

2009-2010 pH1N1 Influenza Pandemic Summary Report

Date:	May 17, 2010
To:	Board of Health
From:	Medical Officer of Health
Wards:	All
Reference Number:	

SUMMARY

In June, 2009, the World Health Organization (WHO) declared the first influenza pandemic of the 21st century, following the emergence and global spread of a novel strain of human influenza A (pandemic H1N1 influenza A, or pH1N1).¹ This report describes the epidemiology of pH1N1 influenza in Toronto in 2009-2010, and outlines the major components of the Toronto Public Health (TPH) pH1N1 response:

- surveillance;
- case investigation and management;
- public information and risk communication;
- immunization;
- flu assessment centres;
- stakeholder liaison;
- occupational health and safety; and,
- logistics and financial support.

Finally, the report reviews lessons learned from TPH's evaluation of the pH1N1 response, and provides recommendations for strengthening pandemic and emergency preparedness and response in Toronto.

RECOMMENDATIONS

The Medical Officer of Health recommends that:

1. the Minister of Health and Long-Term Care:
 - a. update the Ontario Health Pandemic Influenza Plan (OHPIP) by specifying the pandemic roles and responsibilities of the Ontario Agency

- for Health Protection and Promotion (OAHPP), and the Local Health Integration Networks (LHINs);
- b. designate LHINs as the lead agencies for the planning and implementation of flu assessment centres (FACs), including the identification of criteria for opening and closing FACs, in partnership with local public health units and primary care providers, including community health centres as key partners for ensuring that the needs of vulnerable populations are met;
 - c. mandate the province-wide use of real-time surveillance systems for timely monitoring of local influenza-like illness (ILI) activity;
 - d. ensure that the Ontario Government Pharmaceutical and Medical Supply Service (OGPMSS) remains the coordinating agency responsible for processing and pre-approving community-based influenza vaccine orders for Toronto, during an influenza pandemic;
 - e. direct the Chief MOH to lead planning and coordination of communication with the primary care sector regarding pandemic influenza;
 - f. review the effectiveness of different methods of pandemic influenza vaccine delivery, as demonstrated in the pH1N1 pandemic, and include criteria for decision-making in the OHPIP.
2. the Medical Officer of Health report annually on the state of pandemic influenza preparedness, incorporating lessons learned from the pH1N1 pandemic.
 3. the Board of Health request that the City Manager establish service agreements with community agencies with which TPH partners in its role as the City emergency lead for psychosocial response, in consultation with the Medical Officer of Health.
 4. the Board of Health forward this report to the Minister of Health and Long-Term Care, the Chief Medical Officer of Health, the Ministry of Education, the Ministry of Labour, the CEOs of the five Toronto-area Local Health Integration Networks (LHINs), the Association of Local Public Health Agencies (aLPHa), the Ontario Agency for Health Protection and Promotion (OAHPP), the Ontario Medical Association (OMA), the Ontario Government Pharmaceutical and Medical Supply Service (OGPMSS), the Toronto District School Board (TDSB), the Toronto Catholic District School Board (TCDSB), and the City Manager.

Financial Impact

As detailed in Table 1 below, the total estimated extraordinary costs of the TPH pH1N1 influenza outbreak response for 2009 and 2010 was \$6,565.2 thousand. In 2009, the pH1N1 response incurred \$6,072.5 thousand in expenses, and in 2010 an estimated \$492.7 thousand. Extraordinary expenditures include overtime, security, and contracted nursing services costs. These expenditures exclude the base salaries and benefits of all TPH staff assigned to the outbreak.

Table 1: TPH pH1N1 response cost and funding summary for mass immunization clinics

	2009 Actual (\$000s)	2010 Estimate (\$000s)	Total
Total Expenditure	6,072.5	492.7	6,565.2
Revenue			
pH1N1 Offset Revenue (Doses Administered @ \$10)	(2,100.0)	(216.2)	(2,316.2)
Seasonal Flu Offset Revenue (Doses Administered @ \$5)	(95.2)	(9.7)	(104.9)
Provincial Funding to Support Niagara System	(500.2)	0.0	(500.2)
Subtotal: Total Exp Less Offset & 100% Direct	3,377.1	266.8	3,643.9
Provincial Cost Shared Funding (75%)	(2,532.8)	(200.1)	(2,733.0)
Net Expenditure	844.3	66.7	911.0

The Ontario Ministry of Health and Long Term Care (MOHLTC) provided the following funding:

- \$10.00 per dose of pH1N1 influenza vaccine administered by TPH, or \$2,316.2 thousand for approximately 231,620 doses;
- \$5.00 per dose of seasonal influenza vaccine administered by TPH at mass immunization clinics in December 2009 and in catch-up pH1N1 and seasonal flu immunization clinics in January 2010, or \$104.9 thousand for approximately 20,976 doses;
- 100 per cent of the cost to implement the Clinic Event Management System (CEMS), or \$500.2 thousand; and,
- 75 percent or \$2,733.0 thousand of the remaining balance of \$3,643.9 thousand with \$2,532.8 thousand for 2009 and an estimated \$200.1 thousand in 2010. The City of Toronto's share totals \$911.0 thousand for 2009 and 2010.

In addition, the MOHLTC paid 75 percent of the base salaries and benefits of staff paid by the Ministry of Health Promotion and Ministry of Children and Youth Services totalling approximately \$974.4 thousand.

The flu assessment centers (FACs) were funded through a separate process as reported to the Board of Health at its January 18, 2010 meeting. The MOHLTC Emergency Operations Centre provided 100 per cent funding for the reimbursement of extraordinary costs to implement FACs, as part of the City's response to the second wave of pH1N1 in the fall of 2009.

There was no extra cost to the City over the approved budget for 2009. The estimated costs for 2010 of \$492.7 thousand gross are expected to be within the per-dosage funding

and TPH's 2010 cost shared mandatory program funding. There will be no financial impact in 2010 beyond what has already been approved in TPH's 2010 Approved Operating Budgets.

The Deputy City Manager and Chief Financial Officer has reviewed this report and agrees with the financial impact information.

DECISION HISTORY

At the request of the Board of Health, the Medical Officer of Health has provided verbal or written updates on pandemic preparedness, and more recently on the pH1N1 pandemic, at each meeting of the Board. The most recent update was provided at the Board's meeting of May 3, 2010.

ISSUE BACKGROUND

pH1N1 Influenza

Influenza is a highly contagious acute viral infection of the respiratory tract, which causes annual seasonal outbreaks and periodic worldwide pandemics. The WHO's 2005 criteria for an influenza pandemic to be declared required the emergence and spread of a new subtype of influenza A virus. However, a change in the revised 2009 WHO guidelines broadened the criteria for a pandemic, allowing for a new reassortant influenza A virus (i.e. a different virus than its original subtype, but not an entirely new subtype) that spreads easily from person to person to meet the criteria for a pandemic.² In April, 2009, reports emerged of a novel reassortant strain of human influenza A (pH1N1) circulating in Mexico,³ and cases were confirmed in Toronto within the month.⁴ On June 11, 2009, the WHO declared pandemic Phase 6, signalling the first influenza pandemic of the 21st century.⁵

Pandemic Planning and Preparedness

The TPH Plan for an Influenza Pandemic (TPHPIP)⁶ aims to minimize serious illness and death, and to minimize societal disruption. Like the national⁷ and provincial⁸ plans, TPHPIP is based on the assumption of a moderately severe pandemic in which 15 to 35 per cent of the population is infected over two or three waves.⁹ However, because influenza viruses change frequently, a high degree of uncertainty attends any influenza pandemic. The implementation of the plan must be adjusted during the pandemic in response to the patterns of disease spread and severity observed at the time.

When pH1N1 arrived in Toronto, TPH had been working for several years with its City, community and provincial partners to prepare to respond to an influenza pandemic. Although TPH worked to engage the Local Health Integration Networks (LHINs), the OHPIP did not include LHINs (or the provincial Ontario Agency for Health Protection and Promotion) so their roles and responsibilities were unclear. In addition, following the first wave of pH1N1, the City experienced a six-week labour disruption in summer 2009, which resulted in some planning delays.

COMMENTS

1. EPIDEMIOLOGY OF pH1N1 IN TORONTO

The pH1N1 influenza virus caused a less severe pandemic than had been planned for in Toronto, in Canada, and around the world. Globally, the majority of persons infected with pH1N1 experienced mild or moderate, uncomplicated illness. Most cases resolved in under a week, without antiviral treatment or hospitalization.¹⁰ But, whereas 90% of deaths due to seasonal flu occur in frail older persons, the majority of deaths worldwide due to pH1N1 occurred in younger persons, many of whom were otherwise healthy.^{11,12} Pregnant women, young children, persons with severely compromised immune systems, and persons with certain chronic medical conditions (including asthma and lung disease, heart and kidney disease, and some neurological conditions) appeared to be at increased risk of severe or complicated pH1N1 disease.¹³

Laboratory-Confirmed Cases, Hospitalizations and Deaths

TPH monitored all reported laboratory-confirmed cases of pH1N1 illness, as well as hospitalizations and deaths due to pH1N1. All laboratory-confirmed influenza A cases were assumed to be pH1N1 cases, because the pandemic pH1N1 strain quickly became the most common strain of influenza A in Ontario.¹⁴ However, reported laboratory-confirmed influenza A cases captured only a small fraction of the total number of pH1N1 cases in Toronto. This was because most persons with mild or asymptomatic influenza-like illness (ILI) would not have sought medical attention, and also due to changes in laboratory testing practices.¹⁵ There was a major shift in provincial testing recommendations in June 2009, which advised health care providers to limit testing to hospitalized cases and those at high risk for complicated pH1N1 illness.¹⁶

In total, 2422 laboratory-confirmed cases of pH1N1 were reported (Table 2), with an average age of 25 years (ranging from less than one to 95 years). Fifty-two per cent of laboratory-confirmed cases were female, and 4.7 per cent of these females reported being pregnant. Wave 1 of the pH1N1 outbreak caused higher levels of infection in the spring and summer months, as compared to seasonal flu over the previous ten years (Figure 1). During wave 2 of pH1N1 activity in Toronto, reported laboratory-confirmed cases peaked the week ending October 31, 2009. Wave 2 subsided in January 2010, in Toronto and across Canada.^{17,18} A third wave of widespread pH1N1 transmission has not occurred in Canada or in the United States (US).¹⁹ In Toronto, only 13 laboratory-confirmed cases of influenza A have been reported since January 1, 2010. The onset of illness in the last reported laboratory-confirmed case in Toronto was March 17, 2010. The sustained regional flu activity reported in the Southeastern US in March and early April, 2010²⁰ had subsided as of the week ending April 17, 2010.²¹

Reported influenza A incidence rates were highest for school-aged children, teens, infants and children under five years, and lowest in older adults (Figure 2). This contrasts with seasonal flu, where there is typically a U-shaped age distribution pattern, with the majority of illness occurring in older adults and infants. Adults born before 1957 appear to have had some degree of immunity to the pH1N1 virus.²²

Table 2: Number and rates of Influenza A (pH1N1) laboratory-confirmed cases, hospitalizations, deaths and outbreaks, 2009-2010 – Toronto and Canada

Outcome	Toronto			Canada
	Wave 1	Wave 2	Cumulative (Waves 1 and 2)	Cumulative
Laboratory-confirmed influenza A cases (pH1N1 cases)	1827 (1573)	1245 (849)	3072 (2422)	
Number of laboratory-confirmed influenza A hospitalizations (pH1N1 cases)	117 (99)	334 (240)	451 (339)	(7678)
Hospitalized laboratory-confirmed pH1N1 cases per 100,000 population	3.7	9.1	12.8	25.7
Number of laboratory-confirmed influenza A case admissions requiring intensive care / ventilation (pH1N1 case admissions)	28 (25)	45 (41)	73 (66)	(1473)
Laboratory-confirmed pH1N1 case admissions requiring intensive care / ventilation per 100,000 population	0.9	1.5	2.5	4.4
Number of deaths	9	21	30	428
Deaths per 100,000 population	0.3	0.8	1.1	1.3
Number of institutional outbreaks	1	10	11	

Source: Ontario Ministry of Health & Long-Term Care, Integrated Public Health Information System (IPHIS), extracted 14/04/2010.

* In wave 2, two of the influenza A deaths were not subtyped and one was untypeable

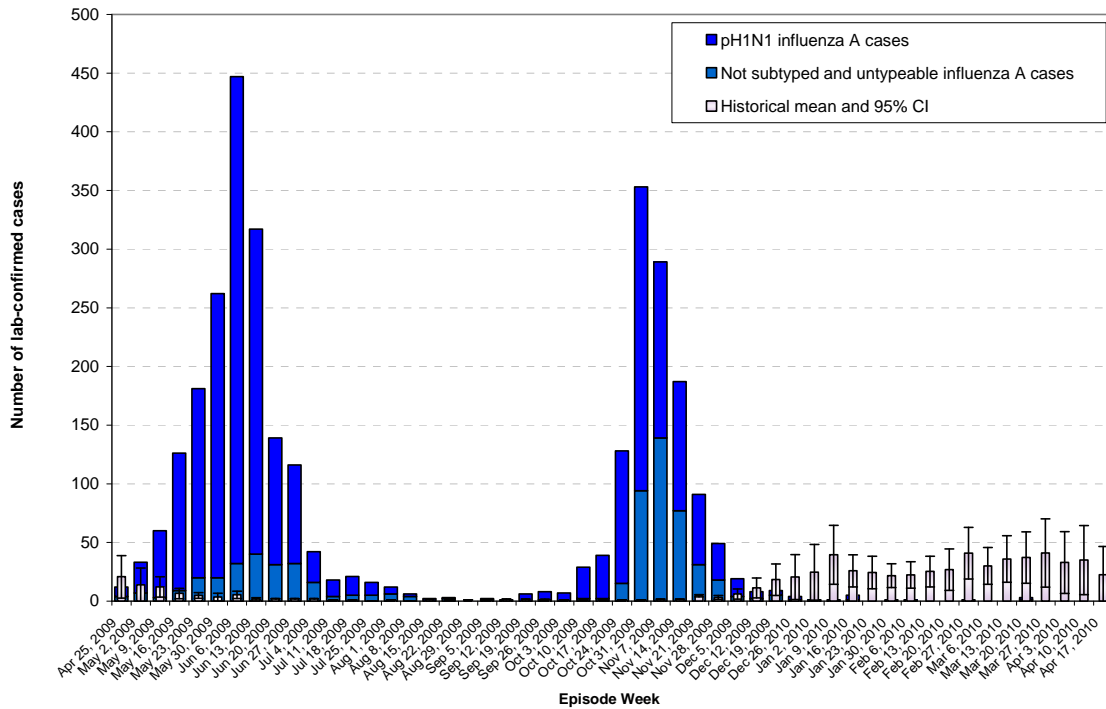
Due to changes in the criteria for laboratory testing in June 2009, the numbers of reported laboratory-confirmed pH1N1 cases can not be compared between wave 1 and wave 2. However, hospitalization rates and rates of admission requiring intensive care and/or ventilation can be compared, and both of these rates were higher in wave 2 than in wave 1 in Toronto (Table 2). Toronto residents experienced similar or lower rates of hospitalization, hospital admission requiring intensive care and/or ventilation, and deaths due to pH1N1, compared to national rates (Table 2).²³ In Toronto and nationally, infants and children under five years of age experienced the highest pH1N1 hospitalization rates, although rates were again lower in Toronto residents (44.7 versus 100.4 hospitalized cases per 100,000 population). The total case-fatality rate over both pH1N1 waves in Toronto in 2009-2010 was lower than the average case-fatality rate for seasonal flu in Toronto from 1999-2000 to 2008-2009 (1.2 versus 2.6 deaths per 100 laboratory-confirmed cases).

TPH also investigated and supported the management of pH1N1 outbreaks in institutions. In wave 1, one pH1N1 influenza outbreak was reported in an acute care hospital, and in wave 2, ten institutional pH1N1 outbreaks were reported in acute and chronic care hospitals, long-term care facilities, a retirement home, and a residential school.

Other Indicators of pH1N1 Activity in Toronto

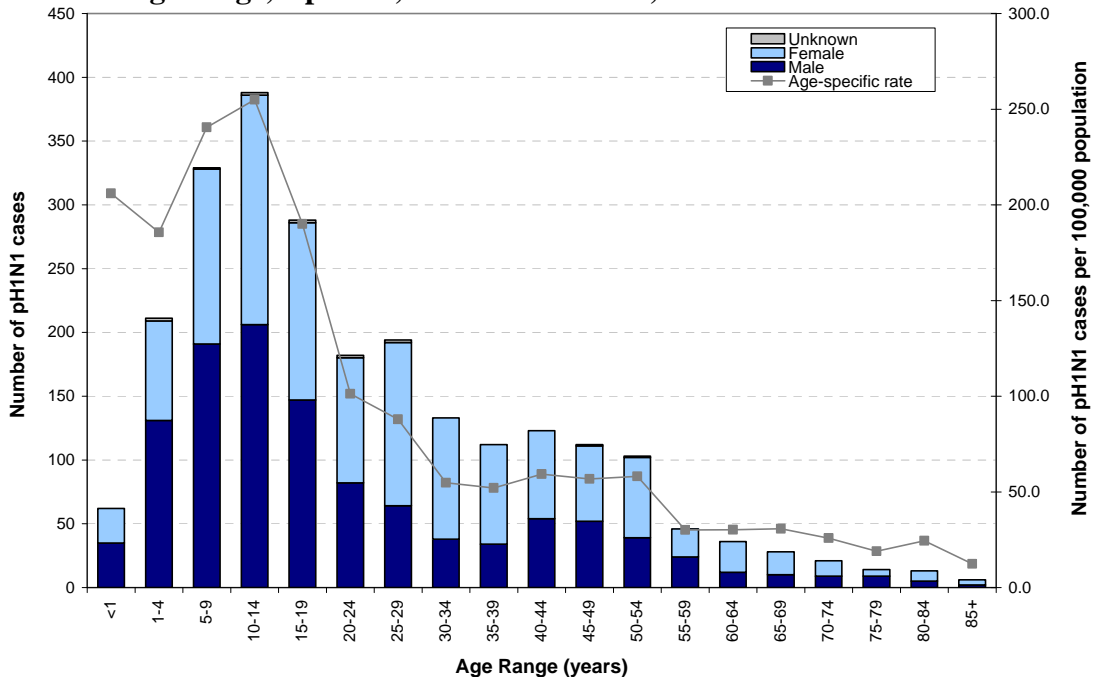
TPH actively monitored several other indicators of pH1N1 activity in the Toronto population to identify trends as early as possible, including the proportion of positive influenza A laboratory tests, hospital emergency department (ED) visits for influenza-like illness (ILI) visits, ILI visits to sentinel physicians, absenteeism and clusters of ILI in Toronto elementary schools, and absenteeism in selected Toronto workplaces (Figure 3).

Figure 1: Number of laboratory-confirmed cases of influenza A, week of April 19, 2009 to week of April 11, 2010, compared to the 1999-2000 to 2008-2009 mean for all influenza cases - Toronto



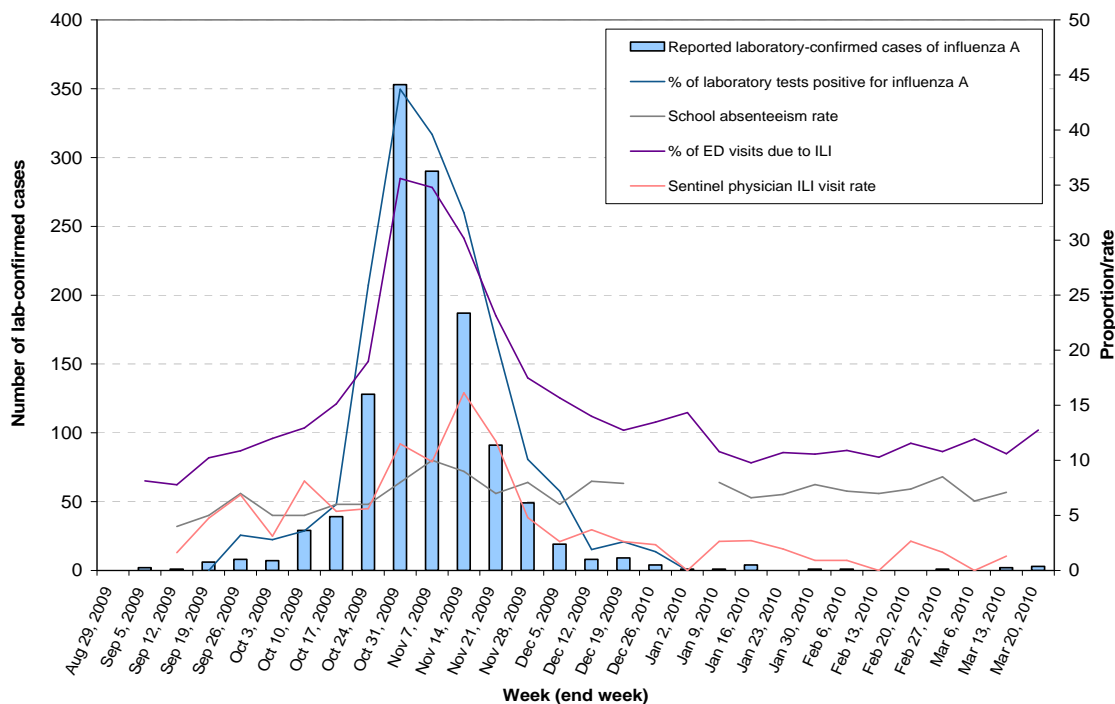
Source: Ontario Ministry of Health & Long-Term Care, Integrated Public Health Information System (iPHIS), extracted 14/04/2010.

Figure 2: Number and rate of laboratory-confirmed pH1N1 influenza A cases, by gender and age range, April 19, 2009 to March 20, 2010 – Toronto



Source: Ontario Ministry of Health & Long-Term Care, iPHIS

Figure 3: Number of reported cases of influenza A and other indicators of influenza activity, August 23, 2009 to March 20, 2010 - Toronto



Source: Ontario Agency for Health Protection and Promotion (OAHPP) Laboratory Pandemic H1N1 Surveillance Report.; iPHIS.
TPH Communicable Disease Surveillance Unit

2. THE PUBLIC HEALTH RESPONSE TO pH1N1

The TPH Pandemic Influenza Plan guided the TPH pH1N1 response, and was adapted to reflect the evolving understanding and experience of pH1N1 globally, and in Toronto. TPH implemented its incident management system (IMS) to organize the pH1N1 response internally, and to coordinate with external partners in the City of Toronto, in the community, and at the Province.

The following section describes the major components of the TPH pH1N1 response:

- a) surveillance;
- b) case investigation and management;
- c) public information and risk communication;
- d) immunization;
- e) flu assessment centres;
- f) stakeholder liaison;
- g) occupational health and safety; and,
- h) logistics and financial support.

a. Surveillance

TPH conducted ongoing data collection, analysis and dissemination to inform the local public health response to pH1N1, and reported new cases to the MOHLTC via the Integrated Public Health Information System (iPHIS). TPH produced and posted influenza epidemiologic reports on the TPH web site at least weekly (three times per

week during peak pH1N1 activity).²⁴ TPH also produced daily reports of pH1N1 vaccine usage in TPH clinics and weekly FAC data reports. In addition, TPH monitored all reported adverse events following immunizations (AEFIs). All AEFIs reported to TPH were in turn reported to the MOHLTC, and then to the federal government, which investigates and monitors adverse events following immunization across Canada.

b. Case Investigation and Management

TPH conducted detailed investigations of the first 100 cases of confirmed pH1N1 reported in Toronto residents, as part of an investigation of the first 200 cases in Ontario. TPH also conducted household, workplace and school contact follow up, and recommended monitoring for signs and symptoms of pH1N1 and/or laboratory testing as appropriate, until this was no longer recommended. In wave 1, TPH investigated suspect ILI cases in schools and day care centres, and notified schools by letter when a confirmed case was identified in the school.

In wave 2, the MOHLTC directed local public health units to investigate cases only in the event of death, hospitalization, or when the case was known to be pregnant or a member of a high risk group. This was done in collaboration with hospitals and the Coroner's Office. In wave 2, TPH provided general messaging and information to all schools. TPH also supported the investigation and management of institutional pH1N1 outbreaks and, where appropriate, provided information to other public health units on their confirmed cases in Toronto hospitals.

c. Public Information and Risk Communication

The key infection control measure implemented by TPH to limit the spread of pH1N1 in Toronto was the provision of public information and education, emphasizing the promotion of hand hygiene, cough and sneeze etiquette, and staying home when ill. Because pH1N1 was less severe than anticipated, the federal and provincial governments did not recommend other public health measures (e.g. school or child care facility closures, and mass gathering cancellations).²⁵

TPH employed multiple strategies to provide public information and risk communication throughout the pH1N1 response: via advertising and social marketing in local newspapers, on City recycling bins and on public transit; via the TPH web site; via TPH and City phone lines; via responding to public email inquiries; and via the media. From October 1 to December 31, 2009, the TPH web site received 1,376,687 visits, a 200-fold increase compared to the previous quarter. TPH developed many pH1N1 fact sheets and other materials that were tailored for particular groups, translated into multiple languages, and posted on the web site. A specific TPH pH1N1 web page was created for physicians. During peak vaccination periods TPH posted clinic wait times on the web site four times a day and provided wait time updates on Facebook.

TPH fielded 37,032 pH1N1-related calls to Toronto Health Connection (THC) in wave 1 and wave 2, and in wave 2 the City of Toronto 311 phone line began receiving additional pH1N1-related calls. From September 21 to December 31, 2009, a dedicated TPH pH1N1 inquiry line received approximately 11,350 calls from the general public, and a

TPH pH1N1 physician inquiry line received approximately 1150 calls. From September 1 to December 31, 2009, TPH also responded to approximately 1200 pH1N1-related media inquiries. TPH and City of Toronto Strategic Communications provided daily media monitoring of pH1N1 news coverage.

d. Immunization

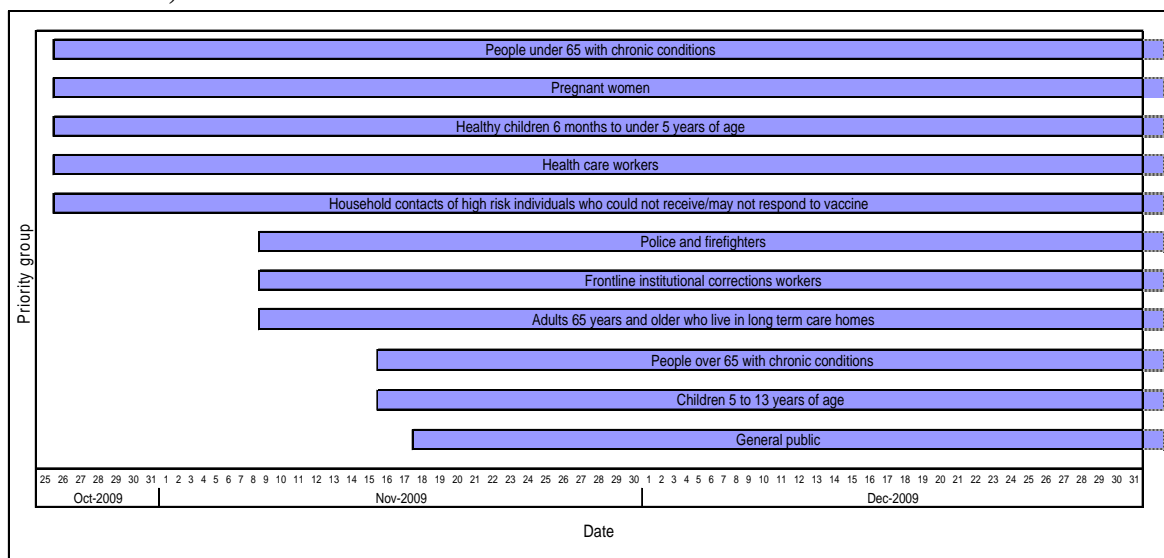
In August 2009, the Government of Canada released its pandemic vaccine priority framework²⁶, and announced its plan to order 50.4 million doses of pH1N1 vaccine.²⁷ Both adjuvanted and unadjuvanted pH1N1 vaccines were approved for use in Canada,²⁸ although the availability of the different vaccines evolved over the response, and provincial recommendations for different priority groups changed frequently (Figure 4).

Adjuvants are used to increase an individual's immune response to a vaccine, and they allow smaller quantities of genetic material to be used for each dose. The adjuvant used in the pH1N1 vaccine in Canada contained squalene oil, water, and Vitamin E.²⁹ The adjuvanted pH1N1 vaccine was considered safe for everyone over the age of six months, and TPH provided the adjuvanted pH1N1 vaccine to any person who wanted it and did not have a specific contraindication, including pregnant women. However, because the squalene-based adjuvant had not been studied in pregnant women, unadjuvanted pH1N1 vaccines were recommended for pregnant women,³⁰ when available.

When pH1N1 vaccine became available in late October 2009, TPH mounted the largest vaccination campaign in its history. TPH operated ten mass immunization clinic (MIC) sites, two smaller vaccination clinic locations, and provided vaccine in shelters and drop-in centres across the city. In addition, TPH coordinated pH1N1 vaccine ordering for all health care providers and facilities who administered pH1N1 vaccine in Toronto.

In total, over 750,000 doses of pH1N1 influenza vaccine were administered during the pH1N1 response in Toronto. An estimated 30 per cent of all doses of pH1N1 vaccine were administered at TPH clinics, with the balance given by Toronto community-based providers. The pH1N1 response achieved an estimated pH1N1 vaccination coverage of 28.2 per cent for the population of Toronto. This estimate includes the number of pH1N1 vaccine doses administered to Toronto residents by neighbouring health units' immunization clinics, and excludes the number of non-residents who were vaccinated at TPH immunization clinics while visiting, working, or receiving health care in Toronto. This estimate is consistent with a provincial public opinion poll for the week ending January 3, 2010, in which 30 per cent of adults from the 416 area code reported that they had received the pH1N1 vaccine, 3 per cent reported that they definitely planned to get the pH1N1 vaccine, and 4 per cent reported that they would probably get the pH1N1 vaccine.³¹

Figure 4: pH1N1 vaccine eligibility by priority groups, October 26, 2009 to December 31, 2009 – Ontario



Source: Ministry of Health and Long-Term Care News Releases, October 23, 2009³², November 10, 2009,³³ November 13, 2009,³⁴ and November 18, 2009³⁵

Mass Immunization Clinics

TPH had planned to open ten large MIC sites for the general public the week of November 2, 2009, when vaccine was expected to become available. However, some vaccine became available a week earlier, at the same time as public demand for pH1N1 vaccine increased dramatically following the tragic deaths of two Ontario children with influenza. These deaths, especially the October 26, 2009 death of a 13-year-old boy from Toronto, received intense media attention. TPH responded by deciding to accelerate the opening of immunization clinics to the public. Expedited clinics were held at eight sites from October 26 through October 31, 2009, with heavy attendance. TPH introduced a time-ticket system to reduce time spent waiting in line, by assigning a time to return to the clinic. Significant wait times occurred on the first few days of MIC operation, but by November 2, 2009, all MIC sites were operational, and the wait time for clinic attendees was greatly reduced.³⁶ TPH initially managed MIC data in an Excel database, and, between November 6 and 20, 2009 implemented the newly available provincial Clinic Event Management System (CEMS) electronic database, which was used to report immunization data to the MOHLTC.

TPH administered a total of 231,675 doses of pH1N1 vaccine. Almost all of these doses were administered at over 390 immunization clinics at ten locations across Toronto, as well as at two smaller clinic sites in 2009 (Table 3), and 11 catch-up immunization clinics in January 2010. TPH administered 3,841 doses of pH1N1 vaccine at 119 Toronto shelters and drop-in centres serving the homeless and under-housed. In addition, TPH administered 20,242 doses of seasonal flu vaccine in MICs, and in catch-up influenza immunization clinics held in January 2010. 56.8 per cent of pH1N1 vaccine doses administered at TPH immunization clinics were given to females.

Table 3: Number and proportion of pH1N1 doses administered at TPH immunization clinics by location, October 26, 2009 to January 31, 2010 – Toronto

	Location	Total # doses given	% of doses given at MICs	# of days clinic open
Mass immunization clinics	North York Civic Centre	33,691	14.5%	48
	Scarborough Civic Centre	31,801	13.7%	45
	Metro Hall	30,789	13.3%	44
	Etobicoke Civic Centre	30,784	13.3%	47
	East York Civic Centre	30,193	13.0%	47
	North Toronto Memorial Community Centre	22,659	9.8%	35
	Timothy Eaton	20,284	8.8%	37
	North Kipling Community Centre	9,866	4.3%	35
	Masaryk-Cowan Community Recreation Centre	8,895	3.8%	26
	Melody Public School	7,248	3.1%	27
	Other public health clinics	Shelters (all combined)	3,841	1.7%
277 Victoria St - MIC Clinic		1,387	0.6%	2
Other		237	0.1%	1
Total		231,675	100%	394

* 169 clinics were held in 119 shelters across Toronto

Source: Toronto Public Health pH1N1 Vaccine Database. Extracted March 24, 2010.

MIC sites were selected based on geographic distribution throughout the city, accessibility, and capacity to accommodate large numbers of clients and staff. Clinics were initially opened six days per week, but quickly expanded to seven days a week to address public demand, including evening hours from Monday to Friday. The number of doses of pH1N1 vaccine administered per day at TPH MICs varied over time, peaking between November 16 and November 29, 2009. At the peak of the vaccination campaign, an estimated 560 TPH staff and 200 external agency staff were deployed to work at MICs, in addition to Red Cross volunteers. TPH worked with local community care access centres (CCACs) to facilitate vaccination of homebound clients and partnered with Toronto Emergency Medical Services (EMS) to provide vaccine to staff in City-run long term care homes, EMS, Toronto Police and Fire Services, Children’s Services, and to TPH staff. Community agency partners collaborated with TPH staff to provide psychosocial support to clients.

Community-Based Vaccine Providers

Although community-based and workplace flu vaccine providers administer the majority of seasonal flu vaccines each year, the provincial pandemic influenza plan called for local public health units to deliver all pandemic influenza vaccine. TPH, the Ontario Medical Association (OMA), and others successfully advocated for a central role for community vaccine providers in pH1N1 vaccine delivery. However, the MOHLTC initially required providers to submit detailed data regarding vaccines given to local public health units on a weekly basis, which had not been required with other vaccines. In September 2009, the

MOHLTC delegated responsibility for processing pH1N1 vaccine requests from all community-based providers to TPH. This was a new role for TPH, which the Ontario Government Pharmaceutical and Medical Supply Service (OGPMSS) had performed in the past in Toronto.

As the MOHLTC received information on pH1N1 vaccine availability from PHAC, it informed TPH of vaccine supply for the next week. Adjuvanted pH1N1 vaccine first became available to TPH for pre-approval of distribution to community providers on October 21, 2009, and unadjuvanted pH1N1 vaccine first became available to TPH on November 2, 2009. In total, TPH pre-approved 1,077,635 doses of pH1N1 vaccine for distribution to 1208 community-based providers across Toronto. These included community-based physicians, community health centres, family health teams, acute and chronic care hospitals, universities and colleges, long term care facilities, correctional facilities and aboriginal access centres. There was no provincial direction to differentiate private clinics from other providers as long as they offered the vaccine at no charge. For the first six weeks that pH1N1 vaccine was available, community-based provider demand for vaccine far exceeded the supply. The MOHLTC initially provided vaccine in 500-dose packages, and each 10-dose vial had to be used within 24 hours of being opened. TPH worked together with the OGPMSS to successfully facilitate vaccine re-packaging to smaller quantities when required by community-based providers. The OGPMSS resumed responsibility for vaccine ordering on December 9, 2009.

TPH responded to a large volume of physician queries via the TPH vaccine ordering phone line, and prepared multiple communications for physicians about flu vaccines, the changing distribution process, and MOHLTC reporting requirements. This information was managed and monitored in the CEMS electronic database. Approximately 72% of the 1,208 community-based physicians who provided pH1N1 vaccination in Toronto reported immunization data to TPH. The estimated number of doses administered by all community-based providers was 516,835, or 50% of all doses shipped (Table 4). The age distribution of persons who received pH1N1 vaccine at TPH clinics was similar to that reported by community-based providers.

e. Flu Assessment Centres (FACs)

The OHPIP (2008) identified primary care practitioners in the community as the key providers of influenza assessment, treatment and referral during a pandemic.³⁷ Based on the emerging epidemiology of pH1N1, PHAC and the Province recommended against using antiviral medications on a preventative basis during the pH1N1 response.³⁸ The MOHLTC instructed community-based health care providers to restrict the use of antiviral medications to persons with ILI who were at high risk of complications, and were within 48 hours of symptom onset.³⁹

The OHPIP called for FACs, if required, to relieve pressure on local emergency departments and primary care clinics. TPH collaborated with existing health care facilities across the city, and was prepared to open eight partnership FACs if required. In addition, TPH actively worked with the Toronto Central LHIN to increase the capacity of community health centres to provide flu assessment for vulnerable clients.

Table 4: pH1N1 vaccine utilization by community-based providers, October 2009 to March 2010 – Toronto

Type of Community Providers	Number of providers	Number of doses distributed	Number of doses given (estimate)*
Non-institutional Providers			
Physicians	951	767,310	359,147
Family Health Team	71	91,085	41,351
Comm. Health Centre	24	30,950	12,605
Institutional Providers			
Acute Care Hospital	16	102,800	59,113
Long Term Care Home / Retirement Home	92	32,690	17,400
Complex Continuing Care	9	13,030	6,195
University/College	8	8,150	8,162
Correctional Facility	4	1,400	381
Other/Unknown	33	30,220	12,480
Total	1,208	1,077,635	516,835

Source: Toronto Public Health pH1N1 Vaccine Database. Extracted March 24, 2010.

* Vaccine utilization by community-based providers was estimated using the following formula:

$$\frac{\text{total \# of vaccinations reported}}{\text{total \# of doses shipped to reporting providers}} \times \text{total \# of doses shipped to all providers}$$

TPH implemented five FACs in partnership with the following health care facilities:

- Scarborough Hospital, 3000 Lawrence Ave East;
- Humber River Regional Hospital, Site No. 2, 2111 Finch Ave West;
- Sherbourne Health Centre, 333 Sherbourne Street;
- South East Family Health Team, 833 Coxwell Ave; and
- York Community Services. 1651 Keele Street.

The first FAC opened November 12, 2009, and the last FAC closed December 1, 2009. Partnership FACs provided services for a total of 819 clients over this period. Both TPH and the partner health care facilities contributed resources and operational support.

f. Stakeholder Liaison

Throughout the pH1N1 response, a dedicated team of TPH staff liaised with TPH's many partners. TPH maintained regular telephone contact with school board officials and prepared communications for Toronto schools, child care centres and parents. In October and November 2009, TPH convened dialogues and round-table meetings to share information and hear from ethno-racial and Aboriginal community leaders; shelters, drop-ins, Out of the Cold and other agencies serving priority vulnerable populations; colleges and universities; and faith community leaders. From October 6, 2009 to December 31, 2009, TPH staff provided 1,410 pH1N1 consultations and delivered 380 pH1N1 presentations to community organizations ranging from Ontario Early Years programs to schools to long term care facilities.

Key health care sector linkages were maintained through regular meetings to plan and implement response activities in the first and second waves of pH1N1. Partners included CCACs, LHINs, the Toronto Academic Health Sciences Network (TAHSN) Pandemic Influenza Steering Committee, the TPH Pandemic Influenza Advisory Group, and the TPH Primary Care Subcommittee. The Ontario Medical Association (OMA) facilitated TPH communication with physicians via email and fax. TPH staff participated in daily teleconferences with the MOHLTC and the OAHPP, and ensured that TPH maintained connections with other public health units (especially in the Greater Toronto Area), provincial partners and PHAC.

Many successful partnerships between TPH and other City divisions, agencies, boards and commissions were further developed during the pH1N1 response. TPH worked with Corporate Human Resources to implement a temporary change to the City's Attendance Management Policy in wave 2, to facilitate staff staying home while ill. TPH provided regular pH1N1 updates to the Toronto Emergency Management Program Control Group, the Mayor's Office, the City Manager, the City Pandemic Influenza Steering Committee, the Corporate Joint Occupational Health and Safety Committee, and the Board of Health.

g. Occupational Health and Safety

TPH staff provided oversight for health and safety issues at MICs and FACs. Activities included review of the use of personal protective equipment at sites, response to health and safety complaints, and weekly inspections to ensure adherence to infection control practices. TPH staff liaised with Corporate Human Resources, Toronto Parks, Forestry and Recreation, the Ministry of Labour, the Corporate Joint Occupational Health and Safety Committee, and union officials around occupational health and safety issues. In addition, mental health nurse consultants and peer support staff offered psychosocial support to MIC and FAC workers.

h. Logistics and Financial Support

TPH staff ensured appropriate receiving, storing, managing, staging and distribution of all supplies and equipment used in the pH1N1 response. Contracted security services were employed for pH1N1 response facilities, in addition to the expert advice and assistance of the City's Facilities Management Division–Security Management section. TPH Information Technology (IT) staff installed and supported the immunization data software and hardware provided by the Province. With the support of the City's Information Technology Division, TPH avoided the risk of personal health information being transported and lost by staff, and developed the technology solutions used to support the pH1N1 response.

TPH developed and implemented staffing models to support the pH1N1 response. TPH human resources staff identified available staff, coordinated shift scheduling, managed labour relations issues, implemented staff time-tracking procedures, and coordinated a complex payroll management response. Contracted nursing services for TPH clinics were secured through the City's Requests for Quotations (RFQs) process. In addition, TPH staff conducted all pH1N1 procurement activities, and performed costing for all components of the TPH pH1N1 response.

3. EVALUATION OF THE pH1N1 RESPONSE

TPH conducted an evaluation of the first and second waves of the pH1N1 response, with a view to informing future pandemic and emergency preparedness and response. This consisted of interviews, focus groups with internal and external key stakeholders, debriefings with the teams that lead the different components of the TPH response, surveys of TPH staff and management, a survey of Toronto physicians, a survey of key stakeholders in the FAC response, and detailed analysis of TPH documents and epidemiologic data. In addition, TPH staff participated in pH1N1 evaluation sessions undertaken by the TC-LHIN, the Council of Medical Officers of Health, and the MOHTLC. The key findings of the evaluation are presented below with respect to:

- a) surveillance;
- b) case investigation and management;
- c) public information and risk communication;
- d) immunization;
- e) flu assessment centres;
- f) stakeholder liaison;
- g) occupational health and safety;
- h) logistics and financial support.

a. Surveillance

The lack of robust surveillance systems with real-time indicators of health care system capacity was a challenge during the pH1N1 response. The pH1N1 response clearly demonstrated the need for real-time surveillance, including the establishment of indicators of local primary care capacity and hospital ED ILI activity, as well as criteria for implementing FACs, and for scaling up and down FAC operations.

b. Case Investigation and Management

Delays in national and provincial recommendations for case and contact investigation and management resulted in numerous challenges at the local level, especially during wave 1. The timely release of recommendations will ensure appropriate case investigation and management at the local level during an influenza pandemic.

c. Public Information and Risk Communication

Overall, TPH received positive feedback on its public information and risk communication during the pH1N1 response. Physicians and key community stakeholders identified the TPH web site as a particularly useful resource. Many of TPH's external partners acknowledged the evolving nature of information shared during the pH1N1 response, and TPH staff identified this as a key challenge during the response. Provincial public opinion polls conducted during wave 2 showed that the percentage of adults surveyed in the 416 area code who said that they trusted their local public health unit for information ranged from 63 to 81 per cent.⁴⁰ External partners also credited key contacts at TPH as being very accessible and helpful during the response.

d. Immunization

Mass Immunization Clinics

Lessons learned regarding MIC processes highlighted the challenges associated with responding to a pandemic in the context of unexpected events, and evolving directions from other levels of government. From the TPH perspective, repeated changes to provincial recommendations for vaccine priority groups were challenging to explain to the public. Implementing these changes at clinics also proved difficult, particularly when vaccine had just arrived and supply was limited. From the external partner perspective, some felt that TPH communications about MIC locations, dates and times were confusing for staff, the public, and partners. TPH plans to explore alternative scheduling and communication options for MICs in the future.

The pH1N1 response also demonstrated the need for back-up locations for MICs; in the TPHPIC MICs had been planned to be located at schools, but as school closures were not occurring, school space was unavailable. Alternative large venues for MICs merit further exploration for future MIC planning. Going forward, TPH's City partners have also encouraged TPH to draw more widely on other City divisions' expertise in operations and logistics, particularly in relation to MICs. At each TPH MIC site, the CEMS database also required substantial unanticipated IT support and hardware, resulting in delays. Measures to prevent such delays should be integrated into future MIC planning and implementation.

Community-Based Vaccine Providers

Many of TPH's health care sector partners, and most of the physicians who responded to the post-pH1N1 TPH survey, perceived inefficiencies and/or inequities associated with the vaccine ordering process for community-based providers. Less than half of physicians who completed the TPH survey felt that the vaccine ordering process went well. Frequently cited concerns included: vaccine delays; excess documentation requirements; wastage due to 500-dose shipments and 24 hour stability after reconstitution; cold chain fridge requirements; and the complexity of messages to physicians and the public. Some physicians also identified a need for more primary care representation in pandemic planning and response.

Despite these challenges, community-based physicians in Toronto administered almost 70 per cent of pH1N1 vaccine during the response. Most physicians surveyed reported that they received the support they needed from TPH, and most found the information that TPH provided with the vaccine to be useful. Vaccine ordering for community-based providers in Toronto was a new role for TPH that began during wave 2 of the pH1N1 response. Given that pre-approving pH1N1 vaccine orders, and collecting and reporting vaccine utilization data were new functions, TPH staff identified the need for significantly more information technology (IT) and communications support.

Vaccine Safety

The adverse event following immunization (AEFI) rate for TPH immunization clinics was < 0.1%. A total of 136 confirmed AEFIs were reported in association with pH1N1 vaccine in Toronto. 76% of AEFIs occurred among persons aged 19 to 64 years. The

most frequently reported AEFIs were sore arm or swelling. A small number of allergic reactions and anaphylactic reactions occurred following immunization, and one case of Guillain-Barre Syndrome was reported in Toronto following pH1N1 vaccination. This case remains under investigation to further assess whether it was causally related to the pH1N1 vaccine.

Estimated Impact of pH1N1 Immunization in Wave 2

Following wave 1, an estimated 15% of Toronto residents were likely immune to the pH1N1 virus.⁴¹ Following wave 2, an estimated 28.2% of Toronto residents had received pH1N1 vaccine. At the individual level, most persons who were vaccinated against pH1N1 are presumed to have been protected from pH1N1 infection and illness, including severe illness requiring hospitalization or death, beginning 10 days after receiving vaccine.⁴²

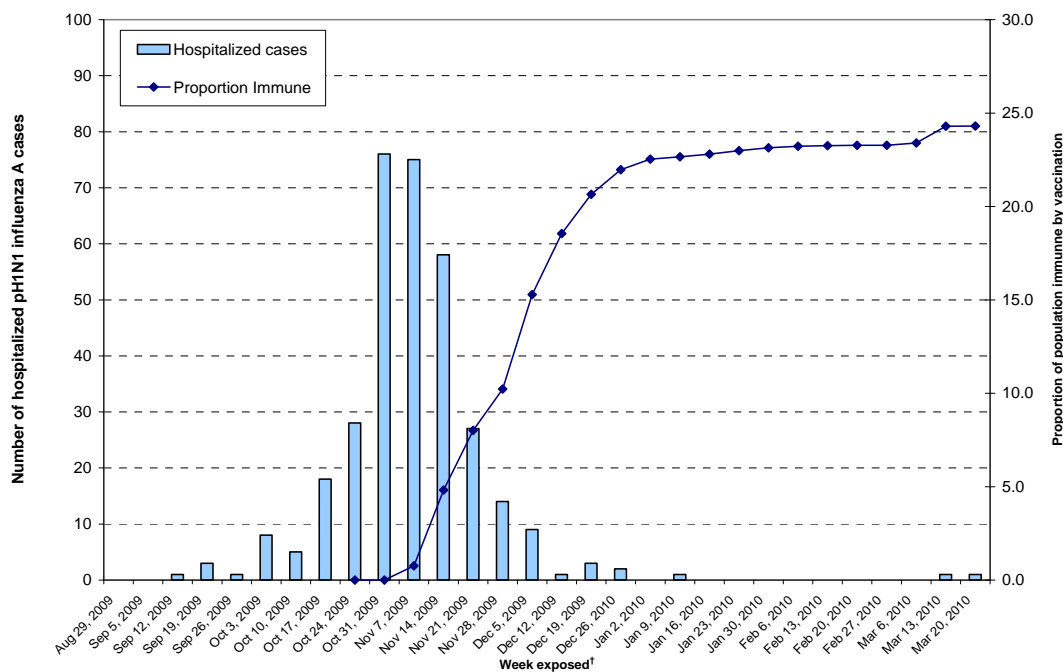
In wave 2, delays in the production of Canada's national supply of pH1N1 vaccine occurred. Figure 5 shows weekly reported hospitalized laboratory-confirmed pH1N1 cases by their date of exposure, in relation to the proportion of Toronto residents estimated to be immune to pH1N1 due to vaccination. Date of exposure was estimated by subtracting three days (a typical pH1N1 incubation period) from the reported date of symptom onset. The proportion of Toronto residents estimated to be immune to pH1N1 due to vaccination was calculated by adding 10 days to the recorded date of pH1N1 vaccination. Although it is difficult to assess the true impact of pH1N1 immunization in Toronto, these findings indicate that most of the infections that lead to severe illness and mortality in wave 2 occurred before significant levels of vaccine immunity occurred.

e. Flu Assessment Centres

Partnership FACs and flu assessment capacity-building with CHCs improved access to ILI-related primary care for some Toronto residents, including vulnerable individuals. The relationships that TPH nurtured with hospitals, family health teams, CHCs and LHINs strengthened our ability to collaborate for the pH1N1 response, and for future emergencies.

In terms of FAC roles, the revised 2008 OHPIP recommended using the existing primary care system for flu assessment, treatment and referral, but it did not designate a body responsible for FACs and left many critical questions unanswered, particularly regarding implementation, remuneration and compensation, and legal liability. The MOHLTC designated TPH as the lead for planning FACs in Toronto, and remained silent on the role of LHINs, despite local public health units' lack of authority and expertise in this area to direct primary care practitioners and hospitals in the community. The need for clear direction around governance of FAC planning and implementation, and the related roles and responsibilities of local public health and the LHINs, was confirmed repeatedly by internal staff and external partners. This is a particular priority for health sector stakeholders who want timely FAC implementation and more clear FAC leadership in the future.

Figure 5: Number of hospitalized laboratory-confirmed pH1N1 influenza A cases and estimated proportion of Toronto residents immune to pH1N1 by vaccination, August 29, 2009 to March 20, 2010 - Toronto



[‡] The date immune by vaccination was calculated for each case by adding 10 days to their date of vaccination.
[†] The exposure date was calculated for each case by subtracting 2 days (typical H1N1 incubation period) from the episode date.
 Source: Ontario Ministry of Health & Long-Term Care, Integrated Public Health Information System (iPHIS), extracted 14/04/2010.

f. Stakeholder Liaison

External partners looked to TPH as the expert lead in the pH1N1 response. Overall, external partners perceived TPH as collaborative, open, and responsive to their needs during the pH1N1 response, and they generally felt that TPH’s role and their related roles in the pH1N1 response were appropriate. TPH staff and external partners emphasized the value of building strong relationships prior to the response phase of a pandemic or public health emergency, through planning and training activities.

g. Occupational Health and Safety

The pH1N1 response emphasized the importance of continuing to build relationships between TPH and other City divisions and labour unions involved in future MIC or other emergency site set-up and operations. Engaging the Ministry of Labour proactively to identify health and safety concerns would facilitate future pandemic responses. Pre-established agreements with partner community agencies could mitigate some of the challenges around recruiting psychosocial support staff, as well as concerns raised during the pH1N1 response around timely access to fit-testing of masks and personal protective equipment training, and potential legal liability related to using community partners in an outbreak. In addition, some City partners identified the need for the City to more clearly distinguish its responsibility for employment decisions related to occupational health and safety from TPH’s role as a public health expert advisor to the City.

h. Logistics and Financial Support

In addition to lessons learned at TPH internally, pH1N1 highlighted the need for a decision on the appropriate use of volunteers in a pandemic or emergency response, based on resource and risk management discussions involving Corporate Labour Relations, and the bargaining units regarding the City's Use of Volunteers Policy.

IMPACT ON PUBLIC HEALTH SERVICES

TPH's response to the pH1N1 pandemic required a significant redeployment of management and staff. At the height of the TPH response, on November 20, 2009, close to 1,000 TPH staff members were redeployed to pH1N1 activities. Approximately 60 per cent of the management team and 55 per cent of staff were redeployed to support a range of pH1N1 functions, with MICs requiring the largest redeployment of management and staff. Redeployed management and staff came from all areas of the division. The majority of redeployed staff returned to their usual roles following the December 13, 2009 closure of the remaining MICs. This redeployment could not have been achieved without an impact on regular TPH services. As the number of staff required to respond to the pH1N1 pandemic increased, the Divisional Continuity of Operations Plan (COOP) provided direction regarding the scale back of services. At the height of the redeployment, the following TPH services were suspended for approximately six weeks:

- Several sexual health clinics
- Vaccine Preventable Disease school assessment program
- Personal service setting inspections
- Low-risk food premise inspections
- Smoke Free Ontario compliance inspections in workplaces, public places, schools and hospitals
- Injury prevention and substance use prevention program
- School health promotion
- Workplace health promotion
- Healthy Babies Healthy Children public health nurse home visiting
- Parenting education programs
- Healthiest Babies Possible program
- Investing in Families program
- Dental and oral health program at collective living centres
- Various planning and policy projects

CONCLUSION:

The pH1N1 influenza pandemic emerged in April 2009, caused two waves of illness in Toronto, and subsided in January 2010. Fortunately there was a low incidence of severe illness and mortality. However, unlike in seasonal flu outbreaks, the highest rates of reported pH1N1 illness occurred among young children and young adults. TPH worked with its many City, health sector and community partners and with the Province to mobilize an extensive response. This included an unprecedented vaccination program, innovative flu assessment centres in partnership with existing Toronto health care facilities, and ongoing provision of public information and risk communication. However, most of the infections that lead to serious illness in wave 2 had already

occurred before the vaccine became available and significant levels of immunity could be achieved.

Following the response, TPH conducted an evaluation with internal staff and external partners. Lessons learned during the pH1N1 response in Toronto will inform ongoing work by TPH and its partners to strengthen pandemic and emergency planning, preparedness, and response. TPH will explore MIC scheduling and communication alternatives. The Province needs to mandate real-time surveillance of local health care system capacity in a pandemic, and needs to designate the LHINs as the lead agencies for FAC planning and implementation, in partnership with local public health units. To support community-based pandemic vaccine providers, who are estimated to have administered almost 70 per cent of pH1N1 vaccine in Toronto in 2009/2010, the Province needs to maintain OGPMS as the coordinating body for vaccine ordering for community-based providers in a pandemic. Provincial leadership for improved planning and coordination with the primary care sector is needed. Finally, TPH and its key City, community, and provincial partners need to continue to develop flexible pandemic and emergency plans and to continue building the relationships that facilitate collaboration during pandemic and emergency response.

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