New York City Syndromic Surveillance Systems

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Abstract

New York City's first syndromic surveillance systems were established in 1995 to detect outbreaks of waterborne illness. In 1998, daily monitoring of ambulance dispatch calls for influenza-like illness began. After the 2001 World Trade Center attacks, concern about biologic terrorism led to the development of surveillance systems to track chief complaints of patients reporting to emergency departments, over-the-counter and prescription pharmacy sales, and worker absenteeism. These systems have proved useful for detecting substantial citywide increases in common viral illnesses (e.g., influenza, norovirus, and rotavirus). However, the systems have not detected more contained outbreaks earlier than traditional surveillance. Future plans include monitoring school health and outpatient clinic visits, augmenting laboratory testing to confirm syndromic signals, and conducting evaluation studies to identify which of these systems will be continued for the long term.

Introduction

The New York City (NYC) Department of Health and Mental Hygiene (DOHMH) has conducted prospective surveillance of nonspecific health indicators (syndromes) since 1995. This paper briefly describes syndromic surveillance systems in operation.

Syndromic Surveillance Systems

Diarrheal Disease Surveillance

NYC's first syndromic surveillance systems were implemented in 1995 to detect substantial outbreaks of diarrheal illness, particularly those caused by waterborne *Cryptosporidium* and *Giardia*. The program included three components: 1) surveillance for diarrheal illness at nursing homes, 2) surveillance of stool submissions at clinical laboratories, and 3) over-the-counter (OTC) pharmacy sales. An evaluation of these systems conducted in 2001 recommended transition to electronic reporting and use of standardized analytic methodology to detect aberrations in the data (*1*). Lessons learned from this evaluation were incorporated into the design of subsequent systems.

Emergency Medical Services Ambulance Dispatch Calls

Monitoring of ambulance dispatch calls for indicators of biologic terrorism began in 1998. Approximately 1 million calls received annually by the NYC emergency medical services (EMS) system are categorized into 52 call types and entered into a centralized database. The main outcome of interest is the percentage of calls categorized as influenza-like illness (ILI), which includes four call types: respiratory, difficulty breathing, sick, and sick pediatric. An adaptation of the excess influenza mortality cyclical (linear) regression model (*2*) detects aberrations in this daily percentage citywide. The model controls for season, day of the week, holidays, positive influenza tests, and heat waves. Daily regressions with ≤3 years of baseline data have been performed since 1999 and have identified widespread influenza epidemics 2–3 weeks before traditional influenza surveillance systems (*3*). A review of 2,294 emergency department (ED) charts determined that patients brought in by ambulance were more likely to be older, more seriously ill, and admitted to the hospital than patients arriving by other means (*4*).

Emergency Department Visits

Syndromic surveillance of ED visits was established after the 2001 World Trade Center attacks to track the acute health effects of the attacks and to detect possible biologic terrorism (*5*). The initial labor-intensive system, which relied on manual data collection, was replaced in November 2001 by an electronic system that has operated daily since then. DOHMH receives data from 48 hospitals encompassing approximately 86% of annual ED visits in NYC. Data files contain the following information for all ED visits logged during the previous day: date and time of visit, age, sex, residential zip code, and free-text chief complaint. Certain hospitals also provide a visit number or medical-record number. Other personal

identifiers are not included. Files arrive via direct file transfer protocol (FTP) or as e-mail attachments. Data are converted to a standard format, and chief complaints are coded by syndrome by using a computer algorithm that searches for key text strings (available at http://www.syndromic.org/work.html). Citywide temporal and spatial clustering in syndrome visits, by hospital location or residential zip code, is assessed by using adaptations of temporal and spatial scan statistics (*6,7*). Results are usually available before noon each day (including weekends). If an unusual cluster is detected, follow-up is conducted the same day. Follow-up involves reviewing the age, sex, and chief complaints of patients in the cluster and telephoning staff at affected EDs to alert them of the cluster and ask whether they have noted unusual presentations or higher-than-usual volume. When necessary, field investigations are conducted. A review of the methods and first year of operation of the ED surveillance system has been published previously (*8*).

Retail Pharmacy Sales

In August 2002, DOHMH established a comprehensive OTC pharmacy sales tracking system. Data from 248 NYC pharmacies (representing approximately 30% of citywide sales) are transmitted to DOHMH daily by FTP from a central pharmacy database and consist of the number of OTC units sold the previous day, grouped by drug name and store. The two syndromes monitored routinely are ILI, which includes cough and influenza medications whose sales correlate most strongly with annual influenza epidemics, and antidiarrheal medicines, including generic and brand-name loperamide. Citywide trends are evaluated by using a linear regression model similar to that used in the EMS system (*3*), controlling for season, holidays, day of the week, promotional sales, positive influenza tests, and temperature. Analysis is conducted weekdays only, with results for the preceding day available by mid-afternoon. In May 2003, DOHMH began receiving OTC pharmacy sales data from the National Retail Data Monitor (*9*).

Worker Absenteeism

Since November 2001, DOHMH has monitored worker absenteeism from a single employer (employee population: approximately 15,000) with multiple locations throughout the city for unusual patterns of illness. The workers' reasons for absence are categorized by a computer algorithm into three syndrome categories: fever/influenza, gastrointestinal, and cold (upper respiratory infection). Agencywide trends are graphed and temporal aberrations assessed by using the cumulative sum (CUSUM) method (*10*) with a 14-day baseline. Analysis is conducted weekdays only, and results for the previous day are usually available by mid-afternoon.

Staffing for Syndromic Surveillance Systems

With exceptions as noted, these systems operate 7 days/week and are staffed by a rotation of eight analysts and five medical epidemiologists. Each day an analyst with master's- or doctoral-level training in public health and statistical software programming experience dedicates 2–3 hours to collect, process, and analyze data and disseminate results. A medical epidemiologist reviews the results daily and, when indicated, directs an investigation with assistance from a public health nurse or field epidemiologist. Approximately 30 additional DOHMH public health epidemiologists and nurses have been trained to assist in signal investigations but have rarely been used. Hospital staff are occasionally enlisted to provide information on patients, perform diagnostic testing on subsequent patients, and assist with other aspects of an investigation. Annual direct costs to DOHMH to maintain the existing systems, including routine follow-up of signals, are approximately $150,000 (not including costs associated with research and development, surveillance for noninfectious disease, or data-transmission costs incurred by hospitals).

Usefulness

Syndromic surveillance has been most useful for detecting citywide increases in illness. Syndromic data have been used to augment health alerts for communitywide gastrointestinal illness caused by norovirus (*11*), annual influenza epidemics, and diarrheal illness following the August 2003 blackout (*12*). Although DOHMH has observed an average of two spatial signals per month for each syndrome, to date none has led to early detection of a localized outbreak. The occurrence of simultaneous signals for the same syndrome from multiple systems has been rare. Experience indicates that ED surveillance has the greatest value because it can track multiple illnesses and enable follow-up with individual patients at the source of care.

Future Projects

DOHMH is developing data sources and testing new analytic methods for outbreak detection. Data sources being explored include school health nurse visits, laboratory-order submissions, and outpatient encounters. Promising methodologic advances include the space-time–permutation method (*13*) and

the use of regression modeling to adjust for known sources of variation before calculating scan or CUSUM statistics. DOHMH continues to explore how syndromic data can be used for general public health surveillance (e.g., detecting carbon monoxide poisonings or examining the impact of smoking legislation on nicotine replacement sales [*14*]).

Conclusion

Syndromic surveillance is one component of overall disease-surveillance and terrorism-preparedness efforts. Formal evaluations will help DOHMH determine which of the current systems will become a permanent public health surveillance activity in NYC.

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