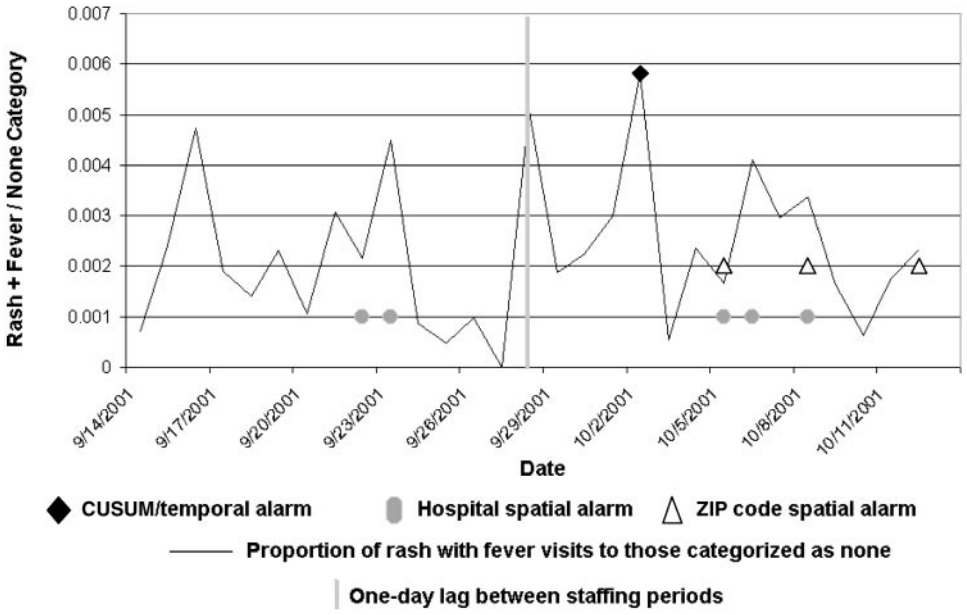


FIGURE 3. Ratio of New York City Emergency Department visits for people exhibiting rash with fever for all ages of the population from September 14, 2001, to October 12, 2001. The graph shows a ratio of rash with fever visits to those categorized in the none category. The time line also indicates syndromic surveillance alarms for which $P \leq .02$ for cumulative sums and spatial scan statistic analyses (by hospital location and patient residential ZIP code).

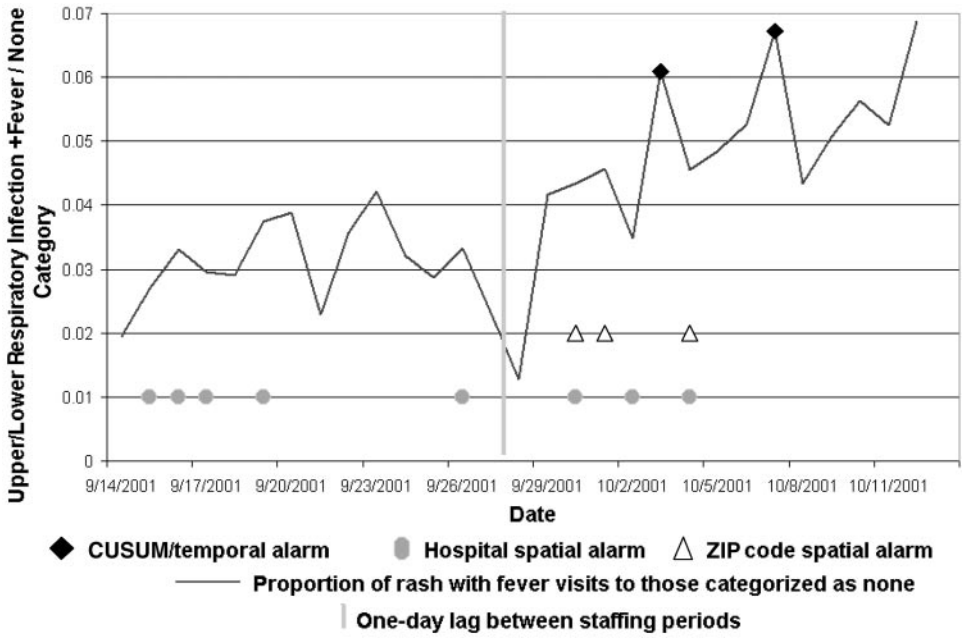


FIGURE 4. Ratio of New York City Emergency Department visits for people exhibiting upper/lower respiratory infection with fever for all ages of the population from September 14, 2001, to October 12, 2001. The graph shows a ratio of upper/lower respiratory infection with fever visits to those categorized in the none category. The time line also indicates syndromic surveillance alarms for which $P \leq .02$ for cumulative sums and spatial scan statistic analyses (by hospital location and patient residential ZIP code).

All alarms, as well as single cases of botulism-like illness, sepsis, and unexplained death with fever were investigated by chart review and patient interview. After review by senior staff, several clusters were found to be due to data entry errors or miscodes. There were no clusters found to be suggestive of bioterrorism, including the simultaneous spatial and temporal alarms on October 1 and 2.

The EISO poststudy survey was designed to assess the experience of the 64 EISOs who worked on the surveillance system. Of 38 (59%) who completed the survey, 25 (66%) were clinicians. Problems cited included travel time, communication with the New York City Department of Health and CDC, insufficient workspace, and difficulty getting physicians to complete the forms. Of the respondents, 50% indicated that it took 2 to 3 hours each day to travel to and from the hospital site due to the increased traffic congestion in the city during the weeks following the World Trade Center attack. Fifty-three percent of the respondents who did not have consistent telephone access at the hospital to contact the New York City Department of Health, and 52% reported no Internet access at the hospital. Sixty-one percent reported that they had to complete the syndrome categorization on the surveillance form over half of the time due to incompleteness by the ED personnel.

DISCUSSION

Our system was developed and implemented with the assistance of CDC within 3 days during a time of crisis in New York City and despite major disruptions in

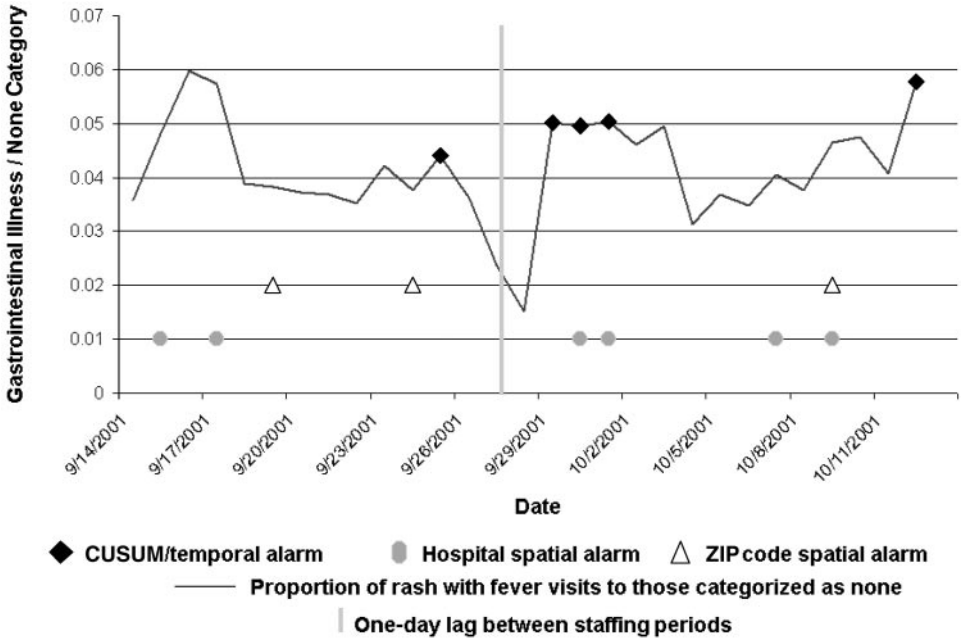


FIGURE 5. Ratio of New York City Emergency Department visits for people exhibiting gastrointestinal illness for all ages of the population from September 14, 2001, to October 12, 2001. The graph shows a ratio of gastrointestinal illness visits to those categorized in the none category. The time line also indicates syndromic surveillance alarms for which $P \leq .02$ for cumulative sums and spatial scan statistic analyses (by hospital location and patient residential ZIP code).

transportation and communication systems. Cooperation among the sentinel hospitals, New York City Department of Health, and CDC was essential to the rapid establishment and daily operation of this system. This ED surveillance system provided the New York City Department of Health with an active mechanism for monitoring for a bioterrorist event in the city, especially since routine surveillance activities were disrupted due to the breakdown of telephone communication systems at the Department of Health.

Syndromic surveillance for bioterrorism is based on the premise that such an attack can be detected in its early stages, and this advance notice will allow health officials to reduce morbidity. The sensitivity of syndromic surveillance to detect a major terrorist event or other large outbreak is theoretical since one has never occurred with which to validate the system. Detection of a large outbreak would be limited by syndromes identified, syndrome coding, data resources, and the sensitivity of the system.

Our data set included approximately 29% of the estimated daily citywide ED visits, and coverage was inconsistent across New York City's five boroughs (see Fig. 2). In addition, high variability in ED visits for some syndrome categories may have contributed to the number of false alarms. ED visits were categorized into 13 categories, 7 of which were designed to look for bioterrorism-related illness. These 7 syndromes possibly related to bioterrorism accounted for less than 7% of all ED visits, and 3 syndromes (meningitis/encephalitis, botulismlike illness, and unexplained death) occurred too infrequently for meaningful statistical analyses. The short baseline during the early surveillance period may have also contributed to the

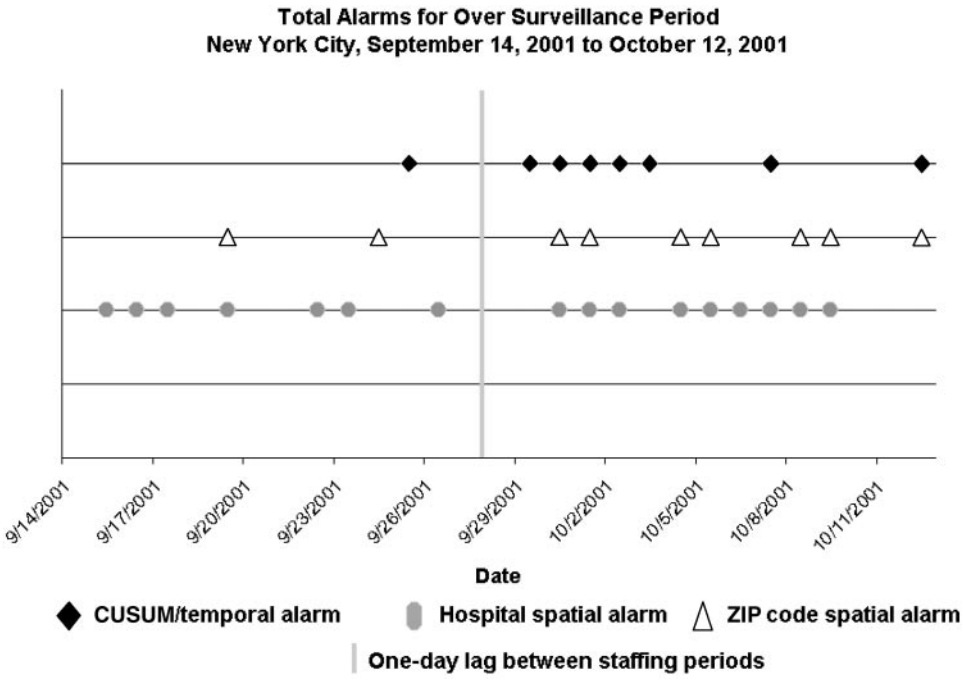


FIGURE 6. Cumulative syndromic surveillance alarms for which $P \leq .02$ for New York City Emergency Department visits for all ages of the population from September 14, 2001, to October 12, 2001, for three syndromes: rash with fever, upper/lower respiratory infection with fever, and gastrointestinal illness. The graph shows a time line of alarms for cumulative sums and spatial scan statistic analyses (by hospital location and patient residential ZIP code).

number of false alarms. The number of syndrome categories and methods used in New York City may not be generalizable to jurisdictions with smaller populations (New York City 2000 census estimate was 8,008,278). Although the analytical methodology described here has been able to detect small aberrations in geographic syndrome distribution as well as citywide outbreaks of influenza and gastrointestinal illness, it remains untested in the face of a large-scale, aerosolized bioterrorist agent release.

Syndrome coding employed for this system was deficient for individuals presenting with nonspecific febrile illnesses whose diagnosis did not fit into any of the syndromes. The prodromal phase of several bioterrorist agents may present with fever, chills, and malaise without cough or rash.[5–9] Instructions for clinicians were limited to the brief description printed on the form, which was open to interpretation, resulting in variation in syndrome coding. The 1-day quality assurance study was insufficient to examine if concordance between the ED clinician and the EISO varied by syndrome. In addition, it would be expected that if a large population were exposed, some of those individuals would have a short incubation period and might present with pathognomonic symptoms to a clinician prior to the generation of a syndromic signal. This underscores the important link between astute clinicians and public health that cannot be replaced by syndromic surveillance.

The threshold for investigating syndrome alarms was selected at $P \leq .02$ to balance the number of alarms investigated with resources available while attempting

to minimize the probability of missing a real outbreak. The level of concern following the terrorist attacks favored alarm sensitivity over specificity, resulting in investigations of an alarm, an individual case, or both on nearly every day during the surveillance period.

The spatial methods used in the systems described here rely on geographic clustering, yet it is conceivable that an event in a public location would expose people from disparate locations throughout the city and metropolitan area and not be detected. Without a strong predominance in a group of ZIP codes or hospitals, it is possible that only a citywide increase would be seen, and pinpointing an outbreak would be more difficult.

Another assumption of syndromic surveillance is that an outbreak would be expected to show a sharp rise and be sustained over several days. No spatial alarm persisted in the same geographic area for the same syndrome for 2 consecutive days. The absence of sustained signals was reassuring and became a benchmark in subsequent syndromic surveillance systems put into place in New York City.

The system aimed to detect medium-to-large events rather than single cases associated with bioterrorist agents, as well as potential disease outbreaks due to illnesses severe enough to require an ED visit. Although this intensive bioterrorism surveillance system was in place during the 2001 outbreak associated with letters that were intentionally contaminated with anthrax spores, we were unable to detect the New York City cases using this system. All anthrax cases in New York City seen during the surveillance period described had cutaneous disease. Only one of the four initial New York City patients with a cutaneous anthrax case visited an ED prior to diagnosis. All other individuals involved in these cases visited an outpatient provider, including either their primary physician or their dermatologist.

Additional limitations of the system were identified through the EISO survey. Despite their efforts to have hospital staff complete the data collection form, they often had to complete forms themselves. Many hospital staff were either too busy to complete the forms or would not completely answer all the questions on the form. Internet access, as reported by EISOs, was extremely limited, so accessing the Web-based portion of the system to retrieve hospital reports and to enter data for the forms was not possible. The long work hours and off-site location of staff made it difficult to hold meetings and discuss and disseminate surveillance results. Communication with EISOs about protocol changes was inconsistent and at times confusing and may have affected data quality.

A major disadvantage of this surveillance system was that it utilized substantial human resources. In addition to CDC epidemiologists, several New York City Department of Health staff were required to provide coordination, transportation, and other support to the EISOs under difficult conditions. There were also daily demands for data management, technical support, analysis, investigation, and reporting of results. The decrease in EISO presence in the EDs during the second 2 weeks of surveillance resulted in a decline in completeness of reporting and the detection of more spatial alarms (16 vs. 9; see Fig. 6). The level of staff commitment required to sustain the system for 4 weeks was large and unlikely to be manageable for local and state health departments over longer periods of time, even with assistance from the federal government.

CONCLUSION

A syndromic surveillance system was employed for bioterrorism in New York City in the immediate aftermath of the attacks on the World Trade Center. The system

was selected for ease of implementation and enabled us to track citywide and spatial elevations in syndromes associated with bioterrorist agents. The system had many limitations. Significant and unsustainable resources were required for operations and preservation of data quality. Data collected showed high variability and produced many false alarms, probably due to high sensitivity and data quality issues. Furthermore, the system was not designed for small outbreaks and was therefore unable to detect the cluster of cutaneous anthrax that occurred in October 2001.

We accepted a high false-positive alarm rate in exchange for increased confidence that an event would be detected. The New York City Department of Health was provided with many resources in the aftermath of the September 11 attack, which allowed us to complete a large number of investigations. Despite the many limitations of the system, given the serious crisis brought on by the attack and heightened concern about a biological attack, the system was valuable. Our goal was to detect a serious, medium-scale to large-scale outbreak such as one that might be seen by an intentional release of aerosolized, weaponized anthrax. None were detected or occurred, and the system provided a sense of security that such an attack would be discovered in a timely manner. It was especially reassuring in that the single case of inhalational anthrax that occurred in New York City was not accompanied by widespread increases in ED visits for respiratory illness.

Our experiences have helped guide the development of the current New York City electronic ED syndromic surveillance system. The new system uses routinely collected electronic chief complaint data that is transferred to the New York City Department of Health daily. The analysis requires 0.5 full-time equivalent (FTE) staff time, compared to the 4.0 full-time equivalent staff required for the drop-in system. Drop-in, ED-based syndromic surveillance systems may have value in specific settings where a bioterrorist attack is of high concern and there are no existing electronic systems. Such systems are not designed and should not be expected to detect single cases of disease. There is no substitute for clinicians maintaining a high index of suspicion and reporting unusual cases or clusters of illness promptly to their public health colleagues.

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REFERENCES

1. Holtz TH, Leighton J, Balter S, Weiss D, Blank S, Weisfuse I. The public health response to the World Trade Center disaster. In: Levy BS, Sidel VS, eds. *Terrorism and Public Health*. New York, NY: Oxford University Press; 2003:19–48.
2. Hutwagner LC. Early Aberration Reporting System (EARS). Paper presented at: Session 4 of National Syndromic Surveillance Conference; 2002. September 23–24, 2002; New York, NY.
3. Kulldorff M. A spatial scan statistic. *Commun Stat Theory Meth*. 1997;26:1481–1496.
4. Mostashari F, Kulldorff M, Hartman JJ, Miller JR, Kulasekera V. Dead bird clustering: a potential early warning system for West Nile virus activity. *Emerg Infect Dis J*. In press.
5. Inglesby TV, O'Toole T, Henderson DA, et al. Anthrax as a biological weapon: updated recommendations for management. *JAMA*. 2002;287:2236–2252.
6. Inglesby TV, Dennis DT, Henderson DA, et. al. Plague as a biological weapon: medical and public health management. *JAMA*. 2002;283:2281–2290.
7. Henderson DA, Inglesby TV, Bartlett JG, et al. Smallpox as a biological weapon: medical and public health management. *JAMA*. 1999;281:2127–2137.
8. Dennis DT, Inglesby TV, Henderson DA, et al. Tularemia as a biological weapon: medical and public health management. *JAMA*. 2001;285:2763–2773.
9. Borio L, Inglesby T, Peters CJ, et al. Hemorrhagic fever viruses as biological weapon: medical and public health management. *JAMA*. 2002;287:2391–2405.