INTRODUCTION AND EXECUTIVE SUMMARY

This compendium is a summary of the work performed on Telehealth Ontario data by the Queen's University Public Health Informatics (QPHI) Team based at Kingston Frontenac Lennox and Addington (KFL&A) Public Health and Queen's University. The Physician Services Incorporated Foundation funded this work over a two year period with anonymised data supplied by the Ministry of Health and Long Term care under a Queen's University Research Ethics Board approved project.

Our primary purpose is to inform decision makers regarding our retrospective evaluation of this data to enable informed decision making by Government. We believe a real time analytical system monitoring anonymised clinical guideline decision data from Ontario Telehealth calls will enhance Public Health surveillance in Ontario and lead to more timely and appropriate interventions to help protect the public.

Telehealth Ontario is often a first contact to the health system and hence it provides a very early warning of infectious illness activity for the Province which is confirmed and validated in our report. This data is collected by trained nurses using a computerized and standardized decision support system which could become part of an integrated real time comprehensive system that could include Emergency Departments, Primary Care and Laboratory surveillance.

Our work is informed by the numerous public health emergencies that have faced Ontarians recently including SARS, Walkerton, West Nile, Mung Bean sprout Salmonella outbreak and others. We have reviewed the National Advisory Committee on SARS reports chaired by Dr. David Naylor as well as the Expert Panel on SARS and Infectious Disease Control chaired by Dr. Walker and the reports of Mr. Justice Archie Campbell. As Justice Campbell's report stipulated " SARS crisis exposed deep fault lines in the structure and capacity of Ontario's
public health system"

Operation Health Protection, a 3-year Action Plan to revitalize the public health system by preventing threats to our health and promoting a healthy Ontario, was also reviewed. The Ministry in this document outlined a goal to have a technologically advanced

infrastructure for public health to deliver necessary information to health care practitioners and the public rapidly. Naylor in his report also outlined that real-time alert systems for respiratory illness need to be created and coordinated. His report also stated that public health capacity needs to be strongly linked to academic health institutions with collaborative research activities. In response to these recommendations, over the last four years we created an expertise at Queen's University in real-time data capture and analysis.

The Queen's Public Health Informatics (QΦ) Team fosters collaboration, innovation, and action. We work alongside health practitioners to develop, evaluate, and implement public health informatics systems strategically and effectively. QΦ helps end-users (from local to international) collect, analyze, manage, and translate data into information to support disease surveillance, management, and response. QΦ efforts include developing new technology solutions, educating stakeholders, informing policy, and conducting research on the appropriate use of real-time public health information systems. Our multidisciplinary team has evaluated the use of Telehealth Ontario data for public health surveillance in Ontario. Our conclusions are very strongly in favor of a further real-time prospective evaluation of this anonymised data stream over five years for the protection of the public's health reporting back to government with a thorough process, outcome and technical evaluation. We believe that based on the evaluations contained in this document, real-time, province-wide surveillance for outbreak detection and situational awareness, can be created which could detect respiratory and gastrointestinal illness much sooner than traditional reporting and have significant representativeness of the population and vulnerable sub groups.

The Ontario Pandemic Plan has documented the need for Telehealth Ontario to report the number of influenza like illness calls as this could be an important system and data source to have in place for pandemic preparedness. But to our knowledge there has been no significant evaluation of this data stream nor real time analysis done. At present 33 of the 36 Health Units have no real-time acute care data collection capability. Enabling province-wide Telehealth Ontario surveillance would negate this inequity. The proposed system would have automated anomaly detection, temporal spatial analysis and GIS mapping to enable evidence based public health decision making and enhanced surveillance and response.

Our evaluation demonstrates that a rise in calls to Telehealth predates the rise in ED visits for respiratory infections and influenza like illness. There is a very good correlation between the reason for the Ontario Telehealth call and the diagnostic codes for respiratory illness in Emergency Departments. We have also demonstrated that you can map and monitor the spatial spread of respiratory infection across Ontario in real time using Telehealth Ontario data. This corresponds well to Influenza lab data and Emergency department visits. Hence you can have an early warning system prior to the surge of respiratory infections in any community in Ontario with minimal cost as the data is already collected for Ontario but not currently analysed. Our analysis on gastroenteritis calls also implies that we could have an Ontario wide surveillance system in place using this system.

The challenge as Dr. Naylor pointed out in his report is to be better prepared for the next epidemic and to renew Public Health. We the Queen's Public Health Informatics team believe in creating and evaluating new tools to enhance surveillance to protect and promote the health of our citizens. It is clear that Telehealth Ontario surveillance can be an important instrument in a new dashboard of real time tools for Public Health. As a result of our work we are immediately available to perform the second phase of this study which is a prospective epidemiological and technical evaluation.

The following is a brief summary of the chapters included in this report. These chapters were created by members of our team including experts in epidemiology, geographic information systems, Public Health surveillance, Emergency Medicine and Computer engineering. We thank the cooperation of John Hopkins University Applied Physic's Lab for allowing us access to their Electronic Surveillance System for the Early Notification of Community based Epidemics (ESSENCE) for which we did a technical and epidemiological evaluation.

Chapter highlights

Chapter 1

- Outlines a proposed study to evaluate the effectiveness of Ontario's telephone nursing helpline as a real-time syndromic surveillance system, and how its implementation, if successful, would have an impact on outbreak event detection

in Ontario. Using data collected retrospectively, all ‘reasons for call’ and assigned algorithms will be linked to a syndrome category. Using different analytic methods, normal thresholds for the different syndromes will be ascertained. The next step will include the prospective monitoring of syndromic activity, both temporally and spatially.

- Project is important as it has the prospect of showing that province-wide surveillance is feasible, cost-effective and has the potential to positively impact public health practice.

Chapter 2

- This chapter gives a thorough description of Telehealth Ontario including an overview of who calls and when and why they are calling.

- Telehealth Ontario receives ~2700 calls daily with over 80% being categorized as a symptom call. The highest volume of calls is seen in winter months during the respiratory season and a majority of the calls are made on the weekend. Referral to a physician (42%), followed by self-care (31%), were the most common dispositions assigned to the Telehealth calls.

- The project’s next steps will include quantitatively comparing Telehealth data with laboratory data and emergency department (A&E) visits, and, using the CDC Framework for evaluating public health surveillance systems for early detection of outbreaks, retrospectively determining whether the Telehealth system could be successful as an early-warning system.

Chapter 3

- Telehealth Ontario had 216 105 calls for respiratory complaints while 819 832 ICD-coded complaints from NACRS were identified with a comparable diagnosis of a respiratory illness. Telehealth Ontario call volume was heavily weighted for the 0-4 age group (49%), while the NACRS visits were mainly from those 18-64 years of age (44%). The Spearman rank correlation coefficient was calculated to be 0.97, with the time-series analysis also resulting in significant correlations at lags (semi-monthly) 0 and 1, indicating that increases in Telehealth Ontario call

volume correlate with increases in NACRS discharge diagnosis data for respiratory illnesses.

- Telehealth Ontario call volume fluctuation reflects directly on ED respiratory visit data on a provincial basis. These call complaints are a timely, useful and representative data stream that shows promise for integration into a real-time syndromic surveillance system.

Chapter 4

- The period between July 2004 and March 2006 produced 30,417 EDSS visits and 4,247 calls to Telehealth Ontario related to local respiratory episodes. The NACRS had 19,315 respiratory disease diagnoses from the Kingston area. EDSS visits were significantly correlated with NACRS and Telehealth Ontario respiratory data (Spearman Correlation Coefficient = 0.98 and 0.91, respectively).

- Results of this study suggest that for a given time period, ED triage chief complaints accurately reflect the true conditions of patients as demonstrated by the strong correlation with NACRS discharge diagnoses. The strong correlations between ED triage chief complaints and NACRS discharge diagnoses and Telehealth Ontario calls, strongly suggest that the EDSS program in Kingston is able to accurately monitor the status of respiratory illnesses in the community.

Chapter 5

- The overall impact of the mapping exercise is positive. Not only do the respiratory data from NACRS and Telehealth Ontario closely follow the temporal sequence of confirmed influenza cases reported by CCDR for the province as a whole, but the temporal sequence of each data series are very similar at the PHU scale.

- Although an influenza epidemic can start in a variety of places in the province it moves to the large urban centres rapidly. The implication is that once the epidemic emerges in a specific locale in the province, all areas of the province should be alert for its potential arrival in their area within 1-2 weeks

- Both the NACRS and the Telehealth Ontario databases are valuable tools in the monitoring of the spread of influenza in the Province. Although both databases identify respiratory illness rather than influenza *per se*, the data track the temporal evolution of the CCDR confirmed cases so closely that there is much confidence in the ability to identify the upsurge in influenza cases in the community.

Chapter 6

- Telehealth Ontario recorded 184 904 calls and the NACRS registered 34 499 ED visits for GI illness. The Spearman rank correlation coefficient was calculated to be 0.90 ($p<0.0001$). Time-series analysis resulted in significant correlation at lag (weekly) 0 indicating that increases in Telehealth Ontario call volume correlate with increases in NACRS data for GI illness.

- Telehealth Ontario call volume fluctuation reflects directly on ED GI visit data on a provincial basis. Telehealth Ontario GI call complaints are a timely, novel and representative data stream that shows promise for integration into a real-time syndromic surveillance system detection of bioterrorism events.

Chapter 7

- 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 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.

Appendix A

- Preliminary report of a cost-benefit analysis looking at an influenza outbreak which relies on detection coming from suspected cases telephoning the Telehealth Ontario Helpline.
- It was concluded that quarantine effectiveness and intervention delays are critical to controlling an epidemic and that the isolation of cases is key to help protect the health of the public.