ED Administration

Influenza assessment centres: a case study of pandemic preparedness to alleviate excess emergency department volume

Geoffrey G. Hall, PhD*†‡; Alexander G. Perry, MSc*§; Adam vanDijk, MSc*‖; Kieran M. Moore, MD*‡‖

ABSTRACT

Objectives: Influenza assessment centres (IACs) were deployed to reduce emergency department (ED) volumes during the pH1N1 influenza outbreak in the Kingston, Frontenac, Lennox and Addington (KFL&A) public health region of Ontario, Canada, in the fall of 2009. We present a case study for the deployment of IACs to reduce ED visit volume during both periods of pandemic and seasonal communicable disease outbreak.

Methods: An emergency department syndromic surveillance system was used to trigger the deployment of eight geographically distributed IACs and to time their staggered closure 3 weeks later. We compared actual and expected ED visit volumes in the KFL&A region to neighbouring regions where no IACs operated by time series regression analysis before, during, and after IAC operation.

Results: The deployment of IACs was triggered with a rise in overall ED volume at the hospitals in the KFL&A region to a level 10% above the 6-month running average. The IACs assessed 2,284 patients during 3 weeks of operation. Thirty-three patients were admitted directly to the hospital from the IACs, bypassing the EDs. During the operation of the IACs, the hospitals in the KFL&A region experienced a modest decrease in daily visits when compared to the 3 previous weeks. Overall ED visit volume in the hospitals in the neighbouring regions increased 105% during the period of IAC operation.

Conclusions: Operating stand-alone influenza IACs may reduce ED volumes during periods of increased demand, as observed during an anticipated pandemic situation.

RÉSUMÉ

Objectifs: Des centres d'évaluation de la grippe (CEG) ont été mis sur pied afin de diminuer le volume de consultations aux services des urgences durant l'éclosion de grippe A (H1N1), dans la région sanitaire de Kingston, Frontenac, Lennox, et Addington (KFLA), en Ontario, au Canada, au cours de l'automne de 2009. Nous faisons état, dans le présent article, d'une étude de cas sur la mise sur pied de CEG visant à réduire le volume de consultations aux SU durant les périodes de pandémie et d'éclosion de maladies transmissibles saisonnières.

Méthode: Les autorités ont eu recours à un système de surveillance du syndrome dans les services d'urgence pour déclencher la mise sur pied de huit CEG répartis en zones géographiques et pour planifier leur fermeture progressive 3 semaines plus tard. Nous avons comparé l'achalandage réel et prévu aux SU dans la région de KFLA avec celui dans les régions voisines qui ne disposaient pas de CEG, à l'aide d'une analyse de régression en série chronologique, avant, pendant et après l'opération de mise sur pied des CEG.

Résultats: La mise sur pied des CEG a été déclenchée par une augmentation du volume global de consultations aux SU, de 10 % supérieure à la moyenne enregistrée pendant les 6 mois en cours, dans les hôpitaux de la région de KFLA. Au total, 2,284 patients ont été évalués dans les CEG, durant les 3 semaines de fonctionnement; 33 patients ont été hospitalisés directement à partir de l'un des CEG, sans passer par les SU. Au cours de la période de fonctionnement des CEG, les hôpitaux de la région de KFLA ont enregistré une faible diminution du nombre quotidien de consultations, comparativement aux 3 semaines précédentes. Par contre, le volume global de consultations aux SU dans les hôpitaux des régions voisines a augmenté de 105 % durant la période de fonctionnement des CEG.

Conclusion: Le fonctionnement de CEG autonomes peut réduire l'achalandage dans les SU durant les périodes de demandes accrues de services, comme en témoigne l'expérience décrite ici, relativement à une période prévue de pandémie.

Keywords: emergency department overcrowding, influenza, syndromic surveillance

From *Queen's Public Health Informatics Group, †Department of Civil Engineering, ‡Department of Emergency Medicine, and §Department of Electrical and Computer Engineering, Queen's University; and ‖Kingston, Frontenac, Lennox and Addington Public Health, Kingston, ON.

Correspondence to: Dr. Geoffrey Hall, Queen's Public Health Informatics Group, Kingston, Frontenac, Lennox and Addington Public Health, 221 Portsmouth Avenue, Kingston, ON K7M 1V5; gh26@queensu.ca.

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Emergency departments (EDs) have increased activity during seasonal influenza outbreaks, straining even further systems at full capacity. The outbreak of a pandemic could overwhelm EDs completely.[1–4] Current planning assumptions such as the Public Health Agency of Canada's (PHAC) Canadian Pandemic Influenza Plan for the Health Sector predict that a pandemic flu could affect 15 to 35% of the population, with up to half of these individuals seeking some form of outpatient care.[5] The pH1N1 experience in Australia in the spring of 2009 saw a 6% increase in ED visits.[6]

Pandemic and communicable disease planning at its core requires preserving the ability to deliver timely, coordinated medical care during periods of increased demand with potentially less staff than normally present. EDs are at the epicentre of this challenge as the ED is the location to where many Canadians will have to turn.[4] Current overcrowding essentially eliminates any required surge capacity for a pandemic situation.

In response to established influenza impact assumptions, many plans have been developed that are intended to alleviate the burden on acute care facilities. In particular, influenza assessment centres (IACs), designed to identify the small proportion of patients who require inpatient care, can be an important step in preventing EDs from becoming overwhelmed and unable to cope.[5,7–9] During an outbreak of a communicable disease, this diversion strategy would ensure the expedient care of those affected while maintaining the ongoing normal operation of acute care facilities.

Temporary, stand-alone IACs were proposed in the 2008 Ontario Health Plan for an Influenza Pandemic.[7] It was envisioned that these IACs could be designed to admit patients directly to the hospital, bypassing the ED if required. The plan also called for a triage nurse in an ED to divert patients away from the ED directly to the IAC prior to physician assessment, based on specified criteria. The PHAC's pandemic influenza plan outlines the urgent need for access to real-time surveillance data on the activity level of influenza to optimize intervention strategies while minimizing costs.[5]

The objective of this study is to describe how IACs were deployed in the Kingston, Frontenac, Lennox and Addington (KFL&A) public health region during the pH1N1 influenza outbreak that occurred during the fall of 2009. We sought to assess the impact of IACs on ED volumes and efficiency in hospitals locally and to compare them to neighbouring public health regions that did not deploy IACs.

Ethics approval for the study was obtained from the Queen's University Health Sciences and Affiliated Teaching Hospitals Research Ethics Board in Kingston, Ontario.

METHODS

System of activation of secondary assessment centres

KFL&A Public Health houses a regional emergency department syndromic surveillance (EDSS) system. The system has been described in detail[10] and uses a modified version of the University of Pittsburgh's Real-Time Outbreak and Disease Surveillance (RODS) system to track activity in area hospital EDs. The modified RODS system identifies the syndrome categories gastroenteritis, respiratory infectious, fever/influenza-like illness, asthma, dermatologic infectious, neurologic infectious, and severe infectious based on keywords entered as the chief complaint given by the patient or caregiver during triage. For the purposes of this article, fever/influenza-like illness and respiratory infections were defined by the identification of specific keywords (Table 1). Throughout this article, both syndromes combined are referred to as Resp/ILI.

Three acute care hospitals with EDs servicing the KFL&A region were examined: site 1, Kingston General Hospital; site 2, Hotel Dieu Hospital; and site 3, Lennox and Addington County General Hospital. Total ED census, wait times, and "left without being seen" counts were tracked based on administrative data sets. The ED chief complaint is delivered in real time to the EDSS system at KFL&A Public Health, where it is analyzed by algorithms specifically designed to detect the above-mentioned target syndromes. Increased activity causes an alert, which is examined by epidemiologists. To trigger the deployment of the IACs, a threshold value of 10% above the previous 6-month-mean reporting frequency for target syndromes was chosen after consultation with ED managers with their knowledge of regional workload capabilities.

Statistical approach to measuring outcomes of secondary assessment centres on ED visits

To evaluate the impact of opening the IACs on ED visits, data from the three hospitals in the KFL&A region were compared to seven hospitals in the

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Table 1. Fever/influenza-like illness and respiratory infection keywords for syndrome identification with the EDSS

Otitis	Swollen neck	Fever and cough
Ear pain/ache	Sore throat/rash	Fever, abdominal pain
Sinusitis	Nasal congestion	Nausea and cough
Laryngitis	Throat problem	Cough/wheeze
Croup	Ear infection	Cough/croupy
Pharnygitis	Difficulty breathing	Cold
Epiglottitis	Stuffy nose	Core throat/chills
URI	Difficulty swallowing	Left earache
Right earache	Sinus congestion	Sore throat, weakness
Bronchitis	Productive cough	Croup
Bronchiolitis	Lungs full	Head cold/runny nose
Pneumonia	Tonsillitis	Bilateral ear infection
Cough	Sinus pain	Cough, fatigue
Chest congestion	Throat swelling	Rough cough
Tracheitis	Cold symptoms	Hoarse voice
RSV	Strep throat	Flu symptoms/cough
Cough/indrawing	Shortness of breath/cough	Flu symptoms
Barky cough	Sore throat, muscle aches	Influenza-like illness
Fever	Flu-like symptoms	Influenza

EDSS = emergency department syndromic surveillance; RSV = respiratory syncytial virus; URI = upper respiratory infection.

neighbouring health unit regions where IACs were not used for the periods before, during, and after the pH1N1 pandemic. The seven hospitals in the neighbouring regions were also acute care facilities and served approximately 500,000 rural and urban residents. The characteristics of the comparative hospital and surrounding communities were very similar to those of the three KFL&A hospitals. Two approaches were taken to analyze the data by direct comparison of ED time series plots and logistic regression.

It was assumed that weekly cyclical patterns, seasonality, and the presence of influenza in surrounding areas were the main predictors of visits. Parameter estimates for the regression model were found using data from January 1, 2008, to June 30, 2009, before the IACs were opened. The regression model accounted for the autocorrelation in the time series (i.e., that visits on one day are potentially correlated with visits on the next) by including an autoregressive error model with lags of up to 3 days (there was no significant autocorrelation after 3 days). The fit of this model was assessed using validation data from July 1, 2009, to October 23, 2009 (also before the IACs were opened), by examining the residuals. The residuals over this period were calculated as the difference between the actual and regression-predicted number of KFL&A ED visits. These residuals were compared to the residuals over the period when the IACs were open (October 24 to November 15, 2009). Because the regression model accounted for time correlation in the data, the residuals can be assumed to represent independent samples. A Mann-Whitney-Wilcoxon test, allowing for nonnormal distribution of the residuals, was performed to compare the residuals over these two periods.

RESULTS

In mid-October 2009, the second wave of H1N1 began in southeastern Ontario, with the first positive laboratory culture in early October and subsequent laboratory results showing strain replacement (i.e., no cocirculating respiratory viruses). The spread was detected as increased activity in both overall ED visits and those for Resp/ILI in the EDs of the three hospitals (Figure 1). The three hospitals had a combined average daily volume of 402, with a standard deviation of 39 visits in the 6 months prior to the opening of the IACs and the threshold level of 500 visits (10% increase) triggered the IAC deployment on Monday, October 19, 2009.

On Saturday, October 24, the level 2 IAC was operational. On Monday, October 26, seven level 1 IACs became fully operational. The level 1 IACs

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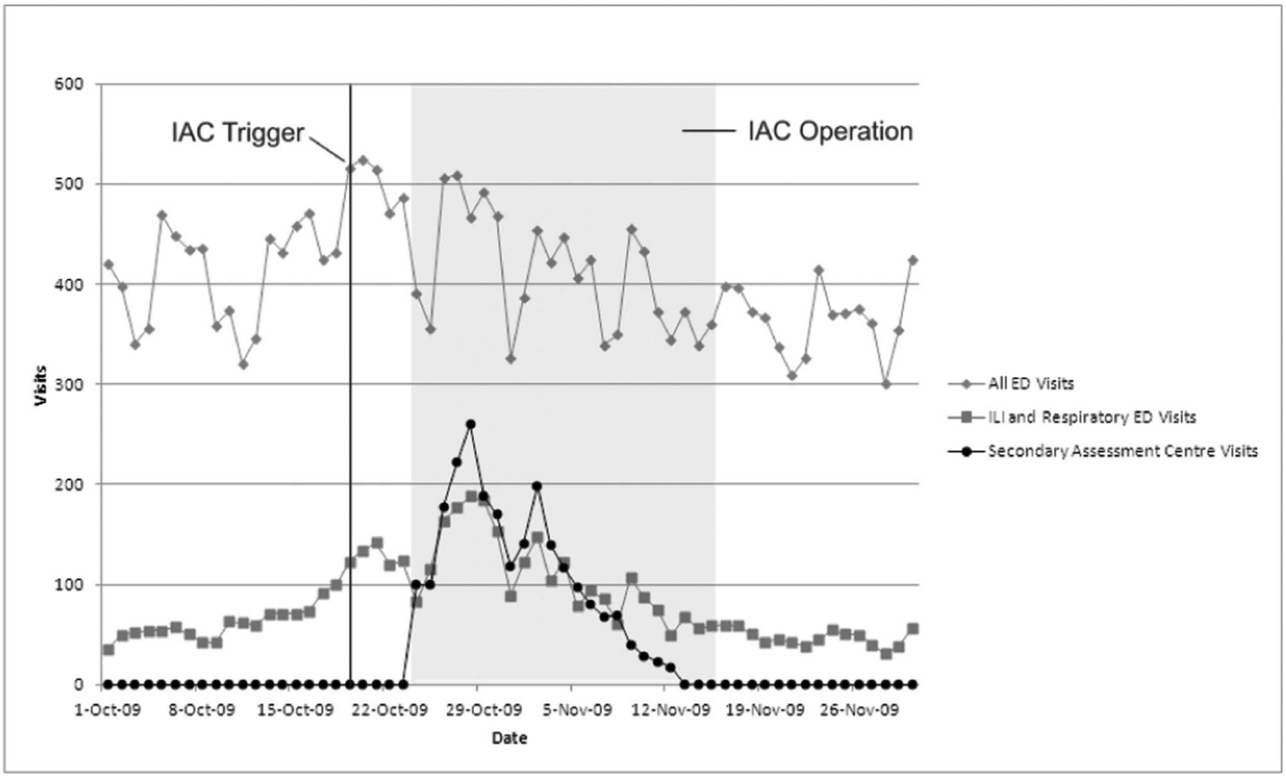

Figure 1. Emergency department (ED) and influenza assessment centre (IAC) visits to hospitals in the Kingston, Frontenac, Lennox and Addington region. ILI = influenza-like illness.

remained in operation for 2 weeks, whereas the level 2 IAC remained operational for a third week (see Figure 1). A total of 2,284 individual patients were assessed at the eight IACs. The level 1 IACs referred 27 patients to the level 2 centre for further assessment. The level 2 IAC admitted 33 patients directly to an inpatient hospital ward.

Comparison among trends in Figure 2 show that the peak ED visits in the KFL&A region hospitals occurred before IACs were opened, whereas the peaks in ED visits to the hospitals in the neighbouring regions occurred later, when the IACs were open. During the period of IAC operation, overall ED volume in the KFL&A region declined, whereas in the neighbouring regions, an increase was observed. Resp/ILI visits increased in both the KFL&A region and the neighbouring regions; however, the KFL&A region visits increased at a lower rate (Figure 3).

Overall ED visit volume decreased throughout the period of IAC operation, whereas in neighbouring regions, overall ED visit volume peaked at 15% higher than the day before the IAC began operation. Resp/ILI visits were more pronounced, with visits related to influenza increasing to a peak of 17% above the level prior to IAC operation in the KFL&A region, whereas in the neighbouring regions, this peak was 105%.

To estimate the potential reduction in overall ED visit volume, a time series regression model was used. Table 2 presents the results of the time series regression model showing the expected number of visits to the KFL&A hospitals. Figure 4 compares the actual expected number of visits in the KFL&A region according to this regression model.

The result of the Mann-Whitney-Wilcoxon test was nonsignificant when comparing the regression model residuals over the validation period (2005–2009) to those when the IACs were open ($p = 0.54$). However, when the regression model residuals over the 23–day period prior to the opening of the IACs were compared to the 23-day period when the IACs were open, the Mann-Whitney-Wilcoxon test was significant at the 0.05 level ($p = 0.045$), with visits being less than expected.

DISCUSSION

The fall 2009 wave of pandemic influenza A/H1N1 represented a unique opportunity to implement a public health intervention to help alleviate the pressure

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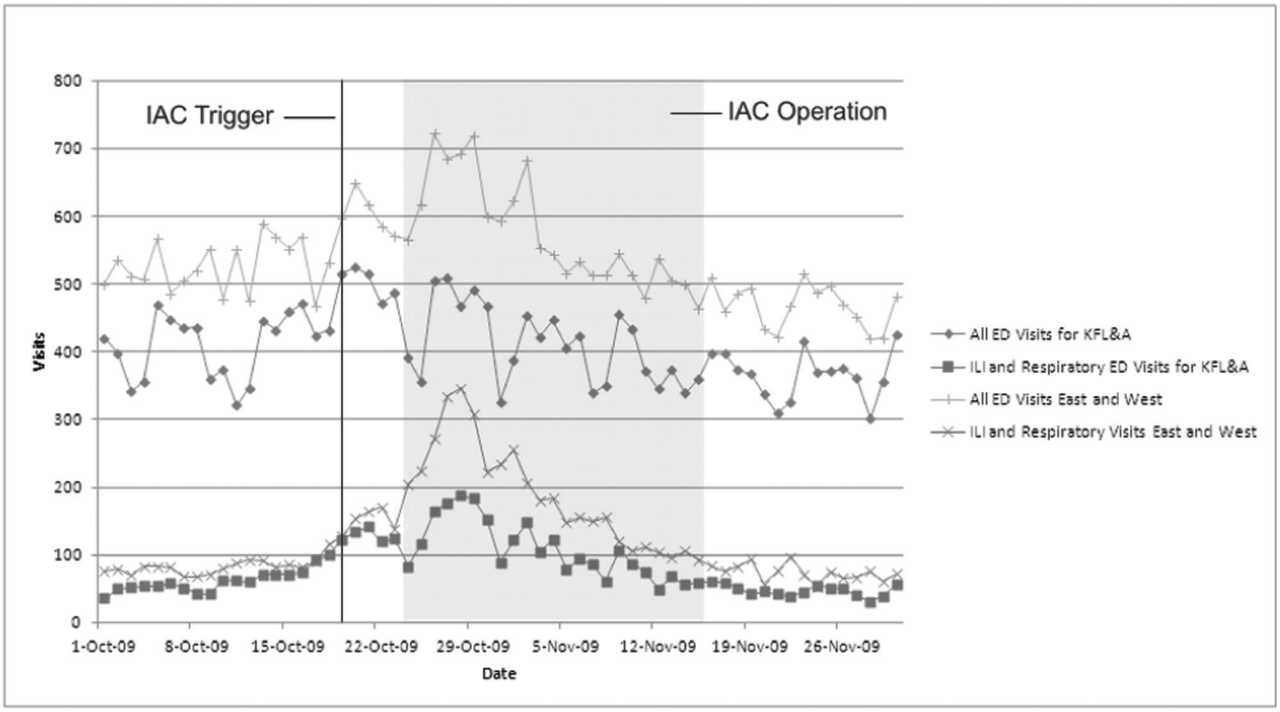

Figure 2. Emergency department (ED) visit volume for the Kingston, Frontenac, Lennox and Addington (KFLA&A) region and the combined east and west neighbouring health unit hospitals. IAC = influenza assessment centre; ILI = influenza-like illness.

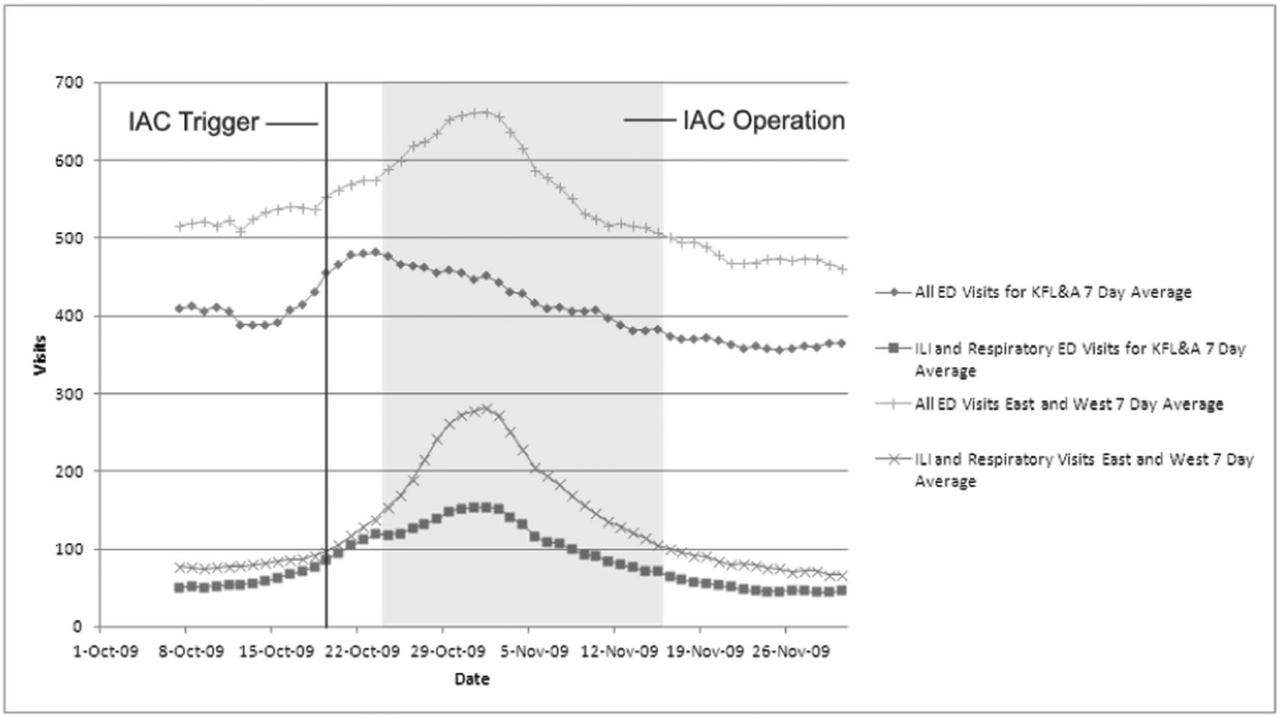

Figure 3. Seven-day running average for emergency department (ED) visits in the Kingston, Frontenac, Lennox and Addington (KFL&A) region and the neighbouring east and west health unit hospitals. IAC = influenza assessment centre; ILI = influenza-like illness.

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Table 2. Time series regression model parameter

Predictor variable	Parameter estimate	Standard error	*p* value
Intercept	289.74	14.12	< 0.0001
Aggregate visits of east hospitals	0.367	0.062	< 0.0001
Aggregate visits of west hospitals	0.196	0.038	< 0.0001
Weekend indicator	−62.32	2.79	< 0.0001
Error lag			
1 day	−0.269	0.042	< 0.0001
2 days	−0.161	0.044	0.0003
3 days	−0.116	0.044	0.0082

faced by traditional acute care facilities during a communicable disease outbreak.

ED visit volume and visits for Resp/ILI at the hospitals within the KFL&A region were associated with deployment of IACs. This is particularly noticeable when compared with hospitals in the neighbouring regions to those in the KFL&A region. It appears that the IACs reduced the peak of both overall ED visits and Resp/ILI visits. However, the lapse of several days between the trigger of the IACs and the full operation of the IACs with the KFL&A region appears to have missed attenuating an increase in visit volume during this time. This illustrates the delicate balance that exists between the triggering of IACs too soon and too late.

The statistical comparison of the residuals before and after IAC deployment is suggestive of a decline in ED visits subsequent to opening of the IACs. Direct comparison of the time series of KFL&A region hospitals with surrounding hospitals also suggests that peaks in overall ED visits at KFL&A region hospitals occurred before the IACs were opened, whereas those at the other hospitals occurred after the IACs were opened. Previous research has shown that ED volume can be expected to increase or at least maintain volume during an influenza outbreak.[11] Yet such an

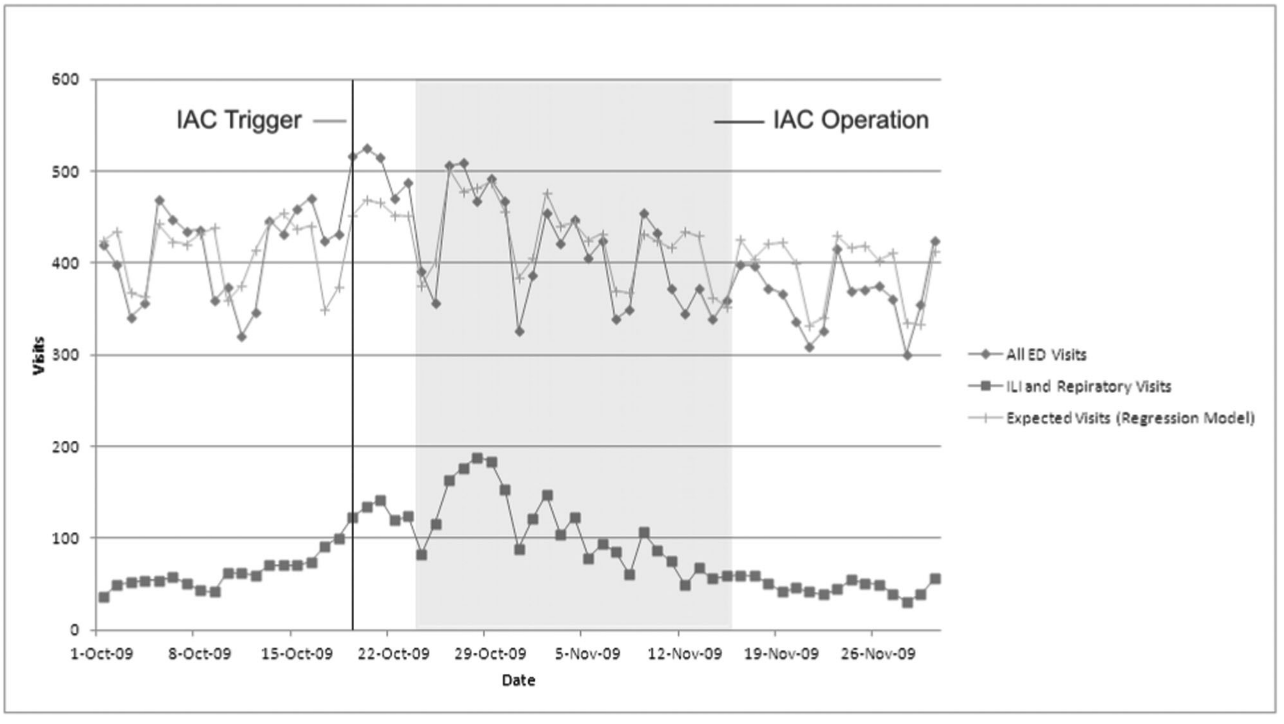

Figure 4. Actual and expected (regression model) emergency department (ED) visits to hospitals in the Kingston, Frontenac, Lennox and Addington region. IAC = influenza assessment centre; ILI = influenza-like illness.

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increase was not observed. During the first 2 days of the hospital-based IAC operation, approximately 100 patients were seen each day and were triaged directly away from the ED to the IACs. The large drop in visits observed on weekends in the KFL&A region may be explained in several ways. First, average ED volume normally dips on weekends, with many people waiting until the start of the week to seek medical attention. Second, an established children's outpatient clinic normally closes on the weekends, reducing the overall ED volume for hospitals in the KFL&A region. In addition, the IACs were open during the weekend.

During IAC activity, only about 1.4% of the patients assessed by the centre physicians were deemed to require the services of an acute care facility and were as such admitted. This result, and the fact that the sum of observed KFL&A region ED and IAC visits would be much greater than the expected number of ED visits, suggests that opening the IACs resulted in an increased demand for health care. This unexpected increased use may create costs that offset any other identified benefits and needs further study. The timing and establishment of IACs have a learning curve to increase efficiency and effectiveness. It may be that a well-timed 2–week period in an 8-week epidemic provides the highest cost benefit; however, further study is required in this area. In addition, the definitive trigger point to opening IACs will depend on regional capacity at acute care centres, expected mortality and morbidity, effectiveness of vaccination strategies, and monitoring health use in other jurisdictions.

As stated earlier, the timing of the IAC deployment was based on a visit volume trigger. There may, however, be more efficient trigger thresholds for this region that would result in the IACs being deployed earlier to catch the upswing in visit volume observed between the trigger event and the actual operation of the IACs. In addition, the establishment of a trigger for IACs would likely be region specific and, in some cases, hospital specific. Other confounders, such as bed meetings and management and surgery cancellations, and their possible effect on ED workload were not investigated. In addition, an academic training centre facility was compared to smaller nonacademic facilities in the surrounding areas. This meant that there was a staffing capability in Kingston to help facilitate the opening of IACs where they may not have been present in surrounding areas, especially during a pandemic in which up to 30% of staff may either be ill or refuse to come to work.

It is possible that the public relations campaign and media coverage during the pandemic, combined with the fact that IACs were more accessible than EDs for many people, may have resulted in a higher user volume than would normally have been experienced. A cost/benefit analysis of this increase is in order for future IAC deployment versus other models of providing surge capacity.

CONCLUSION

Stand-alone IACs are associated with reduced ED volumes, which suggests that it is possible to preserve ED capacity during a pandemic. IACs may also play an important role in protecting the operational capacity/functionality of acute care facilities during epidemics of contagion such as that seen annually with seasonal influenza. The observed benefits imply that timing the start and duration of their operation is critical and ideally best guided by real-time surveillance capabilities. Future research into the costs and benefits against other models of care delivery with similar or better outcomes is needed prior to implementation.

Competing interests: None declared.

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