ACUTE CARE ENHANCED SURVEILLANCE

ACES

Queen's University

KFL&A Public Health

Ontario

BACKGROUND

THE NEED TO IMPROVE THE CAPACITY OF ONTARIO'S PUBLIC HEALTH SYSTEM TO PREVENT AND RESPOND TO OUTBREAKS OF INFECTIOUS DISEASE HAS BEEN WELL-DOCUMENTED BOTH PRE- AND POST-SARS.

In response to this need, Kingston, Frontenac and Lennox and Addington (KFL&A) Public Health began conducting a 2-year pilot project in September 2004 to develop and evaluate an Emergency Department Syndromic Surveillance (EDSS) system. This was done in collaboration with the Ontario Ministry of Health and Long Term Care, Queen's University, Public Health Agency of Canada, Kingston General Hospital and Hotel Dieu Hospital. At that time, a modified version of the Real-time Outbreak and Disease Surveillance (RODS) system, a product from the University of Pittsburgh, was selected as the surveillance tool best suited for the project.

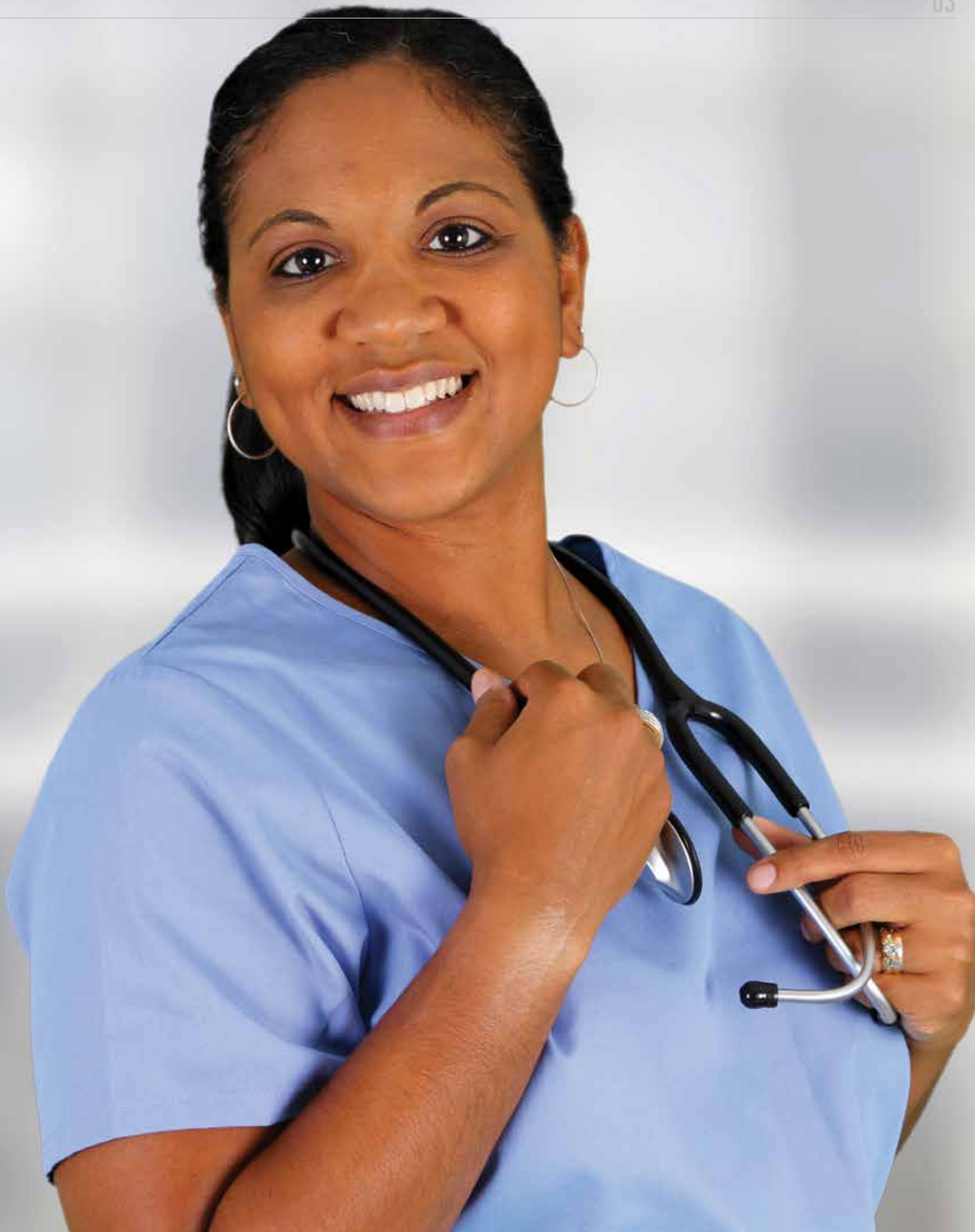
In order to continuously meet the dynamic public health needs of the population, the EDSS/RODS system has recently transitioned into an improved platform that will enhance situational awareness for public health issues. Along with these developments, the name of the system also changed to the Acute Care Enhanced Surveillance (ACES) system.

PURPOSE

The ACES system is maintained by KFL&A Public Health and is funded by the Ministry of Health and Long Term Care. ACES is a real-time syndromic surveillance system with temporal and spatial capabilities that enables public health to be better informed on the health of the community, which in turn can help improve public health protection and prevention initiatives. The system also allows hospitals to monitor emergency department (ED) volume, admissions, and surge capacity to help prepare for high volumes of patients, particularly in the event of a flu pandemic. The goals of the system are to monitor changes and trends in the incidence of endemic disease and to detect new or emerging public health threats. ACES' syndromic surveillance capabilities are useful in a variety of situations, including:

- Acting as an early warning system for emerging pathogens
- Routine monitoring of respiratory and gastrointestinal illness
- Public health emergencies, such as extreme weather events
- Mass gatherings

The flexibility, adaptability, monitoring and analysis capabilities of ACES enhance situational awareness for a variety of common, emerging, or unexpected public health issues.



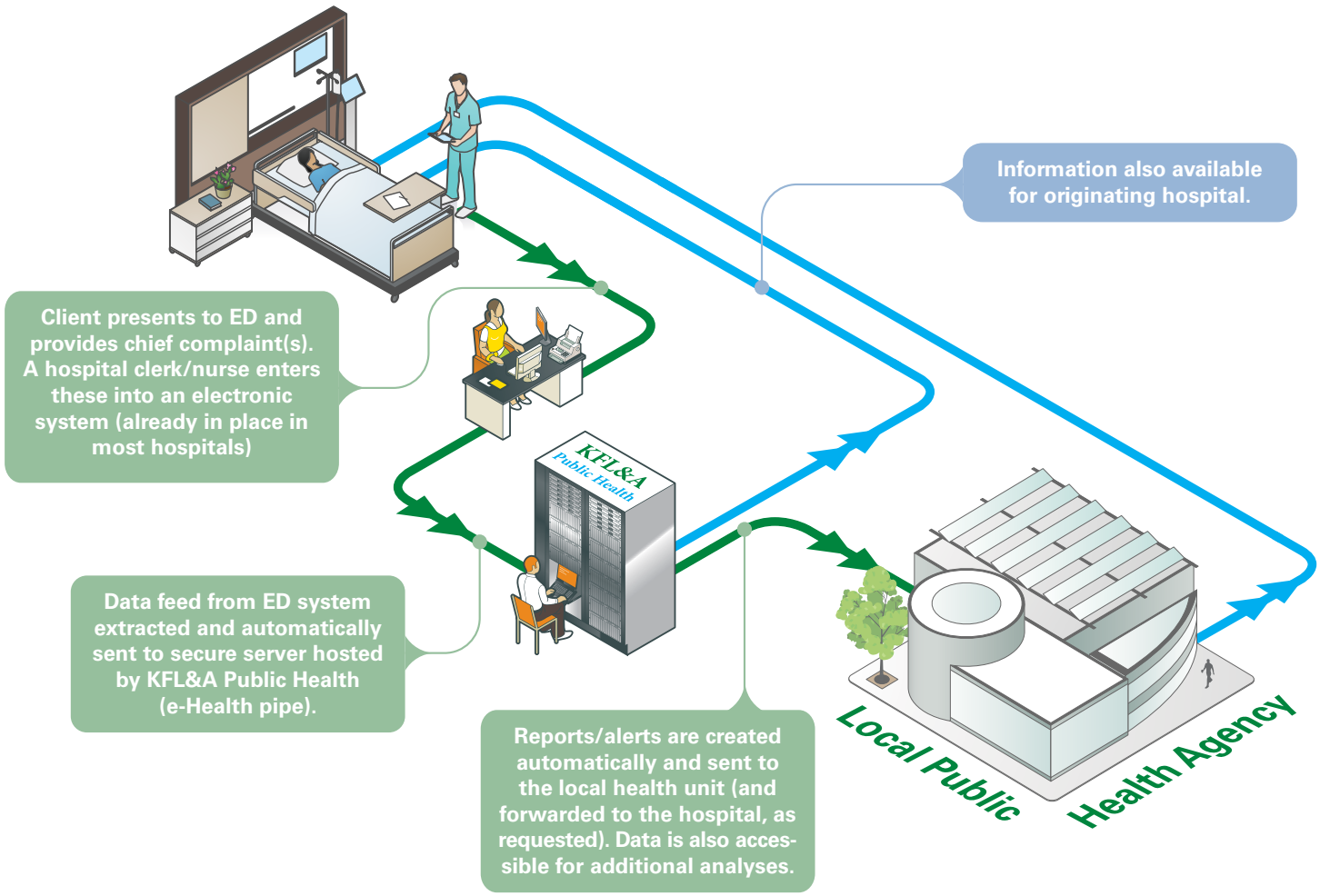


Figure 1: Diagram Depicting the ACES process.

HOW IT WORKS

THE ACES SYSTEM CURRENTLY MONITORS VISITS TO EMERGENCY DEPARTMENTS AT OVER 100 HOSPITALS ACROSS ONTARIO, SPANNING 26 LOCAL PUBLIC HEALTH AGENCIES.

ON AVERAGE, THE SYSTEM RECEIVES DATA FROM APPROXIMATELY 12,000 VISITS AND 3,000 ADMISSIONS PER DAY.

All data for ACES is collected by participating health care facilities during the registration and triage process. When a patient presents at the ED, details describing both the patient and the visit are entered into the hospital's computer system in 'real-time' within minutes of speaking with the triage nurse. The system then seamlessly retrieves select information from the data that has already been collected by hospitals and therefore has no impact on staff workload. Data elements collected by the ACES system include: patient demographics (age and sex), postal code (first 5 digits), the date and time of the visit, chief complaint(s), Canadian Triage Acuity Score (CTAS), Febrile Respiratory Illness (FRI) Screening results, admission diagnosis (if recorded and available), discharge diagnosis, whether the patient arrived by emergency medical service, and whether there was admission to the Intensive Care Unit. No direct personal identifiers (e.g. name or health number) are collected by ACES, and the data is sent from hospitals to KFL&A Public Health's data centre over the secure Ontario e-Health Network.

The information from each ED visit across all sites is collected centrally within the ACES system where it is classified into one of nearly 80 syndromic categories based on the chief complaint or admission diagnosis. From here, anomaly detection using various detection algorithms takes place automatically to detect increasing numbers of visits for different syndromes. In the event that an abnormal number of visits for a particular syndrome is detected, alerts generated by ACES are immediately posted to the website and emailed to public health professionals monitoring the system. Epidemiologists and other health professionals can then use the secure web-based interface to monitor the collected information, and assess the ED visits that comprise the alert to determine if there are any patterns related to demographics, location, or timing of the cases that would justify further investigation by public health staff.

Since the data is collected in real-time and is based on disease symptoms, rather than diagnosis, there is an increased ability to detect and respond to public health events early. The ACES system complements traditional surveillance practices to help improve epidemiological analysis and to enhance integration, collaboration, and communication between public health and the acute care sector.

CASE STUDIES

ACES IS A FLEXIBLE AND ADAPTABLE SYSTEM THAT HAS AND WILL BE USED IN A VARIETY OF SITUATIONS. BELOW ARE EXAMPLES OF SCENARIOS IN WHICH THE REAL-TIME AND FAST-RESPONSE NATURE OF ACES ASSISTED PUBLIC HEALTH PROFESSIONALS WITH EMERGING PUBLIC HEALTH ISSUES.

INFLUENZA

Annual Influenza Season – The ACES system is frequently used during the annual influenza season. During this time, health professionals accessing the system can use it to detect, monitor, and describe the annual outbreak within their community. The ACES system uses the chief complaint information it collects to help track visits and admissions for flu-like illness and pneumonia to detect the annual outbreak earlier. ACES' web-based tools can then be used to describe who is being most effected and where the outbreak is most concentrated in the community. This helps both public health and acute care professionals by informing them of where to prioritize prevention and mitigation efforts, and by helping to prepare earlier for increases in patient volume.

ILI Mapper – One of the applications that uses the syndromic surveillance respiratory data from ACES is the Influenza-Like Illness (ILI) Activity Level Indicator (ILI Mapper). This tool displays provincial respiratory and influenza activity in map and graph form, and is guided by a colour classification system. These functions assist public health professionals in describing outbreaks and assessing weekly progression throughout the annual influenza season. The ILI Mapper is available to the public and can be accessed through the following link: www.kflaphi.ca/ILI-Mapper.

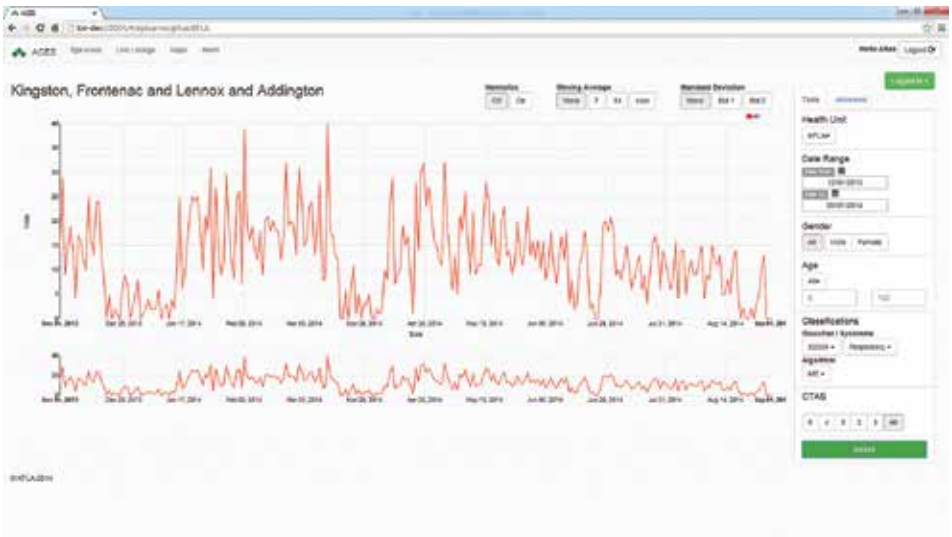


Figure 2: ACES epicurve depicting hospital visits for the Respiratory Syndrome category in the KFL&A region.

H1N1 Influenza in Kingston – In late April of 2009, the first cases of H1N1 influenza were confirmed in Ontario. Though influenza surfaces every year, the H1N1 pandemic was particularly concerning as it did not disproportionately infect older adults (which was not typical), plus it infected a higher than normal number of individuals.

When the second wave of the H1N1 outbreak hit in the fall of 2009, the ACES system was used to monitor the outbreak, in real-time, within the KFL&A region. Analysis of ACES' respiratory and fever/ILI syndromes was able to show the rise in ED visits for respiratory complaints leading up to, and during the outbreak. The ACES surveillance maps were able to visually depict the areas with high numbers of ILI related ED visits. Additionally, the momentum demonstrated in the ACES epicurves indicated that there would likely be continual high numbers of patients visiting KFL&A EDs, threatening a volume larger than the ED capacity could handle. Based on this information, community assessment centres were established to relieve pressure on EDs. This resulted in a decline in ED visits over the next two weeks.

The use of ACES throughout the H1N1 pandemic demonstrated its multiple capabilities in assisting with a disease outbreak. Not only was the system able to help detect, describe, and track the outbreak earlier, it also helped enable enhanced health system response.

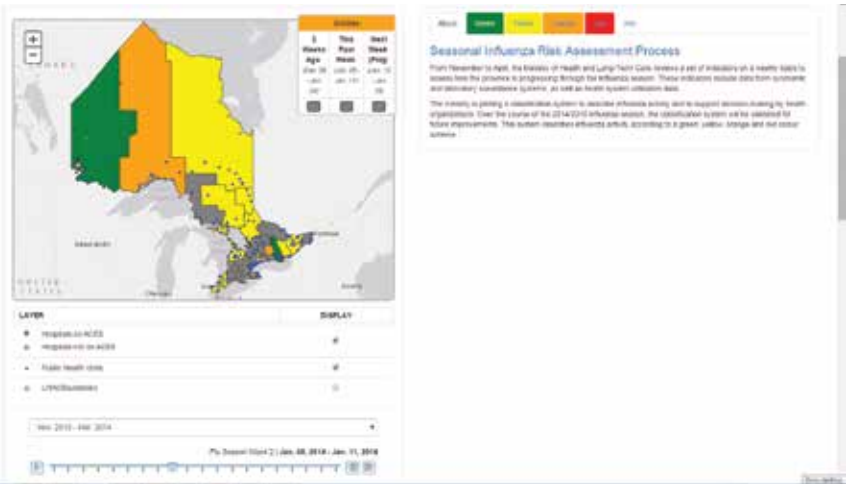


Figure 3: Screen capture of the ILI Mapper website.

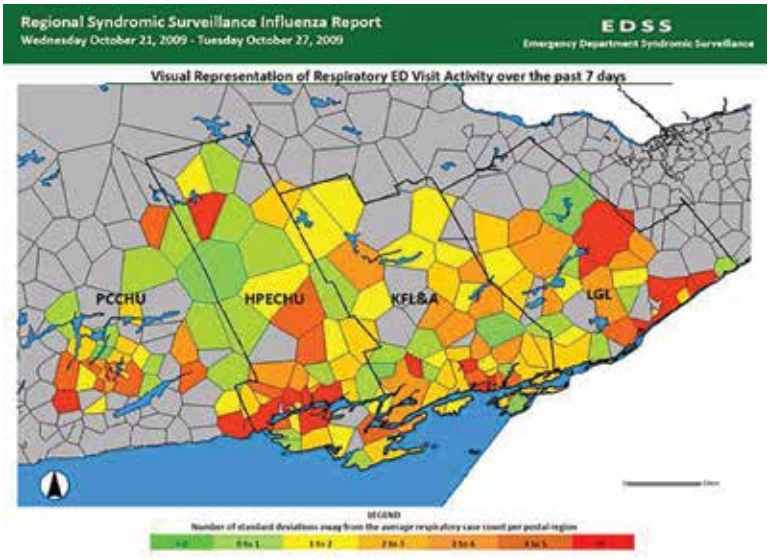


Figure 4: ACES surveillance map showing influenza in KFL&A and surrounding regions during the height of the 2009 H1N1 outbreak.

EMERGENCIES AND EXTREME WEATHER

Kingston Fire – On December 17, 2013 a large fire broke out in a construction site near downtown Kingston, ON. Due to the size of the fire and wind, there was potential for it to spread to nearby buildings and a substantial amount of smoke production. Therefore, the fire posed a safety threat due to the potential for reduced air quality and the risk of exposure to fire, smoke, and carbon monoxide.

Upon being notified of the fire, KFL&A Public Health began monitoring the ACES system for ED visits and admissions to local hospitals that could be related to the event. For instance, the respiratory and asthma syndrome categories in ACES were analysed to determine whether there was an increase in visits for these syndromes. In particular, the system was monitored for increases in visits for smoke inhalation and carbon monoxide exposure. Though no significant increases were detected, the ACES system was able to help quickly assess the extent of the public health threat and inform hospitals of the potential degree of expected patient volume influx. ACES therefore helped increase overall situational awareness and preparation throughout the duration of the emergency.

In addition, the Public Health Information Management System (PHIMS) was used in collaboration with ACES during the fire to enhance surveillance efforts by enabling the monitoring of wind patterns and air quality in the area. ACES and PHIMS were able to assess the geographic locations in the city that were at highest risk for exposure to the fire, and determine the most socially deprived and vulnerable areas, thereby assisting with evacuation priorities and further improving situational awareness.

Midland Tornado – On June 23, 2010, a F2 Tornado hit Midland, ON. Winds in the area reached 180 and 240 kilometers an hour, causing severe damage and led to the town declaring a state of emergency.

In times of unexpected disaster, the ACES system is able to assist first responders and emergency operations personnel. Just after the tornado struck in Midland, ACES was able to see, in real-time, the ED registration data stemming from the tornado at the local hospital. The system was used to monitor visits for trauma to assist in determining the extent of the injuries caused by the tornado. ACES is therefore central in understanding the potential ED surge relative to ED capacity, further enhancing situational awareness during times of emergency.

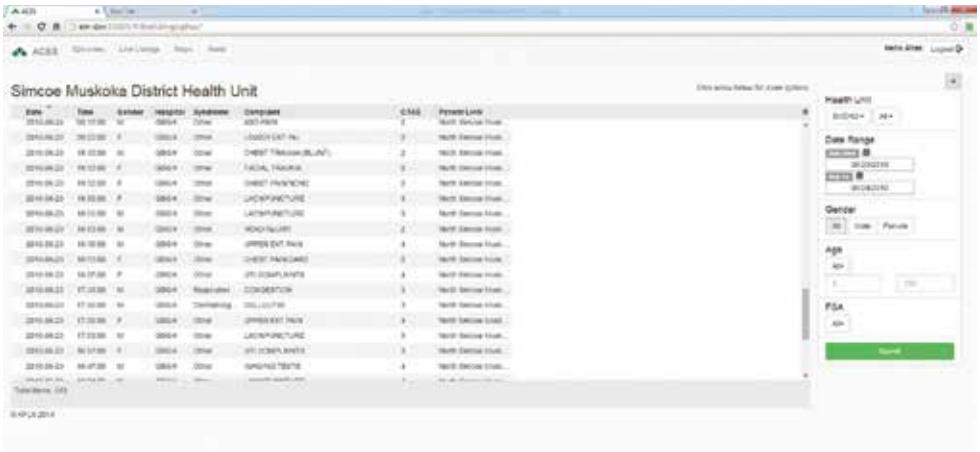


Figure 5: ED visit details after the Midland tornado struck.

MASS GATHERINGS

G8/G20 Summit – Mass gathering events have the potential to generate significant public health risks. These events therefore require appropriate preparation beforehand, and surveillance during, to monitor for potential emergencies. From June 25-30, 2010, the G8 and G20 Summits were held in Huntsville, ON and Toronto, ON, respectively. Due to the large crowds that were expected, a Hazard Identification Risk Assessment (HIRA) was completed in preparation for the event. The HIRA identified several potential risks including: infectious and contagious diseases, food related hazards, environmental/severe weather emergencies, and injury/health and safety hazards.

The ACES system was used as a surveillance tool during the Summit to monitor syndromes that coincided with the identified risks. From June 17th to June 30th the system monitored syndromes every hour, looking for increases in hospital ED visits and admissions that could indicate emerging public health threats related to the event. Throughout the monitoring timeframe, three indicators on the system were higher than the expected values. These included: total hospital admissions, fever/ILI ED visits, and dermatological infectious ED visits. However, it was noted that the increases reported were not significant or sustained.

The use of ACES during the G8/G20 Summit allowed for real-time monitoring of identified public health risks, enabling situational awareness of potential emerging issues and enhancing health system preparedness.

SURVEILLANCE AFTER DRUG POLICY CHANGES

Methodose – On June 26th, 2014, the way in which the Methadone Maintenance Treatment (MMT) program was being delivered in Ontario changed. It began transitioning from a compounded methadone solution to a Methadose oral solution – a more concentrated formulation.

On July 17, 2014, KFL&A Public Health was alerted about concerns that this change could lead to an increase in dosing errors, which could be dangerous given the increased concentration. Upon being notified, ACES was reviewed for presentations of methadone overdose or accidental opiate overdose in the previous weeks to see if the new methadone delivery system was having negative impacts. The pre-existing opiate syndrome in ACES was modified to monitor methadone-specific ED visits and admissions, and from this, public health professionals were able to see that methadone overdose numbers had been stable – indicating there was no public health issue yet. The system continues to monitor this issue and will notify ACES administrators if there is a statistically significant rise in these numbers.

With initial response within 24 hours and ongoing monitoring, ACES was able to enhance situational awareness for this potential public health threat.

Delisting of OxyContin – In March 2012, the drug OxyContin was removed from the list of drugs funded by the province of Ontario. OxyContin is a powerful pain medication that is safe when taken as prescribed, but dangerous if abused. A new and more difficult to abuse formulation, called OxyNEO, replaced OxyContin. Controls on prescribing OxyNEO also became stricter around this time. The changes were intended to try to reduce the harms and deaths associated with OxyContin abuse.

To help determine whether the policy change had any impact, ACES was used to monitor changes in the visit and admission patterns of narcotics abuse. Weekly reports were generated to provide evidence regarding the effectiveness of the policy, and to immediately identify any potential unintended consequences. Analysis of ACES data is still ongoing but it is being demonstrated that narcotic related visits and admissions are remaining stable. The system continues to be monitored to view the potential outcome overtime.

ASTHMA

Annual Asthma Epidemic – Each year, shortly after children return to school in September, there is a predictable increase in ED visits, hospital admissions, and unscheduled physician consultations for childhood asthma across North America. Rhinovirus infections, allergens, and decreased use of asthma medications during the summer are all thought to be contributors to this problem.[1,2]

Every Fall season, the ACES system is used to monitor asthma related ED visits by children in the KFL&A region. ACES is able to detect the significant rise in visits each year. Analysis of this information enables health professionals to assess the annual epidemic and understand the extent of the issue. This information can assist preparation and prevention efforts to help reduce the impact of the problem.

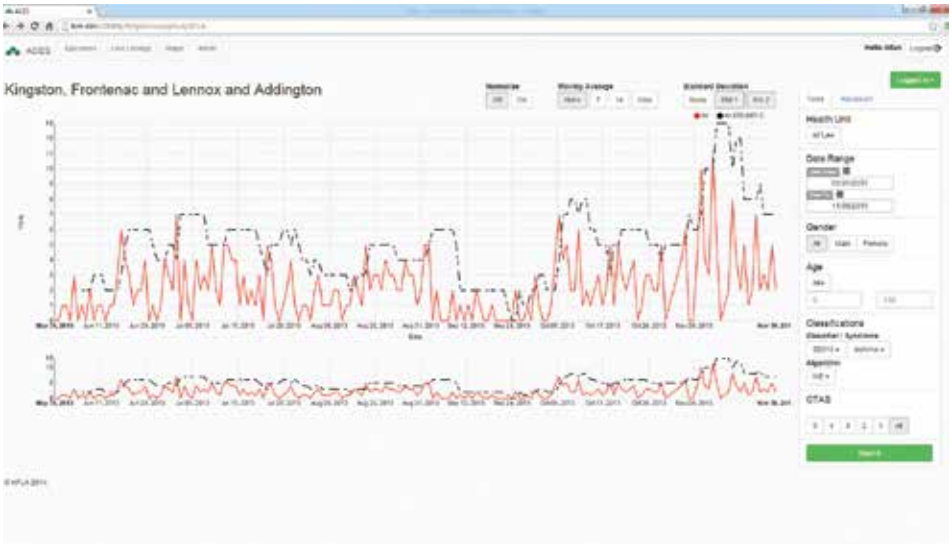


Figure 6: ACES epicurve for asthma related ED visits.

[1]Johnston NW, Johnston SL, Norman GR, Dai J, and Sears MR. The September epidemic of asthma hospitalization: School children as disease vectors. J Allergy Clin Immunol. 2008; 117(3): 557-562.

[2]Virnig C and Gern JE. Attenuation of the September Epidemic of Asthma Exacerbations in Children: A Randomized, Control Trial of Montelukast Added to Usual Therapy. Pediatrics. 2008; 122: S218-S219.

REPORTABLE DISEASE DETECTION

Hospital Admission Monitoring – In Ontario there is a list of over 50 communicable diseases that Public Health is required to track and control through the *Health Protection and Promotion Act (HPPA)*. People that test positive for these diseases need to be followed-up with by Public Health in order to inform them of treatment options and to educate them on what they might expect during the course of their illness. Notification of these cases usually occurs through a laboratory that has tested a specimen taken from a patient and the result of said test was positive for one of the diseases on the reportable list.

The admission data that the ACES system receives from hospitals can be data mined for key words that suggest a patient may indeed be afflicted with one of these reportable diseases based on their reason for admission. This is currently done by epidemiologists looking through the daily line listings in ACES and flagging instances that require further investigation by a public health nurse, infection control practitioner or health inspector. In the near future, this process will be automated and become an even more timely service that includes direct e-mailing of line list data to the appropriate person to allow for even quicker follow-up than may occur via current lines of communication. This will allow Public Health to meet its obligations through the *HPPA* while also allowing for the quick isolation (if necessary) and education of the afflicted patient to mitigate potential spread of disease.

FUTURE DIRECTIONS

Mental Health Surveillance – The ACES system is planning to expand its mental health surveillance capabilities upon further validation of mental health syndromes. These syndromes include: suicidal ideations, alcohol and intoxication, addictions, social reasons for admission or visit, injuries, insomnia, sleep disorders, and opioid intoxication.

ACES' ability to monitor mental health syndromes will help fill a gap in Ontario's surveillance capabilities as there is currently no real-time surveillance system for mental health. The real-time monitoring of mental health related ED visits and admissions will: enable immediate provision of information to health organizations and providers on the volume of patients using EDs for mental health issues; identify emerging substance abuse issues; and improve situational awareness around mental health issues after major events and during mass gatherings. This information could help improve understanding of local mental health needs, improve service delivery, and provide evidence for relevant policy changes. The flexibility of the ACES system will enable efficient expansion for a range of mental health indicators, allowing for the surveillance and improved public health response to these important health issues.

Publicly Accessible Mapping Sites – As mentioned previously, ACES is currently being leveraged by ILI Mapper to help local and provincial stakeholders (along with the public) to be better informed on the progression of the annual respiratory season. There are currently plans to develop similar applications with other ACES syndromes. This includes: an Asthma Mapper which will track the annual Autumn rise of asthma-related visits to hospitals which typically affects young children after they return to school from the summer break; a GI Mapper which will track gastrointestinal related visits to hospitals throughout the year to help with the early detection of potential food related outbreaks; and a Respiratory Syncytial Virus (RSV) Mapper which will track specific respiratory complaints, such as bronchiolitis in children under the age of 5, so that they can be differentiated from the overall respiratory data for focused interventions. In addition, there are other syndromes that could benefit from a specific Mapper once the ACES team has validated such syndromes, and after input has been gathered from stakeholders as to what might be useful for them.

2015 Pan/Parapan American Games – In the summer of 2015, Ontario's Greater Golden Horseshoe area will be hosting the Pan/Parapan American Games. It is estimated that the event will include 10,000 athletes and officials, and up to 250,000 visitors. In preparation for the Games, a provincial Surveillance Operationalization Working Group (SOWG) was created, and several surveillance objectives have been outlined for the event.

To meet the epidemiological needs of the Pan/Parapan American Games, the ACES system has been recommended as a syndromic surveillance tool to be used throughout the event.

With over 100 hospitals and 26 local public health agencies participating in the system across Ontario, ACES extends through all LHINs that may be affected by the Games, and includes nearly all of the hospitals within close proximity to event locations. Due to its flexibility, adaptability, and its strong monitoring and analysis capabilities, ACES will be extensively used by stakeholders during this time.

PRIVACY & SECURITY

KFL&A PUBLIC HEALTH ENTERS DATA SHARING AGREEMENTS WITH ALL OF ITS LOCAL PUBLIC HEALTH AGENCY AND HOSPITAL PARTNERS ON ACES.

Though the information collected from hospitals is stripped of key identifiers (e.g. name or health card number), the information is treated as personal health information under the *Personal Health Information Protection Act (PHIPA)*, and steps are taken to protect the security and confidentiality of the information. The 'Privacy and Confidentiality Charter for Acute Care Enhanced Surveillance' outlines the policies, principles, and procedures for ACES that are necessary to meet the intent of *PHIPA*. A Privacy Impact Assessment has also been conducted for ACES. There are regular reviews of the ACES policies and procedures to ensure they are in alignment with *PHIPA* and any other applicable privacy legislation. These privacy documents, a list of hospitals participating in ACES, and other project documents can be accessed on our website at: www.kflaphi.ca.

CONCLUSION

THE ACES SYSTEM IS A PROVINCIAL-WIDE, REAL-TIME SURVEILLANCE SYSTEM USEFUL FOR MONITORING ENDEMIC DISEASE AND DETECTING EMERGING PUBLIC HEALTH THREATS.

Its use in a variety of public health scenarios has demonstrated its adaptability and ability to help improve health protection, prevention and response efforts. Expanding the coverage of ACES will help compliment traditional practices and enhance the surveillance capabilities of each individual public health unit participating, while also improving situational awareness of potential public health threats throughout the province.

The Acute Care Enhanced Surveillance (ACES) system is hosted and maintained at Kingston, Frontenac and Lennox & Addington (KFL&A) Public Health by the KFL&A Public Health Knowledge Management Division.

Funding and support for the ACES system is provided by the Ontario Ministry of Health and Long Term Care.

For more information about ACES please visit www.kflaphi.ca or contact:

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