

Childhood Immunization Coverage in Toronto

Date:	January 26, 2009
To:	Board of Health
From:	Medical Officer of Health
Wards:	All
Reference Number:	

SUMMARY

The incidence of communicable diseases affecting children has been greatly reduced in Canada since the introduction of vaccination programs 50 years ago. Immunization has saved more lives in Canada than any other health intervention. New vaccines continue to be developed, approved and funded to prevent the death and disease associated with communicable diseases. However, outbreaks of vaccine preventable diseases still occur in Toronto despite free access to most vaccines.

In order for immunization programs to be successful, high rates of coverage are required among children and adults. Immunization coverage rates are a recognized indicator of population health and health system performance. Toronto's coverage rate for mandatory vaccinations among school age children is 96.1%, close to the national target of 99%. However the monitoring and assessment of coverage rates for all vaccines can be improved locally, provincially and nationally.

This report provides information on childhood vaccination coverage rates in Toronto. It provides a summary of the immunization programs provided by Toronto Public Health (TPH) in relation to the new Ontario Public Health Standards. It compares coverage rates locally, provincially and nationally for mandatory and non-mandatory vaccinations. The importance of meeting the national immunization targets is reviewed including strategies to improve coverage for Toronto children. Finally, this report advocates for the systematic collection of immunization data through a local, provincial and national immunization registry.

RECOMMENDATIONS

The Medical Officer of Health recommends:

1. That the Board of Health urge the Ministry of Health and Long-Term Care (MOHLTC) to:
 - i) Work with local public health units and primary care practitioners to implement strategies to promote age-appropriate vaccinations of children and youth.
 - ii) Work with the Medical Officer of Health to further assess immunization coverage-related inequalities for Toronto children.
 - iii) Implement a strategy to measure immunization coverage for children at two years of age in Ontario at regular intervals.
 - iv) Ensure that local Boards of Health have access to a comprehensive immunization registry for collecting immunization information; in particular that the proposed PANORAMA national communicable disease information system:
 - a. is aligned with the data and functional elements recommended by the Canadian Immunization Registry Network (CIRN);
 - b. allows for assessment of all vaccines for public health purposes including mandatory and non-mandatory vaccines, new vaccines and vaccines that are publicly and non-publicly funded;
 - c. is designed so that it can easily accept electronic information from health care provider electronic medical records to allow for the efficient capture of immunizations provided in the community;
 - d. allows for assessment of coverage data by other variables stored in the registry including provider, geographic elements, and socio-demographic variables.
 - v) Ensure that Ontario's e-Health strategy of electronic health record systems for primary care providers is capable of updating and communicating immunization information into the proposed PANORAMA system for public health units.
2. That the Board of Health urge the Chief Public Health Officer of Canada to expand the Canadian National Immunization Survey sample size to allow for analysis of immunization coverage data at the local level and to collect data on socio-demographic and economic factors to assess inequalities in vaccination coverage.

3. That the Board of Health request the Medical Officer of Health to:
 - i) Report back to the Board of Health on inequalities in vaccination coverage in Toronto.
 - ii) Include compliance and resource implications with respect to the Vaccine Preventable Diseases Program as part of his report to the Board of Health on overall compliance with the 2008 Ontario Public Health Standards.

4. That this report be forwarded to the Chief Public Health Officer of Canada, Chief Medical Officer of Health for Ontario, the Provincial Infectious Diseases Advisory Committee (PIDAC), e-Health Ontario, the Provincial Panorama Steering Committee, the Canadian Health Infoway, the Institute for Clinical and Evaluative Sciences, the Canadian Immunization Registry Network, the National Advisory Committee on Immunization, the Canadian Public Health Association, the Ontario Public Health Association, and the Association of Local Public Health Agencies.

Financial Impact

This report has no financial impact.

ISSUE BACKGROUND

Immunization has long been recognized as a proven public health tool for controlling and even eradicating infectious diseases such as smallpox which, before the era of vaccines, threatened 60% of the world's population and killed every fourth infected person. Polio infections and related paralysis has similarly been reduced by 99% worldwide, with polio having been eliminated in North and South America. Licensed routine vaccines have been administered for decades to millions of individuals world-wide and are proven as both effective and safe.

Immunization refers to the creation of immunity or protection against a particular disease, usually by the administration of a vaccine. Temporary, passive immunization can be produced by the administration of antibody in the form of immune globulin for some conditions. A vaccine is a substance used for active immunization, stimulating an immune response in the recipient. For the purposes of this report, the terms vaccination and immunization are used interchangeably.

In Canada, vaccines for humans are regulated by the Biologics and Genetic Therapeutics Directorate of Health Canada. Like all medicines, vaccines must undergo several stages of rigorous testing and safety standards before they are approved for use. Once vaccines are approved, several systems are in place to ensure that they are used effectively and safely. The National Advisory Committee on Immunization (NACI) makes recommendations for the use of vaccines in humans in Canada, including the identification of groups at risk for vaccine-preventable diseases for whom vaccine programs should be targeted.¹ Each province's Ministry of Health determines which vaccines it will fund and distribute through its provincial immunization schedule. In

Ontario, the Ministry of Health and Long-term Care receives expert advice from the Provincial Infectious Diseases Advisory Committee's (PIDAC) Immunization Subcommittee.

Almost 95% of vaccines given in Ontario are administered by primary care practitioners. A small number are given by local public health units. In most provinces and territories the majority of vaccinations are or will be provided by local public health units.² Ontario children are routinely offered combined vaccines to protect against 12 diseases: diphtheria, tetanus, polio, pertussis, *Haemophilus influenzae* b, measles, mumps, rubella, pneumococcal disease, meningitis C, varicella (chicken pox) and hepatitis B (see Appendix 1 for the Ontario Immunization Schedule). In addition, human papillomavirus (HPV) vaccine was introduced in 2007 for grade eight females and annual influenza vaccinations are available for children six months of age and older. All these vaccines are publicly funded for specific age groups. Certain travel-related vaccines and other new vaccines are not publicly funded. Infants receive most routine vaccinations in a primary series. Boosters and some vaccines are given at four to six years of age, during adolescence and in adulthood (Appendix 1).

Children who receive all recommended vaccines by two, seven and seventeen years of age are considered "up-to-date" in their immunization status. Those who receive some, but not all, of the recommended vaccines are considered "under-immunized", while children who receive no immunizations are referred to as "un-immunized".

A number of factors are found to influence whether children are up-to-date for age-appropriate vaccinations. Poverty and factors associated with poverty are the strongest predictors of children being under-immunized. Provider practices have been found to influence up-to-date immunization status of children. Parental attitudes, beliefs and perceptions are also strong predictors of parental vaccination behaviour and whether children are under-immunized or remain un-immunized.^{3 4 5 6 7 8 9 10}

Under-immunized and un-immunized children and adults are both at risk for becoming infected with vaccine preventable diseases that are still transmitted in the world and reintroduced into Toronto through travel and migration. Many international experiences have shown that when vaccination coverage rates fall below a critical level, outbreaks can occur. In the United Kingdom, rates of MMR vaccination fell due to unfounded fears that the vaccine caused autism following a 1998 report.¹¹ This saw the resurgence of measles infection in the U.K., resulting in preventable death and morbidity. In Toronto each year, outbreaks of vaccine preventable diseases continue to occur. In 2007, Toronto had eleven cases of mumps linked to a national outbreak of over 900 cases that began in the Maritimes among university and college students and spread across Canada. The mumps virus in this outbreak is the same strain that caused a large outbreak in the U.S.A. in 2006 and in the U.K. between 2004 and 2006. In 2008, Toronto experienced its largest measles outbreak since 1995 (26 confirmed cases in Toronto were among 56 cases reported in Ontario).

Immunization coverage is a health indicator that measures the percentage of people who are appropriately vaccinated. Assessment of immunization coverage is recommended nationally for children at two, seven and 17 years of age, with national benchmarks set for most vaccines (see Appendix 2).^{12 13 14}

Immunization coverage rates can be estimated in a number of ways, including through surveys or by a registry system.¹⁵ In 1996, participants attending the Canadian Immunization Conference recommended that a national immunization registry urgently be implemented. Registries have the capacity to consolidate vaccination records of children from multiple health care providers, identify children who are due or late for vaccinations, generate reminder and recall notices to ensure that children are vaccinated appropriately, and identify provider sites and geographic areas with low vaccination coverage.¹⁶ A provincial immunization registry would support public health planning by identifying populations at risk for delayed vaccination, thereby enabling health authorities to target interventions appropriately and to evaluate the success of the program.

One component of the National Immunization Strategy (2003) was to set out a plan to coordinate the development of a national network of provincial and territorial immunization registries.¹⁷ Since then the Canadian Immunization Registry Network (CIRN), with representatives from the Public Health Agency of Canada, the provinces, territories and other stakeholders, has developed recommendations for a multi-faceted registry including Functional and Data Standards (2002)¹⁸ and National Standards for Reporting Immunization Coverage (2004).¹⁹ CIRN is also working to promote bar-coding of vaccine products and is working with Pan-Canadian Health Infoway to ensure that immunization information systems meet national standards.²⁰ The first stage for project implementation is the planned 2010 launch of the Pan-Canadian Health Infoway immunization registry (PANORAMA). Once fully operational, this will be available to provinces and territories as a common platform for collection and reporting of vaccination information, with the capabilities of an immunization registry including reminder-recall functionality.

Legislation in Ontario assists local health units to promote and maintain high levels of vaccination in children and adolescents. The Immunization of School Pupils Act (ISPA)²¹ and the Day Nurseries Act (DNA)²² establish vaccine requirements for children attending public schools and day nurseries respectively, to ensure children are vaccinated in accordance with the publicly funded immunization schedule. These laws require proof of immunization with mandatory vaccines or a valid medical, religious or philosophical exemption to attend a school or licensed day nursery.²³ Not all vaccines are considered mandatory and included in these laws. The ISPA requires up-to-date vaccinations of diphtheria, tetanus, polio, measles, mumps and rubella for school attendance. The DNA states that the child must be immunized as recommended by the local Medical Officer of Health to attend a day nursery.

The Ontario Public Health Standards (2008) for vaccine preventable disease assessment and surveillance require public health units to assess, maintain and report on the

immunization status of children enrolled in licensed child care programs (as defined by the Day Nurseries Act), of children attending schools (in accordance with the Immunization of School Pupils Act) and immunizations administered at public health clinics.²⁴ Additionally, boards of health are required to report annual immunization coverage rates for school students, retrospectively at age two for current school students and for all children attending a licensed day nursery. The standards also state that the board of health shall promote and provide vaccination clinic services to individuals at health unit clinics, school-based clinics, community clinics, outreach clinics to vulnerable groups and through the annual influenza program.

Toronto Public Health's School Immunization Assessment Program annually reaches a rate of vaccine coverage of mandatory vaccines among Toronto students of over 95%, approaching the national benchmark for school-aged children. Data for most non-mandatory vaccines are either incomplete or not available.

COMMENTS

The Toronto Public Health Vaccine Preventable Disease (VPD) Program

The Toronto Public Health VPD Program includes components to monitor vaccination, administer vaccines and ensure vaccine safety and effectiveness.

1. Vaccination Monitoring

a) School Immunization Assessment Program

Each school year, TPH assesses approximately 350,000 students at over 850 schools in Toronto for required mandatory vaccines under the Immunization of School Pupils Act (ISPA). A provincial DOS-based system, IRIS, has been used since the mid 1990s to record vaccine information, assess all records and identify those student records which are not up-to-date. Primary students must be up-to-date for diphtheria, tetanus, polio, measles, mumps, and rubella. Secondary students must receive diphtheria and tetanus boosters in adolescence (see Appendix 1). If parents choose not to immunize their child, they must produce a medical exemption or a notarized statement of conscience or religious belief. Students who are not up-to-date and do not have a valid exemption may be suspended from school.

The goal of the program is to ensure students are protected while minimizing suspensions from school. TPH works in partnership with school boards and school staff to increase access to immunization services through the provision of information translated into multiple languages and by conducting community vaccination clinics in accessible locations throughout the city.

Each October, February and July, TPH receives an electronic import of student information from the four school boards in Toronto (Toronto District School Board, Toronto Catholic School Board, Toronto French School Board, and Toronto French Catholic School Board). Private schools participate voluntarily in the program. Each school is assessed at a different point in the school year.

TPH sends three notices at three-week intervals to parents of students whose vaccination records are incomplete, requesting confirmation of student vaccination before suspending students from school by order of the Medical Officer of Health under the ISPA. The letters are generated from IRIS, the provincial information system, and are only available in English and French. A flyer is enclosed with each mailing that states in 26 languages, “This is an important health message. Take the attached form to someone who can read and write English”. Translation services are available for those who call the Immunization Information Line for follow up.

If vaccination information or a valid exemption has not been received by the date on the third notice, a suspension order is mailed to the student’s parent/guardian. There is an additional three-week period from the mailing of the suspension order to the first day of suspension, allowing approximately nine weeks for the family to comply with the request. As the suspension date for each school approaches, TPH provides extra support in an effort to avert suspensions. The nursing staff call the families of students who remain non-compliant. Nurses continue to provide support on the first day of suspension, attending each school where ten or more students face suspension. The nurses assist the school staff, students and families through the process and assess new vaccination information brought by students or parents. Most students who are faced with suspension avoid the process by providing the required information on the first day of suspension. A suspension order can last up to 20 days but is rescinded when TPH receives the required information or an exemption has been filed. Re-suspension in current or subsequent years may occur.

Each year approximately 70,000 students receive a first notice from TPH and about 5,000 students are suspended. The vast majority of these suspensions last less than five days. On average, less than two percent of suspended students face re-suspension. Each year, vaccine coverage rates exceeding 95% for the mandatory vaccines are achieved among the cohort of school-aged students who have gone through the program. However, given that the assessment program is implemented on a rolling basis throughout the school year, a snapshot or cross-sectional coverage rate at any particular time will be slightly lower than 95%. For example, while the coverage rate is over 95% for all mandatory vaccines at the completion of the program, as of June 30, 2008, the overall coverage rate for measles, mumps and rubella was 91% and for diphtheria, tetanus and polio was 87%. The difference in rates is explained by new students who entered the school after the program started who have not been assessed and thus have no information in the system (about 5%) and students who have had a birthday and thus become overdue for a vaccination after the annual assessment.

b) Day Nursery Program

TPH does not currently assess immunization coverage of children in licensed day care settings, which is a requirement of the 2008 Ontario Public Health Standards and was a requirement of the 1997 Mandatory Programs. If TPH receives immunization information from a day nursery, the information is entered into the immunization information system; however the information is not actively sought. TPH collects

immunization information if there is an outbreak of a vaccine preventable disease in the day nursery to ensure that children who are exposed are protected.

A day nursery program is recommended to collect immunization information from day nursery operators on children who attend their facility. Since there is no electronic means to obtain vaccination information for the majority of day nursery children, and since day nurseries are independent bodies without the equivalent of a board of education, to implement this program would require staff to maintain individual contact with all day nurseries in order to promote and provide education about the program, collect data and enter all information manually into the immunization information system.

2. Vaccine Administration

a) Vaccines in Partnership (VIP) Clinics

In 2008, TPH completed a three year expanded pilot to provide community vaccination clinics to Toronto students as a part of the School Immunization Assessment Program. The purpose of the clinics is to provide students with access to immunization services that would support their catch-up on mandatory school vaccines, especially students without access to OHIP or a family doctor or those facing other barriers to receiving immunization. Clinics are held from 4 to 8 pm during January to June, at four civic centres and at five community centres located in high priority neighbourhoods. The locations are public-transit accessible and located in the city's four quadrants. Translation services are available through a telephone-based translation service. Immunization records not in English are sent for translation to determine which vaccines a child received in their country of origin.

In total, 45 clinics were offered in 2008; 1,416 students were immunized and 2,191 vaccinations were given. Each four-hour clinic, run by three nurses and a clerk, saw approximately 30 individuals and provided 50 vaccinations. In 2008, a third of clients who attended the clinics did not have either OHIP or a family physician.

The Vaccines in Partnership clinics do not currently have sustained funding although they continue to be a program priority, reducing barriers to access for required vaccinations. The provision of community immunization clinics is identified as an Ontario Public Health Standard requirement.²⁵

b) School-based vaccination programs

Each year, TPH offers all grade seven students in public and private schools two doses of hepatitis B vaccine and one dose of meningitis C vaccine through school-based clinics. Since 2007, grade eight females are offered three doses of the human papillomavirus (HPV) vaccine at school clinics as well. All school-based vaccinations require signed parental consent for those 14 years of age or younger. Catch up clinics in the community are also scheduled throughout the school year for those who missed a school clinic.

c) Community influenza clinics

Each fall, TPH holds approximately 60 influenza vaccine clinics across the city in malls, community centres, libraries, civic centres and other public places as part of the province's Universal Influenza Immunization Program. Children six months of age or older are vaccinated with free influenza vaccine as well as adults of all ages. In 2007, over 9,000 children less than 18 years of age were immunized for influenza at TPH clinics (out of a total of 32,500).

3. Vaccine Safety and Effectiveness

a) Cold chain program

Vaccine Storage and Handling, also known as "The Cold Chain", refers to the storage of vaccines between +2° C to +8° C from the time a vaccine is manufactured, to the time it is administered. The purpose is to maintain vaccine potency and minimize wastage. Administering vaccines that lack potency due to a cold chain failure can result in a poor immune response and lack of protection for the client. Certain vaccines are particularly sensitive to temperature abuse. Each year TPH nurses conduct on-site inspections of more than 1700 fridges at over 1500 facilities including doctors' offices, hospitals, long term care facilities and community health centres that contain publicly funded vaccines, to ensure they are compliant. Nurses also provide education, training and recommendations to maintain optimal practices.

b) Monitoring and follow up of adverse events following vaccination

An adverse event following vaccination is an unwanted or unexpected event following the administration of a vaccine. The event may be caused by a vaccine or may occur by coincidence (i.e. it would have occurred regardless of vaccination). In the Ontario Health Protection and Promotion Act, all health care professionals who administer vaccines and/or care for patients who may have had an "adverse event" following immunization are required by law to report the event to local public health authorities within seven days of recognizing the event. TPH investigates these reports and determines if the adverse event is likely caused by the vaccine or another cause. Reports of adverse events following vaccination are sent to the Ministry of Health and Long Term Care, where it is forwarded to the Public Health Agency of Canada (PHAC). The data are monitored in the Canadian Adverse Events Following Immunization (CAEFI) database to ensure the safety of vaccines on the Canadian market and to respond to unusual occurrences. Adverse events are also compared internationally.

Immunization Coverage Rates

In Ontario, mandatory school vaccinations include protection against diphtheria, tetanus, polio, and measles, mumps and rubella (MMR). Canada's benchmarks for up-to-date (UTD) immunization coverage of children at two, seven and 17 years of age for required school vaccines are 97%, 99% and 99% respectively for most vaccines (Appendix 2).

Other recommended childhood vaccines also have high national coverage benchmarks that vary according to age and vaccine. Immunization coverage detailed in this report, compares immunization coverage in Toronto with established national benchmarks.

1. Immunization Coverage at Two Years of Age

Being up-to-date at two years of age is considered a benchmark for receiving routine infant vaccines in a timely manner. Since young children are more susceptible to complications of vaccine preventable diseases, ensuring they are protected as early in life as possible is of the utmost importance.

a) Toronto Coverage:

Currently TPH does not have access to data on two year old immunizations, as TPH only collects data on school children. However, a provincial study by the Institute for Clinical Evaluative Sciences (ICES) based on doctors' billings estimated that 75% of children at age two in Toronto were up-to-date for age-appropriate vaccines, and four percent had received no vaccines.²⁶

b) Provincial Coverage:

Similarly, ICES estimated that approximately 66%²⁷ to 70%²⁸ of all Ontario children at two years of age were up-to-date for vaccines. An additional 20% could be brought up-to-date with one vaccination. Approximately four percent of children at two years had received no vaccine.²⁹

The provinces of British Columbia, Alberta, and Manitoba also report varying levels of under-immunization for two year old children (Appendix 3). As coverage is measured differently in each jurisdiction, direct comparisons are limited.³⁰

c) National Coverage:

National immunization coverage rates are estimated through the Canadian National Immunization Coverage Surveys (NICS). Every two years, a telephone survey is conducted of households across the country to estimate coverage rates for routinely recommended childhood immunizations by the second, seventh and seventeenth birthdays. Results are used to guide the development of immunization policies, identify populations or vaccines with low coverage and to provide annual statistics to the World Health Organization. Response rates tend to be low (30%) and responses can only be analyzed at the regional and national level. In 2006, coverage for diphtheria, tetanus and pertussis at two years of age was 62% in Canada, which is well below the national target for this age.³¹ Coverage for one dose of the MMR vaccine at two years of age was 85%, which is also below the national target.

In view of these rates, it is recommended that new methods to capture two year old immunizations, such as local representation in the National Immunization Survey, or an expanded registry system that collects immunization data directly from the provider, should be pursued.

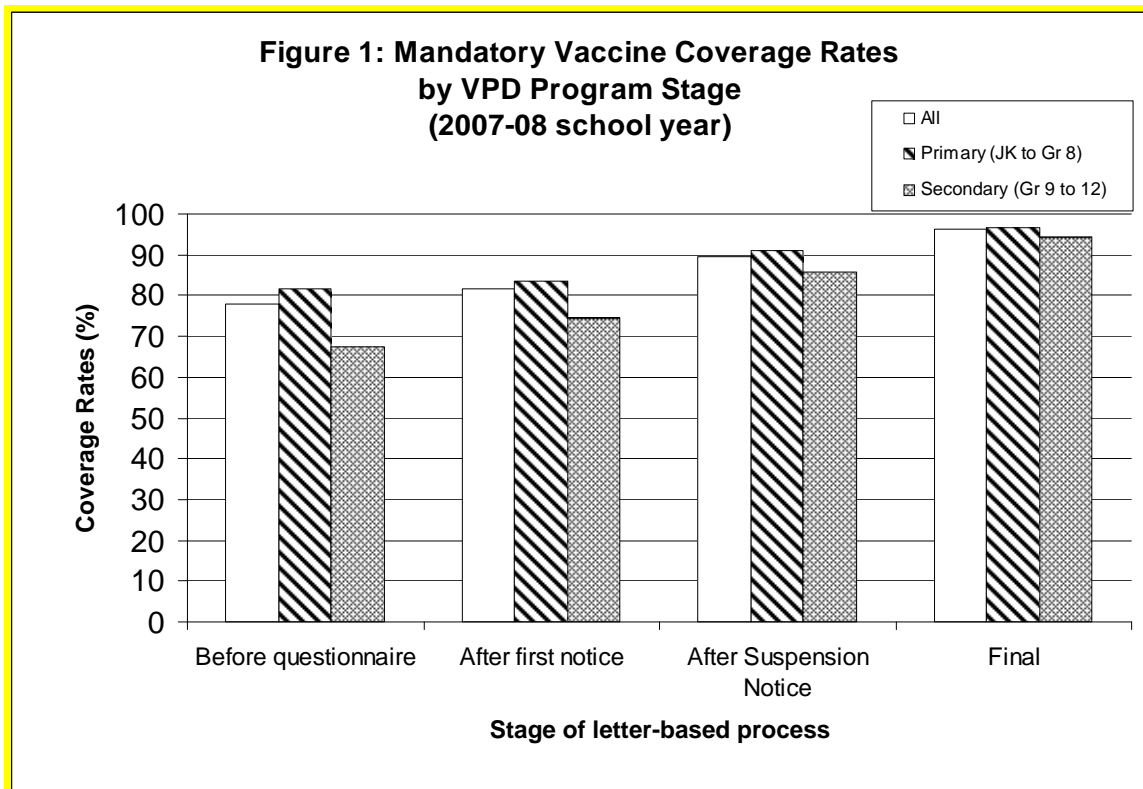
2. Immunization Coverage of Children at Seven and Seventeen Years of Age

a) Toronto Coverage: Mandatory Vaccines

TPH data show that by the end of the 2007-08 school year after the School Immunization Assessment Program, the overall coverage for vaccines required for school attendance among Toronto students was 96.1%. Authorized exemptions for mandatory vaccinations

were received from 1.9% of students. Primary school students had higher (96.8%) coverage rates than secondary school students (94.3%) (Appendix 3). Part of this difference can be explained by the higher exemption rates in secondary schools, which averaged 2.4%, as compared to primary schools which had an exemption rate of 1.6% for the 2007-08 school year.

The progression of coverage rates through the School Immunization Assessment Program shows that while coverage rates are low when first assessed (77.8% for all schools), the final coverage rates reach over 94% among both primary and secondary students (see Figure 1).



Previous research by TPH has shown that through this process, notifications either stimulate vaccination among unvaccinated students or prompt parents to provide documentation that students had been previously vaccinated.³² Of students assessed that did not have the required immunization documentation, 85% provided proof of prior vaccination to TPH and 15% received the required vaccines. This research highlighted the inefficiencies of the current system of collecting and recording students' immunization information from parents when their children were immunized. A comprehensive immunization registry that collects vaccination information at the point-of-service would be more a more efficient way of keeping student vaccination records current.

b) Toronto Coverage: Other Recommended Vaccines

Coverage rates among Toronto students during the 2007-08 school year for non-mandatory vaccines are not routinely available. If a parent voluntarily provides a record of receipt of non-mandatory vaccinations such as varicella (chicken pox) or pertussis (whooping cough) vaccine, TPH will record it in the child's electronic record. The completeness of these voluntary records is uncertain. Current coverage rates for non-mandatory vaccines in the immunization database for school-aged children are 96% for *Haemophilus influenzae type b* (Hib) and 67% for pertussis. The high rate for the Hib vaccine reflects its use as a combination vaccine with mandatory vaccinations for infants. The lower rate for pertussis vaccination is due in part to the delay in adolescents receiving their booster.

In 2005, chicken pox, pneumococcal and meningococcal C vaccines became publicly funded for all infants born in 2004 or later. Recorded coverage rates for school-aged children born in 2004 who would have been eligible for publicly funded vaccines were 48% for chicken pox, 30% for pneumococcal, and 48% for meningococcal C. It is unclear how accurate these rates are.

TPH administers hepatitis B and meningitis C vaccines to grade seven students annually through school-based vaccination programs. In 2007-08, 84% and 79% of grade seven students in Toronto were up-to date for the first and second dose respectively of the hepatitis B vaccine and 81.6% were up-to-date for the meningitis C vaccine. Since TPH does not have all reports of hepatitis B and meningitis C vaccinations that could have been provided through the child's health care provider, the actual coverage rate for these vaccines may be higher. Since September 2007, the human papillomavirus (HPV) vaccine was provided to grade 8 female students at school-based clinics. Coverage rates of HPV vaccination for 2007-08 were 64% for dose one, 62% for dose two and 56% for the third dose. The lower coverage rates in the first year of the program reflect constraints of implementing the program in a short time frame, with media controversy and concerns about the safety and effectiveness of this new vaccine.³³

c) Provincial Coverage of Mandatory and Other Recommended Vaccines

Provincial coverage rates of mandatory and other recommended vaccines in Ontario are not published. Up-to-date rates in other provinces are higher than for two-year olds, but still below the national targets (see Appendix 3).

d) National Coverage

The 2006 National Immunization Coverage Survey (CNIS)³⁴ estimated that coverage for diphtheria, tetanus and pertussis at seven and 17 years of age respectively was 65% and approximately 35% and for two doses of MMR vaccine at age seven and 17 was 73% and 52% respectively (see Appendix 3).

Factors Affecting Immunization Coverage Rates

1. Mandatory Vaccination

Toronto's immunization coverage data reflect mandatory immunizations for children and youth enrolled in school. Toronto Public Health's School Immunization Assessment Program produces high annual coverage rates that approximate national benchmark levels for school-aged children. Few other provinces show overall coverage rates among school children over 90%. Toronto rates are a reflection of the implementation of the Immunization of School Pupils Act. Such laws and their enforcement have helped to improve vaccine coverage and reduce vaccine-preventable diseases in the U.S.A.^{35 36} Currently, every state in the U.S.A. has vaccine requirements for enrolment and/or attendance in child-care and school.³⁷ Vaccines and the age at which they are required vary by state. Immunization laws reduce the disparity found in vaccine coverage among student populations regardless of where children live, their socio-economic status, race and ethnicity.³⁸ New vaccines such as varicella (chicken pox) and hepatitis B have been added to immunization laws in some states, to both increase coverage and reduce the disparities related to immunization.^{39 40 41}

Two provinces in Canada have school immunization laws, New Brunswick and Ontario.⁴² The introduction of new vaccines to the Ontario immunization schedule has not been followed with the addition of mandatory vaccines to the Immunization of School Pupil's Act (ISPA). Rates of non-mandatory vaccinations such as hepatitis B and meningitis C in Toronto are lower than those for mandatory vaccinations, despite public funding and universal access.

2. Immunization Information Systems

One of the best methods for improving immunization rates is through investments in information technology and electronic health records.⁴³ TPH is awaiting the implementation of PANORAMA, which is a web-based, menu-driven, multi-module, public health information system. One module for PANORAMA will replace the current immunization information system (IRIS) and will be the immunization registry for all public health units in Ontario. It will have capabilities for other areas including surveillance analysis, communicable disease and outbreak management, and vaccine ordering and distribution. After significant investment, PANORAMA is scheduled to be implemented in Ontario in 2010, with a roll-out in other provinces expected.

Even though the Canadian Immunization Registry Network (CIRN) proposed the functional requirements for PANORAMA, each province and territory decides which of these requirements to implement to best meet their needs. As a result, a unified national immunization registry will not be in place. It is also unclear whether the provincial PANORAMA registries will be able to interface with each other to transfer out-of-province records and consolidate information nationally.

In Ontario, two functional elements of the proposed registry are no longer considered "in scope". Health providers will not have access to PANORAMA and thus the 95% of Ontario's immunizations provided by primary care practitioners will not be input into the immunization registry at the point of service. As well, PANORAMA in Ontario will not

have the ability to read the bar-coding of vaccines, again reducing the efficiency of the registry to maintain accurate and timely data. For this reason, it is essential that the implementation of PANORAMA in Ontario place a priority on the development of the interface between the electronic health record systems of individual health care providers and the registry component of PANORAMA. As well, it is important that point of service electronic health record systems are capable of exchanging information using standard electronic messaging protocols with the province's immunization information system (PANORAMA). With the significant investments by the Ministry of Health and Long-term Care (MOHLTC) in both the development of the PANORAMA Immunization Registry and in Ontario's e-Health strategy, the MOHLTC should ensure these systems are able to interface with each other.

The assessment of immunization coverage at the neighbourhood level⁴⁴ using standardized socio-economic indicators is important for program planning and targeted interventions.⁴⁵ One method for analyzing health disparities associated with vaccination is to geo-code and map health data according to census-tract characteristics.⁴⁶ Thus, for the identification of immunization-related health disparities, it is a priority for PANORAMA to have the ability to export immunization information to other data systems for analysis.

3. Missed Opportunities for Immunization

Research suggests that missed opportunities for immunization of young children, adolescents and adults contribute to lower immunization rates.^{47 48 49 50} Ontario OHIP data show that under-immunized children had slightly lower but adequate rates of primary care visits.⁵¹ In the 2004 Canadian National Immunization Survey,⁵² approximately 30 to 50% of parents of two and seven year old children over-estimated their child's immunization status. The most commonly cited challenge for keeping children up-to-date was remembering to have it done.

Many studies document provider practices as important predictors of immunization status, namely the use of provider reminder and recall systems.^{53 54} These studies found that reminding people to have vaccinations increased the number of adults and children who were vaccinated. Reminder methods of telephone, letter, postcard and in-person communication were all effective to increase vaccinations. However, telephone was found to be more effective than postcard or letter reminders. Numerous notices were more effective than single reminders. Reminders also worked whether they were from a private doctor's office, a medical center or a public health department. Incorporating a reminder and recall system into physicians' offices and public health units through PANORAMA or other electronic health record systems will help to reduce missed opportunities for immunization.

4. Socio-Demographic and Economic Status

Research indicates there are several groups of children who are more likely to be under-immunized or un-immunized: those from disadvantaged families, those from families with higher educational levels and concerns about the adverse effects of immunization,

and those whose parents disagree with immunization for philosophical reasons.^{55 56 57 58 59 60}

Maternal education and factors associated with poverty have been shown to be linked to lower rates of childhood immunization in the U.S.A. and elsewhere.^{61 62 63 64 65 66} In Australia, children in larger and lower income families are less likely to be age-appropriately immunized.⁶⁷ Australia's initiative to link immunization to the maternity allowance and child care benefit has encouraged both overall uptake and timeliness of immunization. Yet, lower-income children were still less likely to be age-appropriately immunized.

The province of Alberta⁶⁸ and the city of Saskatoon⁶⁹ report that income is the strongest predictor of under-immunization, with factors related to access identified as the strongest barriers to immunization. Barriers include meeting basic needs (e.g. food and shelter) rather than incurring costs associated with immunization (e.g. transportation or lost wages for time off to visit the clinic); limited access to clinics; lack of time, energy, and knowledge of the importance of immunizing on schedule; and lack of knowledge about the risks and benefits of immunization versus vaccine preventable diseases.

In Ontario^{70 71}, higher rates of up-to-date vaccinations for two year old children were also found among those who lived in higher income neighbourhoods. Ontario children who were up-to-date for vaccines at two years of age also had more well-infant and primary care visits in the first two years and a higher level of continuity of care.⁷² Two year old Ontario children of urban immigrants in 1997-98 had slightly higher immunization rates (69%) compared to children of parents born in Canada (66%).⁷³ The National Advisory Committee on Immunization indicates that immigrant populations may be susceptible to certain vaccine preventable diseases because the vaccines, such as for mumps and rubella, or diseases such as chicken pox, are not as routine in their countries of origin.⁷⁴ A Montreal study reports serological evidence of immigrants' susceptibility to vaccine preventable diseases.^{75 76}

Aside from ICES data on Toronto neighbourhoods showing immunization coverage of two year olds⁷⁷, data is lacking to do a complete health inequities analysis in relation to vaccinations. With the assistance from the Ministry of Health and Long-Term Care, TPH plans to gather additional data and report to the Board of Health on mandatory and other recommended vaccinations of students by socio-demographic factors to better evaluate health inequities in immunization coverage.

CONCLUSIONS

Immunization is widely recognized as one of the most successful public health interventions. Good overall immunization coverage has been achieved for mandatory vaccines for Toronto students. Yet, it appears that a significant proportion of pre-school children may be under-immunized.

Toronto Public Health should continue to strive for equitable vaccine coverage across all populations to attain national benchmark levels. Improved immunization coverage among all populations in Toronto requires the identification of under-immunized groups

through a point-of-service immunization registry system. The full implementation of the PANORAMA system based on the functions listed by the Canadian Immunization Registry Network is encouraged. To ensure that the 95% of Ontario's immunizations provided by primary care practitioners are included in the registry, it is essential that Ontario's e-Health strategy of point-of-service electronic health record systems is capable of exchanging information with the province's immunization information system (PANORAMA).

Parents whose children are under-immunized may be unaware of the recommended immunization schedule or they may have concerns regarding vaccine side effects. Communication strategies such as recall and reminder systems and innovative web-based approaches are needed to address both issues.

CONTACT

Joanne Kaashoek
Health Promotion Consultant
Tel: 416-338-1229
Email: jkaasho@toronto.ca

Dr. Vinita Dubey
Associate Medical Officer of Health
Tel: 416-397-4696
Email: vdubey@toronto.ca

Dr. Barbara Yaffe
AMOH, Director Communicable
Disease Control
Tel: 416-392-7405
Email: byaffe@toronto.ca

SIGNATURE

Dr. David McKeown
Medical Officer of Health

ATTACHMENTS

Appendix 1 – Ontario's Immunization Schedule for Children and Youth
Appendix 2 – National Immunization Goals and Coverage Targets
Appendix 3 – Summary of Childhood Immunization Coverage Rates from Selected Jurisdictions

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Ms. Joanne Cameron, Manager, Vaccine Preventable Disease Program, (TPH)

Dr. Michael Finkelstein, Associate Medical Officer of Health, TPH

Ms. Effie Gournis, Manager, Communicable Disease Surveillance Unit, TPH

Dr. Astrid Guttmann, Scientist, Institute for Clinical Evaluative Sciences and Staff Physician, Hospital for Sick Children

Mr. Faron Kolbe, Manager Infection Control and Infectious Diseases, CDC, TPH

Appendix 1 – Ontario’s Immunization Schedule for Children and Youth

Age at vaccination	Diphtheria ***	Pertussis	Tetanus ***	Polio ***	HIB	Pneumo- coccal conjugate	Measles mumps rubella (MMR)* ***	Men-C conjugate	Chicken pox (Varicella)	Hepatitis B	Human Papilloma virus (HPV)
2 months	●	●	●	●	●	●					
4 months	●	●	●	●	●	●					
6 months	●	●	●	●	●	●					
12 months							●	●			
15 months†						●			●		
18 months	●	●	●	●	●		●				
4-6 years	●	●	●	●					●**		
12 years (grade 7)								●‡		●	
13 years (grade 8)											● (for females)
14-16 years	●	●	●								

* MMR = measles, mumps and rubella vaccine must be given after the first birthday.

** If a child has not had chicken pox or the vaccine he/she can receive the chicken pox vaccine at 5 years of age.

*** Mandatory school-entry vaccines

† These vaccines can be given as early as 12 months of age.

‡ If your child has not had the meningococcal C-conjugate vaccine (at 1 year of age) then he/she can receive the vaccine at 12 years of age or in grade 7.

Source: Excerpted from: <http://www.health.gov.on.ca/english/public/program/immun/immunization.html>

Appendix 2 - National Immunization Goals and Coverage Targets^{78 79}

Immunizations Required for School Entry in Ontario	
Goals:	Coverage targets:
Diphtheria <ul style="list-style-type: none"> Eliminate indigenous cases of diphtheria 	<ul style="list-style-type: none"> 97% of children up-to-date by 2nd birthday 99% up-to-date by 7th birthday
Tetanus <ul style="list-style-type: none"> Maintain absence of neonatal and childhood tetanus 	<ul style="list-style-type: none"> 97% up-to-date by 2nd birthday 99% up-to-date by 7th birthday
Poliomyelitis <ul style="list-style-type: none"> Maintain the elimination of wild indigenous poliomyelitis 	<ul style="list-style-type: none"> 97% immunized with 3 doses by 2nd birthday 99% up-to-date by 7th birthday
Measles <ul style="list-style-type: none"> Eliminate indigenous measles in Canada by 2005 	<ul style="list-style-type: none"> 97% of children have had 1st dose by the 2nd birthday 99% of children have had the 2nd dose by the 7th birthday
Mumps <ul style="list-style-type: none"> Maintain an active prevention program for mumps to minimize serious sequelae. 	<ul style="list-style-type: none"> 97% of children up-to date by their 2nd birthday 99% of children up-to date by their 7th birthday
Rubella <ul style="list-style-type: none"> Eliminate indigenous rubella infection during pregnancy by 2000. Adopt the World Health Organization / Pan-american Health organization (WHO/PAHO) regional goal to eliminate indigenously transmitted cases of rubella and congenital rubella syndrome (CRS) from Canada by 2010. 	<ul style="list-style-type: none"> By 2010, achieve and maintain rubella post-partum immunization coverage in 99% of susceptible women prior to hospital discharge By 2010, achieve and maintain age-appropriate immunization coverage for rubella-containing vaccine: <ul style="list-style-type: none"> In 97% of children by their 2nd birthday (1 dose) In 97% of children by their 7th birthday. Among 97% of adolescents 14 to 16 years of age.
Other Routine Childhood and Adult Immunizations	
Goals:	Coverage targets:
Invasive Haemophilus influenzae type b <ul style="list-style-type: none"> Achieve and maintain the absence of preventable cases of invasive Haemophilus influenzae type b by 1997. 	<ul style="list-style-type: none"> 97% of children up-to-date by 2nd birthday
Pertussis: <ul style="list-style-type: none"> Reduce morbidity and mortality related to pertussis infection. Immunize all Canadian children against pertussis according to NACI. 	<ul style="list-style-type: none"> By 2010, achieve and maintain age-appropriate immunization coverage with acellular pertussis vaccine in: <ul style="list-style-type: none"> 95% of infants by 3 months of age. 95% of infants/children by 7 months of age. 95% of children by their 2nd birthday. 95% of children by their 7th birthday . By 2010, achieve and maintain age-appropriate immunization coverage with the Adacel adult vaccine (Tdap) vaccine in: <ul style="list-style-type: none"> 85% of adolescents by their 18th birthday Provinces/territories should replace diphtheria-tetanus adult vaccine (Td) with the Adacel adult vaccine (Tdap) by 2010.

Goals:	Coverage targets:
<p>Hepatitis B</p> <ul style="list-style-type: none"> ▪ Reduce the prevalence of indigenously acquired chronic hepatitis B infections in children and young adults by 90% by the year 2015. 	<ul style="list-style-type: none"> ▪ 95% of populations immunized (targeted in universal programs). ▪ Each province and territory has a policy to provide Hep B to high risk individuals as outlined in the Canadian Immunization Guide.
<p>Varicella (chicken pox)</p>	<p>By 2010 achieve and maintain age-appropriate immunization coverage with varicella vaccine in:</p> <ul style="list-style-type: none"> ▪ 85% of children by their 2nd birthday ▪ 85% of susceptible children by their 7th birthday ▪ 85% of susceptible adolescents by their 17th birthday
<p>Invasive Pneumococcal disease (IPD)</p>	<p>Achieve and maintain age-appropriate immunization coverage in:</p> <ul style="list-style-type: none"> ▪ in 90% of children by 2nd birthday by 2008. ▪ with a single dose of pneumococcal polysaccharide vaccine in 80% of adults = 65 years of age by 2010. ▪ with pneumococcal polysaccharide vaccine in 95% of residents of long-term care facilities by 2008.
<p>Invasive Meningococcal disease</p>	<p>Achieve and maintain age-appropriate immunization coverage with meningococcal C conjugate vaccine in:</p> <ul style="list-style-type: none"> ▪ 100% of <i>N. meningitidis</i> serogroup C close contacts of cases by 2010. ▪ 95% of high-risk groups for <i>N. meningitidis</i> serogroup C disease. ▪ 97% of children by their 2nd birthday by 2010. ▪ 90% of adolescents by their 17th birthday by 2012.
<p>Influenza To prevent serious illness caused by influenza and its complications, including death.</p>	<p>The following 2001 national immunization coverage targets should be maintained until a task group has been convened and made updated recommendations:</p> <ul style="list-style-type: none"> ▪ 95% coverage of residents of long-term care facilities and staff who have extensive contact with residents ▪ 80% coverage of persons aged = 65 years of age ▪ 80% coverage of persons < 65 years of age with high risk conditions ▪ 80% coverage of health care workers ▪ 100% coverage of vaccinators ▪ 80% coverage of household contacts of people at high risk

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Appendix 3

Summary of Childhood Immunization Coverage Rates from Selected Jurisdictions

Location	Source of data	Age	Diphtheria (D) Tetanus (T) Polio (P)	Measles (M) Mumps (M) Rubella (R)	Percent Up-to-date for age*
Local					
Toronto	Institute for Clinical Evaluative Sciences (ICES) 2002-03 ⁸⁰	2 years of age			75% of 2 year old children had 5 or more OHIP billings for immunizations
	Toronto Public Health (assessment based on school year 2007-08)	elementary students (JK to grade 8)			Overall 96.8% coverage at the end of the program.
	Toronto Public Health (assessment based on school year 2007-08)	secondary students (grades 9-12)			Overall 94.3% coverage at the end of the program.
Selected Provincial National, International					
Ontario	ICES (2002-03) ⁸¹	2 years of age			70% of 2 year old children had 5 or more OHIP billings for immunizations 4% had no billings despite primary care visits.
Alberta	Alberta Immunization Strategy (2007-2017) ⁸²	2 years of age (birth cohort assessed 2004)	82%	91%	
Manitoba	Manitoba Immunization Management System (2006) ⁸³	2 years	73.8%	86.1%	47.8% of 2 year olds "complete for age" and have received all doses of the vaccines recommended for his or her age.
		7 years	72.8%	79.3	68.1% of 7 year olds are "complete for age"
		17 years	D - 66.9% T- 67.2% P- 89.2%	83.3	37% of 17 year olds are "complete for age"
British Columbia	BC Centre for Disease Control (2008) ⁸⁴	2 years of age (2005)	74.6%	75.3%	
		Children in Junior Kindergarten (2008)	79.5%	87.1	
Canada	National Immunization Survey, (2006) ⁸⁵	2 years of age	62%	85%	
		7 years of age	66% (D,T) 80% (P)	73%	
		17 years of age	38% (D) 28% (T) 73% (P)	52%	

Location	Source of data	Age	Diphtheria (D) Tetanus (T) Polio (P)	Measles (M) Mumps (M) Rubella (R)	Percent Up-to-date for age*
Australia	Australian Childhood Immunization Register (quarterly report for birth cohort Oct – Dec 2005) ⁸⁶	2 yrs of age	94.8%	93.7%	92% have received all scheduled vaccines before two years of age
		6 years	88.8%	88.9%	88%
United States	National Immunization Survey (2007) ⁸⁷	Children 19-35 months of age	94.5% \geq 4 doses DTP	92.3%	82.8% for \geq 4 doses DTaP, \geq 3 doses of poliovirus vaccine and \geq 1 doses of any measles containing vaccine

* definition of up-to-date for age varies according to region

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