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Introduction: Electronic syndromic surveillance may have value in detecting emerging pathogens or a biological weapons release. Hospitals that have an agile process to evaluate chief complaints of patients seeking emergency care may be able to more quickly identify subtle changes in the community’s health. An easily adaptable prototype system was developed to monitor emergency department patient visits during the Kentucky Derby Festival in Louisville, Kentucky, from April 16–May 14, 2002. Use of the system was continued during the same festival periods in 2003 and 2004.

Method: Twelve area hospitals in Louisville, Kentucky, participated in a prospective analysis of the chief symptoms of patients who sought care in the emergency department during the Kentucky Derby Festival during 2002. Six hospitals were classified as computer record groups (CRG) and used their existing computerized record capabilities. The other 6 hospitals used a personal digital assistant (PDA) with customized software (PDA group). Data were evaluated by the health department epidemiologist using SaTScan, a modified version of a cancer cluster detection program, to look for clusters of cases above baseline over time and by Zip code.

Results: All 12 hospitals were able to collect and provide data elements during the study period. The 6 CRG hospitals were able to perform daily data transmission; however, 3 CRG hospitals were unable to interpret their data because it was transmitted in pure text format. In contrast, data from all 6 PDA group hospitals were interpretable. Real-time data analysis was compared with postevent data, and it was found that the real-time evaluation correctly identified no unusual disease activity during the study period.

Conclusions: The 12 hospitals participating in this study demonstrated that community-wide surveillance using computerized data was possible and that the 6 study hospitals using a PDA could quickly interpret emergency department patients’ chief complaints. The emergency department chief complaints group could serve as a disease sentinel for the community.
providers are re-evaluating current surveillance systems and response capabilities. These evaluations assist in identifying flexible and nontraditional ways of addressing the concerns raised about detecting potential acts of bioterrorism, as well as identifying manifestations of naturally occurring disease. Syndromic surveillance and an astute clinician’s observations enhance traditional disease surveillance and response.

Syndromic surveillance and an astute clinician’s observations enhance traditional disease surveillance and response.

The purpose of this article is to describe a process used in Louisville, Kentucky, to monitor community risk assessment during the Kentucky Derby Festival, a time when the area could have increased vulnerability to infectious disease threats. This particular time of year was deemed especially vulnerable given that it was a 2-week-long, multi-event festival with large local, regional, national, and international attendance and culminated with the televised running of the Kentucky Derby. No assessment of the community’s health during this event had been done, and city planners questioned whether a change in health could be detected.

The discussion offers an overview of the development and implementation of a community-wide syndromic surveillance with a focus on use of an alternative method that used the personal digital assistant (PDA) with customized software. The activities used to engage all participating hospitals and potential obstacles in attempting to use a “one program fits all” approach are described.

### Designing a Syndromic Surveillance System

In February 2002, the Medical Subcommittee of the Louisville Crisis Management Group began discussions to explore how syndromic surveillance might be utilized to assist the local public health department and the emergency management agency. The Group recognized that the Derby Festival is a large, multi-day, outdoor event that lasts 2 weeks, ending after the running of the Kentucky Derby horse race on the first Saturday in May. During the Festival, numerous outdoor events attract thousands of visitors. For example, “Thunder Over Louisville,” a large fireworks demonstration, attracts close to 500,000 persons, in addition to a large television audience. The large gatherings could provide a venue for significant disease transmission due to an emergent disease or an intentional release of a bioterrorism agent.

### Table. Clinical syndromes targeted for monitoring as syndromic surveillance

| Syndromic surveillance categories | Major symptom(s) |
|----------------------------------|------------------|
| Clinical area                    |                  |
| Cardiac                          | Chest pain       |
| Gastrointestinal                 | Vomiting/diarrhea|
| Infectious disease               | Fever with rash/myalgias|
| Neurologic                       | Seizure/paralysis|
| Psychiatric                      | Mental status changes/emotional instability|
| Respiratory                      | Difficulty breathing/shortness of air|
| Other                            | Trauma/wound/childbirth complications|

During March 2002, the staff of the Infection Control Department at the University of Louisville Hospital (IC/UL) worked under the direction of the Jefferson County Health Department (JCHD) to introduce community-wide syndromic surveillance to all area hospitals with emergency departments (EDs). The area’s 13 hospitals include community hospitals, a Veterans Affairs Medical Center, a pediatric hospital, and a university hospital that is the region’s only level I trauma center.

A surveillance plan, “BT Survey 2002,” was developed to collect daily data from participating hospitals from mid April through mid May, 2002. The data that were to be collected was representative of a full range of types of clinical syndromes that would be expected to occur following the release of various biologic or chemical agents (see Table). A total of 7 syndromic categories were used, including an “Other” category to include patients whose presentation did not match the other 6 specific syndromes. All patients who utilized EDs would have a recorded syndrome.

A surveillance plan, “BT Survey 2002,” was developed to collect daily data from participating hospitals.

Hospital participation was voluntary, and each hospital would be given the option of ongoing data collection. Data would be collected and forwarded to the JCHD for synthesis, analysis, and feedback. Three objectives were identified for the BT Survey 2002 project: (1) to determine if baseline demographic and syndromic data could be collected on patients accessing care in the EDs in the Louisville metropolitan area during the 4 weeks surrounding the Kentucky Derby; (2) to determine the feasibility of daily, community-wide syndromic surveillance during a nationally recognized annual event; and (3) to determine if a handheld
device, that is, a PDA, could provide a satisfactory method for data collection and transfer.

### Methods

Hospitals with EDs in the metropolitan Louisville, Kentucky, area were contacted by the project leaders (IC/UL) and were invited to participate in the project. They were asked to report basic demographic and syndromic data. They could use either their current computerized information system (referred to as computerized record group or CRG) or an alternative method for surveillance—a simple, inexpensive system that used a PDA (referred to as the PDA group or PDAG). The UL/IC personnel designed software for use with the PDA.

The data collection period began April 17, 2002, and ended May 15, 2002. The highlight of the festival, the running of the Kentucky Derby, occurred on May 4, 2002; therefore, surveillance was continued for 11 days following that highly publicized event. The extended time period would give the study the ability to evaluate the health of the community after an acceptable incubation period.

UL/IC personnel visited each participating hospital to identify key contacts, methods for initial and ongoing training, and information transfer processes. Site visits were done at least weekly at all 12 facilities during the 4-week data collection process.

### Key Contacts

The key contacts (eg, representatives from executive, information systems, emergency, and infection control departments) were used to promote ongoing communication and participation. The contacts at each hospital were compiled and distributed to all participants in an effort to form a cohesive group of participants.

### Training

The BT Survey 2002 project planners identified the need to conduct training at each participating hospital. Equipment needs, a training schedule, and a clearly defined implementation process were discussed.

Planners agreed that participants should be instructed in the purpose of syndromic surveillance, syndromic categories, and how surveillance activities could be supported within the current hospital processes. The processes of choosing a syndrome category at triage were reviewed with ED staff; however, efforts were made to minimize reporting bias while supporting the questions of the staff. The syndromic categories were not presented in any particular order and staff were instructed to use their clinical judgment and first impression regarding the reason they felt the patient presented to the emergency department.

Training occurred by demonstration, case study, and question/answer.

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The data collection process was reviewed with the designated ED representative and any additional staff that could attend a one-time meeting. The UL/IC personnel involved in the training process spent approximately 1 hour for each CRG hospital and 1 to 2 hours for each of the PDAG hospitals. The training needs for CRG hospitals were minimal because there was not a change in technology. The group meeting was used to familiarize staff with surveillance objectives and to engage them in the process.

Training for the PDAG personnel was more extensive because participants needed to be trained in the use of the PDA and the software. IC/UL personnel reviewed basic PDA operation, all software, and all applicable PDA capabilities with the designated staff. The hospital staff then assumed responsibility for all subsequent training using a train-the-trainer approach. IC/UL personnel also installed the accompanying PDA software in a personal computer in the ED of each
facility. Figure 1 shows the data entry screen used for each individual patient encounter. Figure 2 shows the clinical syndrome category choice list as seen on the PDA screen.

Each of the hospitals in the PDAG purchased a PDA, and document reader software and printing software were added. The total cost of the PDA hardware and software with these 2 additions was $250. In an effort to increase interest in PDA use, the PDAG hospitals also were given value-added elements that enhanced the information capabilities of a mobile unit. These additions included bioterrorism fact sheets from the Center for the Study of Emerging Infections and Bioterrorism, St Louis University (now the Institute for Bio-Security) and the 2001 edition of the US Army Medical Research Institute of Infectious Diseases Medical Management of Biological Casualties Handbook. The extra features were accessible through the preloaded document reader software (iSilo, DC & Co.). Printing software (PrintBoy, Bachmann Software, Sparta, NJ) also was loaded to enable the PDA user to beam the fact sheet to an infrared accessible printer for printing of a full-sized copy of the fact sheet. The added features were available only to the PDAG participating hospitals. Project organizers provided training for the beaming and printing capabilities by using demonstration, case study, question/answer, and a complete reference manual that was left on site.

Information Transfer Processes

Each hospital was evaluated for its information systems capabilities and ED registration or triage process. Participating hospitals were divided into 2 groups based on their chosen method of data collection: the CRG, which used a pre-existing, hospital-specific, computerized data collection system to collect and export data; or the group that would use a PDA (PDAG) and its associated database.

The surveillance project was designed so that data could be electronically transferred from each participating hospital to the JCHD every day. Hospitals that agreed to be in the PDAG were assessed for current technologic and software capabilities, such as hardware available for staff use, differing operating systems, and differences in versions of supporting software.

Results

Twelve of the 13 local Louisville and southern Indiana acute care hospital EDs agreed to participate. Those twelve hospitals consisted of one pediatric facility, one university trauma center, and 10 acute care facilities. One hospital declined to participate, citing concerns with unanticipated costs and a lack of desire to be part of the project. Data were received from all 12 hospitals during the course of the 4-week study, and 9 of the 12 hospitals submitted usable data (see Figure 3). Participation by hospitals varied during the 4-week project, with an average of 6 to 7 hospitals providing data on any given day. This variation was, in part, the result of variable compliance with data transmission on weekends. In both the PDAG and CRG groups, the category labeled “Other” was the most frequently assigned reason for accessing care at EDs. No obvious acute increases in ED utilization for a particular syndrome were identified during the study period.

Participation by hospitals varied during the 4-week project.

Six hospitals were designated as the CRG because they elected to use existing internal computerized patient record systems that would categorize patients’ presenting complaint. The CRG was further subdivided according to their ED triage process. Three of the 6 CRG hospitals performed some minor programming changes to allow triage personnel to select one of the syndromic categories during the patient’s initial ED assessment. This was not an additional requirement but, instead, involved a minor change in the available options for data entry. The other 3 CRG hospitals elected to report the patients’ chief complaints as they were routinely collected (ie, not in a syndromic category). Compliance with the
process was assessed weekly by the UL/IC staff, and contact with the Information Systems personnel was maintained throughout the project. During the 2002 project, participants were not mandated to complete all data fields. If no entry was done, it did not change or delay the triage process.

The Information Systems representative from the participating hospital worked with the IC/UL to determine the best mechanism for electronic transfer of the information files; the goal was to have files sent prior to 10 AM each day. The CRG hospitals used a process that sent files electronically directly to the JCHD 7 days a week. Three of the CRG hospitals were unable to group their ED patients into one of the identified syndromic categories, but data based on chief complaint was still forwarded to the JCHD for review. The PDAG hospitals required a system that would allow for the PDA database file to be downloaded and transferred. Test files were sent from all 12 hospitals to evaluate the process and make any necessary adjustments.

Data were sent via e-mail to the JCHD Medical Director of Communicable Disease Services and a JCHD epidemiologist. The JCHD personnel were responsible for the compilation and daily analysis of all data and for issuing regular feedback to all participating hospitals. Hospital-specific information, as requested by individual executives, was shared with each participating hospital throughout the project. The hospital infection control professional coordinated the internal monitoring process to ensure that all information was sent to the JCHD on a daily basis. The process needed to be performed 7 days a week throughout the data collection period. The infection control professional was viewed as the on-site project shepherd. Data were separated by hospital with all entries automatically time and date stamped by the BT Survey 2002 software for those in the PDAG. The CRG hospitals received information in individual, hospital-designed formats.

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Discussion

The study’s objectives were evaluated to determine if the surveillance systems were effective.

Ability to Capture Syndromic Data

The most complete data were submitted by hospitals using computerized records and having triage personnel assign the category at the time of patient assessment. Although the syndromic category field was not mandatory data during the 2002 project year, hospitals tended to be very compliant (i.e., reported more than 80%) with this data entry. The 3 CRG hospitals that did not use the syndromic categories at triage had data that were pertinent but not useable to facilitate any real-time analysis.
Feasibility of Collecting Daily Community-wide Syndromic Data

Data entry and transmission were performed by different categories of personnel at different hospitals. For example, in some hospitals, information was entered solely by registered nurses as part of the initial assessment process, whereas in other hospitals, unlicensed personnel who functioned as scribes at the ED triage desk entered the data. Training and feedback during training included methods to address inter-rater reliability using scenario and patient presentations.

Basic computer technologies and capabilities also differed between hospitals. Even hospitals within the same system demonstrated varying levels of capabilities both in terms of personnel, data, and technology. Each hospital had its own unique computer system that, as a general rule, did not communicate or interface with the systems at any other hospital. Standardizing data elements and transmission processes enabled the project to compare data between groups.

Hospitals demonstrated the ability to work together on a community-based project. They accepted the health department as the data repository because the individual hospital proprietary information (ie, number of ED patients, reasons for seeking care, Zip codes) was kept confidential. In addition, the health department was able to provide hospital-specific reports that reinforced the capabilities and value of their role in the process.

The financial costs of the project varied according to personnel time and equipment costs. IC/UL had the greatest labor cost because their staff were project leaders and actively involved at all 12 participating hospitals. Estimated total time required for the project averaged 20 hours per week for the IC/UL personnel.

CRG hospitals required no investment in equipment, but some labor time was involved in training ED staff on the syndromic categories and data entry. Three of the 6 CRG hospitals performed minor programming changes resulting in slight changes in data entered at the time of triage. This change involved the addition of one data field in the existing record used during the triage process and resulted in an increased data collection time of less than 15 seconds. Labor time by the individual hospital IS staff was incurred in setting up the information transmission process and monitoring compliance to ensure ongoing data transmission.

PDAG hospitals incurred a cost of less than $250 for the PDA and all associated software. Labor time involved approximately 15 seconds for each patient seen at the triage area. If an average of 100 patients were entered on an 8-hour shift and the time added was 15 seconds each, this would total an additional 25 minutes per shift. If the average wage of personnel time were $20 per hour, the 25 additional minutes would total less than $30 per day in personnel time expenses.

Satisfaction with Use of PDA with Data Collection

PDA data quality and quantity varied according to hospital and shift. During a review of the data with the PDAG hospital staff, comments were made indicating that the staff did not feel the data collection was important and, in some instances, “not worthy of their time.” Of note, data collection using the PDA required approximately 20 seconds for each patient entry by first-time users and 10 seconds for more experienced users.

Although the most complete data were submitted by the CRG, hospitals using the PDA demonstrated that this tool could be quickly installed, updated, and used with a very short learning curve for the end user. Project-specific software can be developed quickly and implemented in any hospital with minimal cost. This same methodology was used during the 2003 and 2004 Derby Festivals, demonstrating the ability to re-implement the simple surveillance system. The ability to use a PDA for other uses or in other settings is an important factor for determining value. PDA software was written and tested, PDAs and associated equipment purchased, and individual hospital contacts identified and educated within 1 week. Equipment costs were minimal for the CRG and less than $250 for the PDAG. The lack of expense and ease of use demonstrate that the PDAs are flexible for use in such a short period of time. The highest costs were associated with the labor involved, especially for the IC/UL staff.

As the need for community-wide data collection continues to grow, new applications of technology and software will be needed. The PDA was identified as a powerful and useful tool because it required minimal staff training and data entry time. Hospital personnel were able to learn and use the PDA system; however, this study found that they lacked consistency in reporting the data.

Conclusion

A prospective study was conducted to determine the ease and effectiveness of having ED staff collect
syndromic surveillance data. The participating hospitals could use their current internal computerized data collection systems or use a customized PDA system to report selected data to the county health department for analysis and monitoring. The costs, flexibility, reliability, and validity of data collected by each type of computer method were evaluated. It was concluded that data from EDs were a good source for collecting information about potential infectious disease outbreaks and that hospitals can work together and with their local health department for the good of the community.

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