Chapter 7: Integrating Ontario's Telehealth program into a provide-wide public health surveillance system: Evaluation and Recommendations

Introduction

Public health surveillance requirements in Ontario are mandated by the Ontario Health Protection and Promotion Act. This mandate includes the development and maintenance of reportable disease lists (including case definitions) as well as adherence to reporting standards (which includes prospective surveillance of health events).

Events such as Walkerton and, to a larger extent SARS, forced Ontario to realize that its disease surveillance infrastructure was inadequate and prone to collapse in times of surge capacity[1-3]. Much of the government-mandated literature on SARS suggests a number of strategies to address the shortcomings that were brought to the spotlight during SARS. It is clear that completely overhauling the disease surveillance infrastructure in Ontario is neither realistic nor necessary – for example, case definitions used by the province's system were never an issue of contention. However, the ease of communication between levels of government within the province (e.g. regional versus provincial) as well as the delay in reporting of diseases were and continue to be a significant issue.

The SARS Report is most vocal in stating that that the failures in public health surge capacity could be potentially addressed by "hav[ing] a well-developed system for real-time data sharing and reporting, and for the rapid dissemination of surveillance information" [4]. In particular, the report mentions the potential to "broaden the information collection capacity of Telehealth as a syndromic surveillance tool" [4]. In fact, the notion to use Telehealth as an early-warning system predates SARS and the recommendations that followed it. In 2002, Hogenbirk *et al*. conducted an evaluation of the pilot implementation of Telehealth in Ontario. In this evaluation, the authors suggest that "…teletriage services could be used for surveillance purposes such as the monitoring of infectious diseases, environmental health hazards such as toxic spills and even bio-terrorism."[5]

In an effort to build upon these suggestions, funding from Physicians Services Inc. was secured in 2005 to investigate and evaluate the utility of data collected through Ontario's Telehealth program as a potential component of a comprehensive early-warning system for the province. There are very few Ontario-wide health utilization databases that could conceivably contribute to a near real-time surveillance system. The basic approach taken in this study was to (1) investigate the utility of Telehealth data for surveillance early outbreak detection by comparing it to more traditional sources of health data (eg., emergency room visits and laboratory confirmations), and (2) to assess the feasibility of integrating Telehealth data into a province-wide real-time surveillance system. Two years of Telehealth data (July 1, 2004 to June 30, 2006) were provided and used in this investigation and a series of studies were conducted. In this chapter, the Telehealth program and results from the previous chapters (Chapters 1-7) are reviewed in the contents of CDC's *Framework for evaluating Public Health Surveillance Systems for Early Detection of Outbreaks*[6].

Methods

Investigation of Ontario's Telehealth program as a potential contributor of data to a province-wide early-warning surveillance system was based on the CDC's *Framework for evaluating Public Health Surveillance Systems for Early Detection of Outbreaks*[6]. This framework was originally developed following the publication in 2004 of an evaluation of the usefulness of 35 bioterrorism surveillance systems. The majority of these evaluations were of very poor quality and incomplete[7,8]. These guidelines were subsequently developed to supplement existing CDC guidelines to evaluate public health surveillance systems[9] specifically for syndromic surveillance systems. As the CDC framework was designed for the evaluation of mature and fully operational surveillance systems[10], it was necessary to modify the approach in our study. As the study consisted of evaluating retrospective data, and not data feeding real-time into a surveillance platform (e.g. RODS, ESSENCE, etc), the focus of the evaluation was (1) investigating if the data themselves are of value for surveillance and early outbreak detection, and (2) assessing the feasibility of integrating Telehealth data into a province-wide real-time surveillance system.

Telehealth program description

Details of the overall Telehealth program were obtained by reviewing key documentation and by consulting with key stakeholders. Understanding how data are currently collected, manipulated, and stored was key to assessing their utility towards a potential province-wide surveillance and early warning system. A detailed description of the Telehealth program has been provided elsewhere (Chapters 2 and 3). Presented here are key elements relevant to the surveillance evaluation.

Surveillance and outbreak detection capacity of Telehealth data

Telehealth data surveillance and outbreak detection capacity was evaluated by assessing the temporal and temporal-spatial relationships between Telehealth data and datasets associated with two independent programs, the National Ambulatory Care Reporting System (NACRS) and the national FluWatch program. Two illness groups were the focus of the evaluation, acute respiratory and gastro-intestinal associated conditions. Analyses methods and results have been presented and discussed in detailed elsewhere (Chapers 3, 4, 6). Presented here are key elements relevant to the evaluation.

Temporal investigation: Briefly, Telehealth, NACRS, and FluWatch data were compared by fitting time-series models and estimating correlations at different lags. Data sets were transformed and detrended by differencing. Autoregressive moving average models were fitted to the differenced series to ensure the residuals were white noise. The autocorrelation and partial autocorrelation functions of the models were examined to determine autoregressive and moving average characteristics. Residuals were checked for normality against the fitted values, and checked for white noise by the Portmanteau test. To test for cross-correlations, Spearman rank tests were performed. The cross-correlations were estimated for residuals (to account for seasonality and trends) at different lags.

Temporal-spatial investigation: Respiratory related emergency room visits (NACRS database) and Telehealth calls were geocoded to Ontario public health unit as previously described (Chapter 5). Public health unit Telehealth call intensity adjusted rates were compared to public unit health emergency room visit intensity adjusted rates over two influenza seasons (October 31, 2004 to April 30, 2005; December 11, 2005 to May 27, 2006) by generating weekly maps.

Technical feasibility of a province-wide real-time surveillance system

The Telehealth program and data were evaluated from a technical perspective for ease of integration into a province-wide real-time surveillance system.

Results & Discussion

Telehealth program description

The Ontario Telehealth Telephone Helpline was first implemented in Ontario in 2001. It was initiated as a pilot study, which included the Greater Toronto area (416 and 905 calling areas), as well as the Northern area of Ontario (705 calling area). The Northern Pilot was subsequently evaluated and results suggested that the program may have contributed to decreased visits to emergency departments[11]. One of the original goals of Telehealth was to “lead to more appropriate use of emergency departments” [12].

The program was expanded province-wide at the end of 2001, and has been administered by Clinidata since then, a private contractor hired by the Ontario Ministry of Health and Long-Term Care. The helpline is available 24 hours a day, 7 days a week, including holidays, at no cost to the caller. The calls are answered by registered nurses who are required to have multiple years of clinical experience prior to their involvement with Telehealth. Although calls are primarily answered in both official languages (English and French), the system has the capability of responding to calls in 110 different languages within 60 seconds (with the help of translators in a three-way calling setup) [13].

Calls are handled by four calling centres that use identical decision rules (algorithms) and store all call information into one centralized data repository. The calls are usually approximately 10-minutes, patient based, and are directed by trained nurses who use an electronic clinical support system that can be used to provide either clinical guidelines (approved by a panel of clinicians), health information, care information, and a health care referral system. All calls are classified as a health information call, a referral call, or a symptom call. All symptom calls are triaged using a decision tree, which leads to one out of a possible 440 algorithms. Depending on the final algorithm and/or the severity of the patient’s condition, a disposition is assigned to each call: Information call (calls initially coded as symptom calls, but where no care is recommended); Community service; 911 Ambulance/Dispatch; ED (Guideline directed); ED (No alternative); Pharma; Physician reference; Poison control; Self-care; Other health care provider; Other.

Surveillance and outbreak detection capacity of Telehealth data

Traditionally, a syndromic surveillance system’s aptitude at accurately predicting aberrations is determined by measuring its sensitivity, specificity and positive predictive value. According to Doroshenko [14], in the context of syndromic surveillance, this is difficult to achieve. The unit of analysis is the detection of an outbreak or trend, but not an individual illness. Such a detection is frequently based on drawing information from various sources and ultimately on professional judgment. The standard needed for calculations is rarely available and frequently represents a variable itself. Another approach is to determine the correlation between data derived from different surveillance (and related) systems. Consequently, we also opted to use a comparative approach to evaluate the surveillance utility of Telehealth data. Detailed results are provided in previous chapters. Summary results are presented here.

When considered on a province-wide basis, weekly Telehealth call volumes relating to respiratory conditions closely reflect weekly emergency department visit volumes associated with respiratory conditions and Ontario influenza data derived from the national FluWatch program. When considered on a province-wide basis, weekly Telehealth call volumes relating to gastrointestinal conditions closely reflect weekly emergency department visit volumes associated with gastrointestinal conditions.

Time-series analysis comparing NACRS emergency department respiratory associated complaints and Telehealth Ontario respiratory associated calls demonstrated very good correlation (0.93; P-value < 0.0001) at a lag of 0 weeks. Comparing Telehealth Ontario call volume and weekly respiratory virus isolations also showed good correlation at 0.84 ($p<0.0001$) at a lag of 0 weeks. Furthermore, statistically significant cross correlations of were found up to lag 3 weeks suggesting that rises in calls to Telehealth Ontario for respiratory-related illnesses may precede laboratory confirmed data of influenza A and B by as much as 3 weeks.

Time-series analysis comparing NACRS emergency department gastrointestinal associated complaints and Telehealth Ontario gastrointestinal associated calls demonstrated very good correlation (0.90; P-value < 0.0001) at a lag of 0 weeks.

Stratification of weekly NACRS and Telehealth respiratory data by public health unit demonstrated considerable consistency in volume trends when mapped over the 2004-05 and 2005-06 influenza season. Results thus suggest that Telehealth data could be potentially used not only for provincial surveillance, but also for local surveillance. The restriction of the geographic coding of released data to 3-digit postal codes (FSAs) forced the introduction of estimation techniques in generating PHU counts for Telehealth Ontario calls. While reasonably robust, any such estimates require assumptions about local distribution of calls which are not easily testable. It would be useful to explore ways of releasing more detailed geocodes (such as 6-digit postal codes or coding to Statistics Canada Dissemination Areas) while maintaining appropriate protection of individual privacy. This would be an important step if links to other resources such as local socio-economic and demographic profiles available from the Census were desired for further analysis of factors affecting the spread of epidemics.

Although additional refined analyses are needed to further investigate the surveillance capacity of Telehealth data (eg. stratification by age group and other socio-demographic characteristics, and the examination of other syndromes), the analyses conducted to date strongly suggest that Telehealth call volume is a very good proxy for population level acute respiratory and gastrointestinal activity both temporally and spatially. Results also suggest that Telehealth respiratory activity may be a good early warning for Influenza activity.

Technical feasibility of a province-wide real-time surveillance system

Although only a preliminary assessment, it appears that Telehealth data can be easily integrated into a real-time surveillance system (eg RODS, ESSENCE, etc) with minimal effort. Described below are the basic steps that would be required to integrate Telehealth data into a real-time surveillance system:

(1) The development of a simple interface to pull data from the central Teleheatlh database at regular intervals.

- Databases have the same basic design and all that is needed is the right ‘select’ statements to pull data from the provincial database and script/code to format data into HL7.
- Data would be anonymized and all personal identifiable information would be removed prior to transmission.

(2) Establishment of a secure data transfer protocol/network to transfer data from the Telehealth database to the real-time surveillance system.

- A port would be opened at the Telehealth database and data would be securely transferred to the syndromic surveillance system. The transfer could occur across a VPN or via the Smart Systems for Health (SSH) infrastructure.

(3) Implementation of an HL7 parser to read the formatted records and make the data available to the real-time surveillance system.

- An existing HL7 parser currently implemented for the EDSS project could be configured. Alternatively, ESSENCE utilizes ms sql server DTS which makes parsing of records for insertion into a database relatively simple. Writing an HL7 parser is not a difficult exercise.

(4) Implementation of a Quality Assurance (QA) process to validate the data transfer.

- Regular QA cycles would be performed to ensure that the found at the real-time surveillance system database matches the data at Teleheatlh Ontario.

Conclusions and Recommendations

Prompt detection of infectious disease events is a primary concern for Public Health. To address the issues of delayed outbreak recognition and intervention inherent in traditional health surveillance methods, efforts are currently underway in many jurisdictions in Canada and the United states to leverage timely non-traditional data sources. Although the Telehealth Ontario program was not originally designed for real-time surveillance, results of several analyses presented in this compendium, and summarized in this chapter, support the integration of Telehealth Ontario data into a real-time province-wide surveillance system.

Although additional analyses are needed to further investigate the surveillance capacity of Telehealth data, analyses conducted to date strongly suggest that Telehealth data are good proxies for both acute respiratory and gastrointestinal conditions. Results also suggest that Telehealth respiratory activity may be a good early warning for Influenza activity. Technical investigations to date suggest that little effort would be required to integrate Telehealth data into a real-time province-wide surveillance system.

References

1. Walker D. *For the Public's Health: Initial Report of the Ontario Expert Panel on SARS and Infectious Disease Control*. Toronto: Ministry of Health and Long-Term Care; 2003.

2. Campbell A. *The SARS Commission Interim Report: SARS and Public Health in Ontario.* Toronto: Government of Ontario; 2004.

3. O'Connor D. *Report of the Walkerton Inquiry: The Events of May 2000 and Related Issues.* Government of Ontario; 2002.

4. Control, O. E. P. o. S. a. I. D. (2003). For the Public's Health. Toronto, Ministry of Health and Long-Term Care.

5. Hogenbirk, J. C., R. W. Pong, et al. (2002). Evaluation of a Teletriage Pilot Project in Northern Ontario. Sudbury, Centre for Rural and Northern Health Research, Laurentian University.

6. Group, C. W. (2004). "Framework for Evaluating Public Health Surveillance Systems for Early Detection of Outbreaks." *MMWR Morb Mortal Wkly Rep.* 53(RR-5): 1-14.

7. Bravata, D. M., K. M. McDonald, et al. (2004). "Systematic review: surveillance systems for early detection of bioterrorism-related diseases." *Ann Intern Med.* 140: 910-22.

8. Bravata, D. M., V. Sundaram, et al. (2004). "Evaluating detection and diagnostic decision support systems for bioterrorism response." *Emerg Infect Dis.* 10: 100-8.

9. CDC (2001). "Updated guidelines for evaluating public health surveillance systems: recommendations from the guidelines working group." *MMWR Morb Mortal Wkly Rep.* 50(RR-13).

10. Lombardo, J. S., H. Burkom, et al. (2004). "ESSENCE II and the framework for evaluating syndromic surveillance systems." MMWR Morb Mortal Wkly Rep **53 Suppl**: 159-65.

11. Hogenbirk, J. C., R. W. Pong, et al. (2005). "Impact of Telephone Triage on Medical Service Use: Implications for Rural and Remote Areas." J Agric Saf Health **11**(2): 229-37.

12. Force, T. T. (1999). Recommendations for a Telephone Health Education and Triage/Advisory Service: Final Report to the Ontario Ministry of Health and Long-Term Care. Toronto, Ministry of Health and Long-Term Care.

13. Care, M. o. H. a. L.-T. (2005). "Ontario Ministry of Health and Long-Term Care Public Information: Telehealth "   Retrieved 09 March 2007, 2007, from http://ogov.newswire.ca/ontario/GPOE/2003/12/22/c5081.html?lmatch=&lang=_e.html.

14. Doroshenko, A., D. Cooper, et al. (2005). "Evaluation of syndromic surveillance based on National Health Service Direct derived data--England and Wales." *MMWR Morb Mortal Wkly Rep.* 54 Suppl: 117-22.