Integration of Syndromic Surveillance Data into Public Health Practice at State and Local Levels in North Carolina

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ABSTRACT

Objectives. We sought to describe the integration of syndromic surveillance data into daily surveillance practice at local health departments (LHDs) and make recommendations for the effective integration of syndromic and reportable disease data for public health use.

Methods. Structured interviews were conducted with local health directors and communicable disease nursing staff from a stratified random sample of LHDs from May through September 2009. Interviews captured information on direct access to the North Carolina syndromic surveillance system and on the use of syndromic surveillance information for outbreak management, program management, and the creation of reports. We analyzed syndromic surveillance system data to assess the number of signals resulting in a public health response.

Results. Syndromic surveillance data were used for outbreak investigation (19% of respondents) and program management and report writing (43% of respondents); a minority reported use of both syndromic and reportable disease data for these purposes (15% and 23%, respectively). Receiving data from frequent system users was associated with using data for these purposes (p=0.016 and p=0.033, respectively, for syndromic and reportable disease data). A small proportion of signals (<25%) resulted in a public health response.

Conclusions. Use of syndromic surveillance data by North Carolina local public health authorities resulted in meaningful public health action, including both case investigation and program management. While useful, the syndromic surveillance data system was oriented toward sensitivity rather than efficiency. Successful incorporation of new surveillance data is likely to require systems that are oriented toward efficiency.

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Effective use of surveillance data is essential to good public health practice. In recent years, public health agencies have experienced a significant increase in the amount of data available for surveillance (e.g., data used for syndromic surveillance), and this increase is likely to continue. For example, the federal Health Information Technology for Economic and Clinical Health Act (HITECH Act) supports forwarding medical record data to public health agencies. Published work demonstrates that better data are needed for communicable disease surveillance; communicable disease reporting is not complete,[1] and many cases are reported later than is necessary for public health action.[2] While the medical record data that may be provided to public health have the potential to improve completeness and timeliness, these datasets are likely to have many records that are not usable for public health purposes.[3] Furthermore, limited staff are available to review these data.[4,5] Effective use of these new data for public health surveillance will require efficient identification of and access to the usable data elements present in new datasets.

The implementation of syndromic surveillance is an example of the incorporation of new data sources. Syndromic surveillance systems were established to facilitate early detection of events requiring a rapid response, such as outbreaks caused by bioterrorism agents. Events that may require public health intervention are identified using aberration detection algorithms and individual record review. Most states have a system of this type,[6] and their value for public health event detection and characterization has been demonstrated.[6–10] Lessons learned from attempts to integrate syndromic data for public health surveillance and response can inform future management of new data.

While syndromic surveillance data can be valuable to public health practice, the design of these systems frequently limits their use to jurisdictions with greater capacity. Alerts created by system algorithms are often of low positive predictive value,[11,12] and these systems can require a high level of staff time for detecting events that require public health action.[8] Therefore, syndromic surveillance data are most commonly used by state and large city public health departments that have enough staff time for reviewing alerts and individual case records.[6,13,14] Although these data can be useful to health departments of all sizes, little is known about how best to make these data usable in situations with limited surveillance staff. The use of syndromic surveillance data in smaller population settings, such as most local health departments (LHDs), has not been described.

North Carolina can provide an example of the integration of syndromic surveillance data into public health surveillance practice. Current electronic surveillance for communicable disease in the state includes a population-based syndromic surveillance system, the North Carolina Disease Event Tracking and Epidemiologic Collection Tool (NC DETECT), and a population-based reportable communicable disease surveillance system, the North Carolina Electronic Disease Surveillance System (NC EDSS). Both syndromic and reportable disease data have been used for public health surveillance since 2006. NC DETECT use is the responsibility of syndromic surveillance staff, which includes two state-level epidemiologists and 11 hospital-based epidemiologists. All other public health agency staff may use NC DETECT. NC EDSS use is required for and restricted to staff responsible for communicable disease reporting at state and local levels.

The objectives of this study were to quantitatively assess the use of syndromic surveillance data at state and local public health agencies in North Carolina, to describe how syndromic surveillance is incorporated into public health practice in the state, and to make recommendations for the effective integration of syndromic and reportable disease data for public health use.

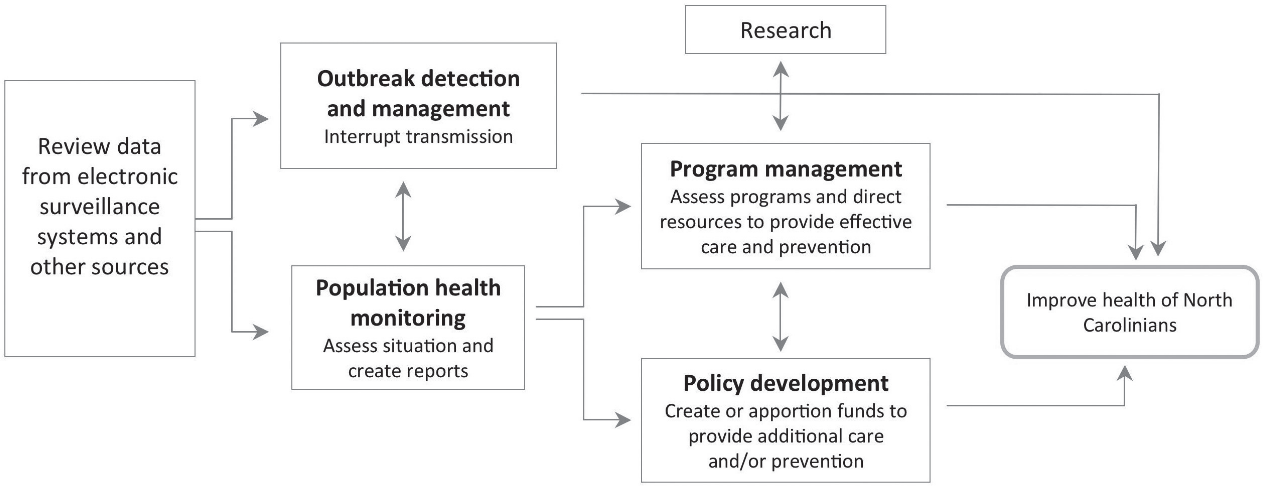
METHODS

Outcome measures for surveillance data use were derived from a logic model of public health surveillance (Figure 1). Measures of syndromic surveillance data use included (*1*) the proportion of syndromic surveillance signals used for public health action (defined as steps taken by public health staff to investigate or report on population health events); and (*2*) the proportion of surveillance data users using syndromic surveillance information for outbreak investigation, policy development and program management, and the creation of reports for stakeholders. The measure of combined syndromic and reportable disease data use was the proportion of users reporting use of both syndromic and reportable disease information for these purposes. Published guidelines on surveillance system evaluation were consulted for this assessment.[15–17]

System data analysis

We examined NC DETECT system data from January to December 2009 to assess the proportion of syndromic surveillance data resulting in public health action. The NC DETECT system captures data from emergency departments (EDs; visit records), the Carolinas Poison Center (CPC; poison control center call records),

Figure 1. Logic model describing public health surveillance data use in North Carolina



and the North Carolina Prehospital Medical Information System (PreMIS; emergency medical service run reports). PreMIS data were not used for public health surveillance during the period of this study.

NC DETECT uses algorithm processing to identify dates when the number of cases of a given "syndrome" (a combination of symptoms, such as fever with rash) is higher than comparison data for previous time periods.[18,19] These dates, with the number of syndrome cases and links to the case records, are listed in a database as signals that are reviewable by public health staff. A system variable can be used to record action taken by system users. By default, the variable indicates "not yet documented." After reviewing a signal, syndromic surveillance staff members use this variable to indicate the level of action taken (e.g., active investigation, monitoring, investigation completed, or no action needed). In the rare instances of LHD staff reviewing signals, this variable is generally not used. This action-level variable allows staff to assess the number of signals meriting public health action by syndromic surveillance staff.

We quantified the proportion of signals at each action level, as well as the proportion of signals not reviewed (i.e., signals where the action-level variable still indicated "not yet documented"). We classified signals labeled "active investigation," "monitoring," and "investigation completed" as signals meriting public health action. The types of public health action performed were captured in free-text comments appended to the signal record by syndromic surveillance staff.

Survey

A survey was conducted from May through September 2009 to gather information on how the NC DETECT system and syndromic surveillance data are used at state and local levels. Information was collected on whether respondents used NC DETECT (direct access) and whether respondents received NC DETECT case records and/or reports from others (indirect access). In addition, information was gathered about two outbreak investigations: a respondent-selected outbreak investigation from the past year (June 2008 to May 2009) and the 2009 H1N1 influenza outbreak (May to August 2009). The survey included questions on how respondents were alerted to events of public health significance, how such events were monitored, and whether NC DETECT and NC EDSS information was used for the outbreak investigations, program management and policy development, and report writing.

The survey population included public health agency staff responsible for surveillance, event response, and program management and policy development. All epidemiologists in the state division of public health communicable disease branch, as well as epidemiologists from other groups with the potential to use data captured by NC DETECT (e.g., an asthma epidemiologist), were invited to participate. The 85 LHDs were stratified by population, and one very large LHD (population >200,000), seven large LHDs (population 53,377–200,000), and seven small LHDs (population <53,377) were randomly selected. The LHD director and a communicable disease nurse

(CD nurse) from each LHD were invited to participate. In all, 48 individuals (18 from state-level health departments and 30 from LHDs) were invited to participate. This sample did not include the hospital-based public health epidemiologists who do not have responsibility for program management and policy development. Two project staff administered the survey via face-to-face interviews and by telephone when face-to-face interviews were not possible.

To examine user characteristics and uses of syndromic surveillance data, proportions were calculated and compared; because of small cell sizes, we used Fisher's exact test and odds ratios (ORs) to assess associations. All quantitative data analysis was performed using SAS® version 9.1.[20] Because responses to questions on program management, policy development, and report writing were similar, we grouped these results for analysis and identified them as program management and report writing. We limited our analysis of the combined use of syndromic and reportable surveillance data to state epidemiologists and local CD nurse staff, who routinely have access to both types of data. (State-level chronic disease, environmental, and injury epidemiologists did not have access to NC EDSS at the time of the survey. In general, LHD directors did not use NC EDSS or NC DETECT.)

RESULTS

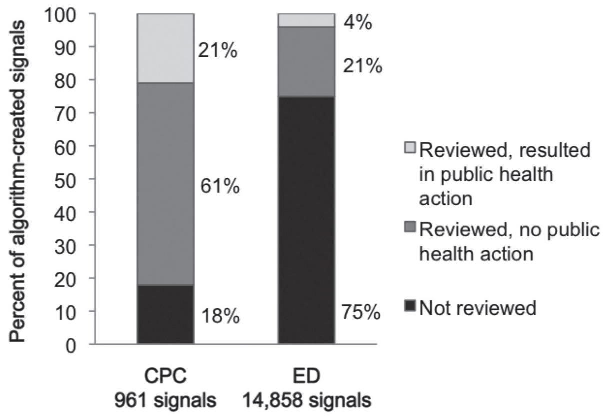
System data analysis

Between January and December 2009, 961 signals were generated from CPC data and 14,858 signals were generated from ED data. Of the signals from CPC data, 788 (82%) were reviewed, and 199 (21%) resulted in action by public health staff (Figure 2). Of the signals from ED data, 3,715 (25%) were reviewed, and 600 (4%) resulted in action by public health staff. Public health action resulting from signal review included calls to LHDs, other health agencies, and hospitals; participation in investigations; and calls to organizations potentially involved in an outbreak. The majority of ED signals (n=11,143; 75%) and a minority of CPC signals (n=173, 18%) were not reviewed.

Survey

Forty-four of 48 invitees participated in the survey interview (response rate = 92%). The final survey population included 17 state-level staff (epidemiologists and public health nurses responsible for communicable disease, tuberculosis, immunization, environmental epidemiology, chronic disease, injury, surveillance, and preparedness) and 27 staff from 14 LHDs (14 directors and 13 CD nurses).

Figure 2. Proportion of NC DETECT signals reviewed and acted upon by public health staff, January–December 2009



NC DETECT = North Carolina Disease Event Tracking and Epidemiologic Collection Tool

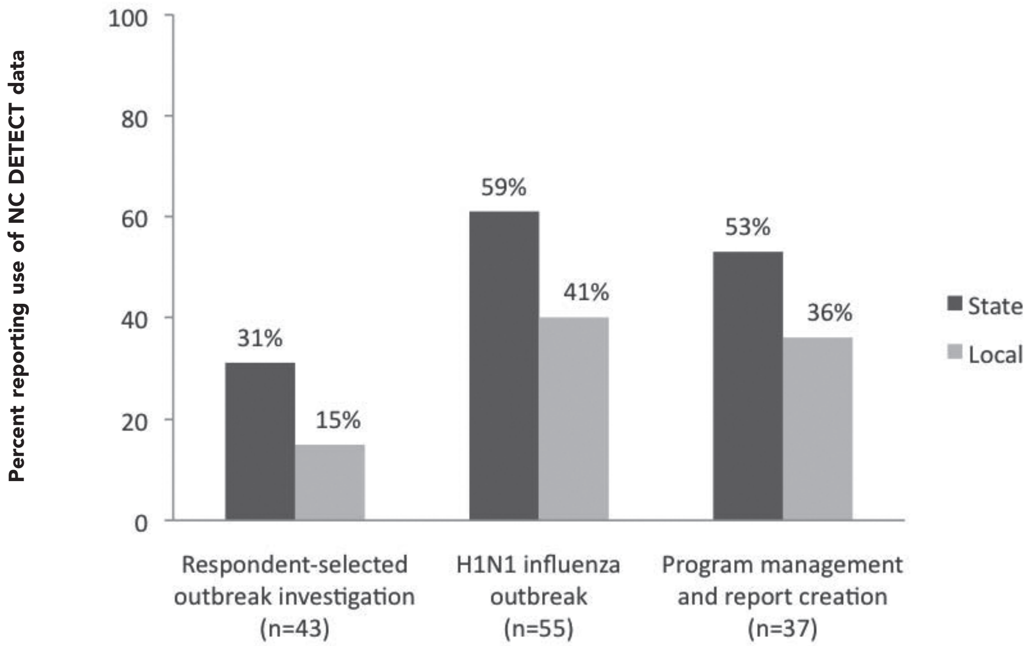
CPC = Carolinas Poison Control

ED = emergency department

Syndromic surveillance data were used for outbreak investigation, program management, and report writing by both state- and local-level public health staff. Among 13 state-level staff participating in an investigation in the past year, 31% (four of 13) reported using NC DETECT data for outbreak investigation (Figure 3). Among LHD staff, 15% (four of 27) reported using these data for outbreak investigation. The proportion of respondents that reported using NC DETECT data for management of the H1N1 influenza outbreak was higher: 59% (10 of 17) among state staff and 41% (11 of 27) among local staff. Among 15 state-level staff participating in program management, eight (53%) reported using NC DETECT data for program management and report writing. Among 22 LHD staff participating in program management, 36% (eight of 22) reported using NC DETECT data for program management and report writing (Figure 3).

Survey respondents reported on their access to NC DETECT in the 12 months preceding the survey. Among the 43 respondents, modes of access included: none (n=11), direct only (i.e., respondent used NC DETECT; n=5), indirect only (i.e., respondent received information from a user of NC DETECT; n=15), or both direct and indirect (n=12). Respondents reporting indirect access received case records and/or reports from syndromic surveillance staff (including public health epidemiologists), other state staff, and/or hospital staff. Having indirect access to NC DETECT during the 12 months prior to the survey was associated with

Figure 3. Proportion of survey respondents using NC DETECT data for public health surveillance activities: North Carolina, June 2008 to June 2009



NC DETECT = North Carolina Disease Event Tracking and Epidemiologic Collection Tool

use of NC DETECT data during an outbreak (Figure 4; $p=0.016$, OR not calculable); respondents without indirect access (whether or not they had direct access) did not report using NC DETECT data for outbreak investigation. Having indirect access to NC DETECT was also associated with the use of syndromic surveillance data for program management and report writing (OR=7.15, 95% confidence interval [CI] 1.3, 39.8). Respondents with both direct and indirect access most frequently reported use of NC DETECT data and information for outbreak investigation, program management, and report writing.

Most state and local communicable disease staff members can create user accounts for both NC DETECT and NC EDSS. Among 13 state-level staff who could use both systems, five (38%) reported having user accounts and using both, while three (23%) LHD CD nurses reported using both (Figure 5). A minority of respondents used data (accessed directly or indirectly) from both systems: four of 26 (15%) staff reported using data from both systems for the respondent-selected outbreak investigation and six of 26 (23%) reported using data from both systems for program management and report writing. However, a higher proportion (14/26; 54%) reported using data from both systems during the H1N1 influenza outbreak (data not shown).

DISCUSSION

The routine use of syndromic surveillance data by North Carolina state and local public health authorities resulted in meaningful public health action, including both case investigation and program management. Employees at state health departments and LHDs used syndromic surveillance data both for the originally envisioned purpose of syndromic surveillance (early event detection) and for traditional public health practice. Therefore, this new data source has been incorporated into daily surveillance practice in North Carolina and is used for key public health purposes across the state.

Although syndromic surveillance data are used for public health action, the observed association between indirect access and data use suggests that a dedicated staff is required to filter the data to identify events requiring action. This association is addressed at the state level in North Carolina by assigning responsibility for filtering to syndromic surveillance staff. However, because this small staff cannot review all ED data signals, only a subset of signals is reviewed. Because limited staff are available for public health surveillance and epidemiology,[4,5] it is unrealistic to expect this filtering to be performed at the local level. During the H1N1 outbreak, a small number of additional personnel were recruited to send weekly H1N1 influenza

Figure 4. Use of NC DETECT data for respondent-selected outbreak investigation, program management, and report writing, by access mode: North Carolina, 2009

[a]Respondent used NC DETECT

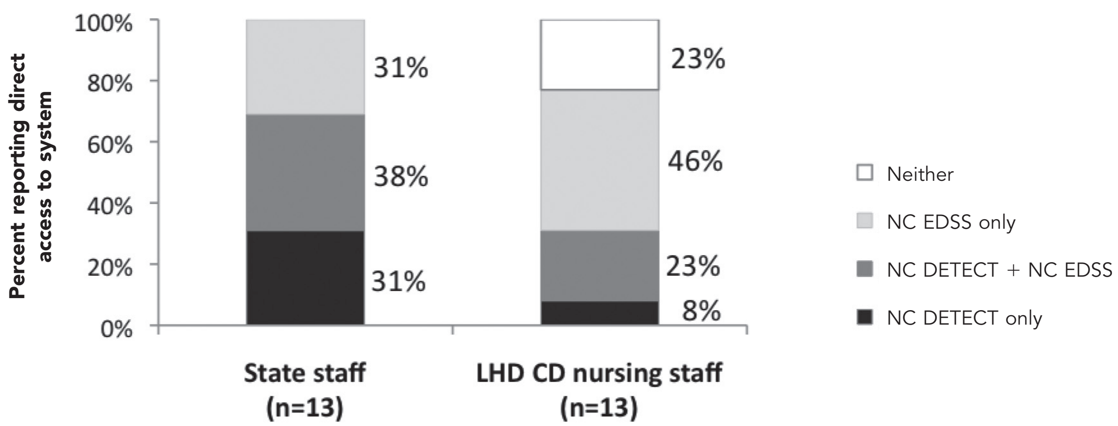
[b]Respondent received NC DETECT data or information from a user of NC DETECT

NC DETECT = North Carolina Disease Event Tracking and Epidemiologic Collection Tool

reports including syndromic surveillance information to all LHDs, and reported use of syndromic surveillance information increased. This finding supports the conclusion that the use of syndromic surveillance information is limited by the number of staff available to distribute it.

Although syndromic surveillance information has been integrated into public health practice at the state level and in some LHDs, the majority of public health staff in North Carolina does not routinely integrate NC DETECT and NC EDSS data for outbreak investigation, program management, or report writing. The syndromic surveillance staff does not have permission to access NC EDSS, so they cannot use NC EDSS data

Figure 5. Direct access to syndromic and reportable disease surveillance systems among staff members with potential access to both systems (*n*=26): North Carolina, 2009



NC EDSS = North Carolina Electronic Disease Surveillance System

NC DETECT = North Carolina Disease Event Tracking and Epidemiologic Collection Tool

LHD = local health department

CD = communicable disease

for context when NC DETECT data are forwarded; and local staff responsible for reportable diseases do not access NC DETECT because it is not structured for their effective use. To have the most complete information on the epidemiology of diseases in North Carolina and the outbreaks affecting the population, public health staff would use data from both NC DETECT and NC EDSS.

Limitations

Although this study provides novel information on the use of traditional and new communicable disease surveillance systems, it was subject to several important limitations. While syndromic surveillance personnel conduct most signal review, a small number of others review signals but do not use the action-level variable. Therefore, the number of signals with an action-level change captured by the NC DETECT system represents a minimum estimate of the proportion investigated. Information captured on the use of syndromic and reportable disease data for program and report writing purposes was captured only as yes/no. This question could not differentiate between relatively simplistic use of syndromic surveillance data (e.g., inclusion of syndromic surveillance data in one or several reports) and real incorporation of this information into program development and report writing (e.g., ongoing observation of the number of syndrome cases in the jurisdiction EDs and inclusion of these numbers in reports and program planning discussions). Interviews were performed face to face; as such, respondents may have reported using surveillance data systems more frequently than they normally do, resulting in social desirability bias and an overestimation of NC DETECT and NC EDSS use.

Recommendations

We suggest three strategies to support broader use of syndromic surveillance and other new data. The first is to develop algorithms for syndromic surveillance based on actionability. Our findings and others[8,11,21] show that the proportion of signals requiring public health action is very small. New algorithms could be developed based on the signals that have resulted in public health action historically, with the goal of identifying similar signals. Because these signals are a small proportion of current signals, the total number of signals generated by the modified algorithms should be smaller. A higher proportion of signals created by these new algorithms should merit action by public health staff. The importance of including actionability in creating syndromes is highlighted in work on syndromic surveillance systems across the United States.[13,18,19] Decreasing the number of non-actionable signals to investigate could decrease the time needed to review syndromic surveillance data.

Second, the group of users directly accessing syndromic surveillance data and reports could be broadened. This broadening could be supported by Web portals designed for users at different levels. Regional and/or local-level portals could be designed, including maps and reports oriented toward local/regional public health action. These reports could include aggregated infectious and/or chronic disease data that are useful for disease reporting, local program management, and report writing; current syndrome signals could also be added if desired. These approaches could also be combined, thereby strengthening syndromic surveillance data algorithms while making the data more accessible via efficient Web portals.

Third, NC DETECT and NC EDSS could be designed to look similar and be accessed by the user from a single website. Currently, the syndromic and reportable disease surveillance systems in North Carolina have a different visual organization and design. The use of similar icons would facilitate moving from one system to the other; graphs and charts could be labeled similarly. The systems could be designed to exchange data electronically; for example, when a pertussis outbreak event is created in NC EDSS, data on the number of cases presenting to the ED with signs and symptoms characteristic of pertussis could be provided in a pop-up box. Design similarity and interoperability could support more effective surveillance data integration.

CONCLUSIONS

Research has demonstrated that syndromic surveillance data are valuable to national public health practice. Syndromic surveillance systems hold large amounts of data that can go unused, and this is also a potential issue with new types of data. Unless budgets for surveillance are significantly increased, developing computer systems that facilitate the management of these growing data pools will be essential. The focus must be on making review and use of new data efficient, rather than on system sensitivity for rare events. Technology should be used to support public health surveillance practice, providing usable data while allowing increased sensitivity if desired. Future research should include the development of syndromes based on data on public health actionability, and organizational protocols should be developed to support state and local access to important surveillance data.

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