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Immunization coverage report for school pupils in Ontario

2013–14, 2014–15 and 2015–16 school years

TECHNICAL REPORT
June 2017

Public Health Ontario

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Contents

Key messages

Immunization coverage report for school pupils in Ontario
2013–14, 2014–15 and 2015–16 school years

Over the course of 2013 to early 2016, Ontario implemented a Digital Health Immunization Repository, which is accessible to Public Health Units through Panorama. With the implementation of this repository, Ontario has gained the ability to calculate *up-to-date* immunization coverage, aligning our methodology with nationally recommended best practices and advancing the accuracy of Ontario's coverage estimates.

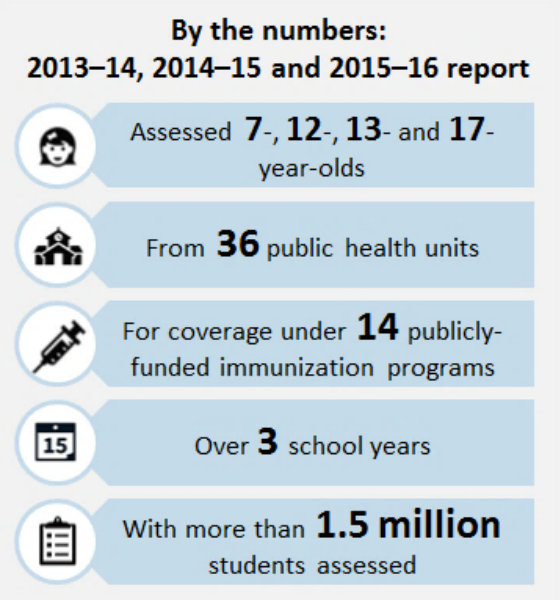
What is *up-to-date* immunization coverage?

Up-to-date coverage refers to the proportion of a population that has received the recommended number of doses of a certain vaccine by a certain age. Many children who are not *up-to-date* have received some, but not all, recommended doses in a vaccine series.

The implementation of a digital provincial immunization repository in Ontario has strengthened our ability to monitor immunization coverage and will enhance future evaluations that aim to increase the number of children protected against vaccine-preventable diseases.

High immunization coverage prevents disease

Ensuring high immunization coverage in Ontario is essential to prevent outbreaks of vaccine-preventable diseases.



Summary of key findings

- Immunization coverage estimates vary greatly in Ontario based on the vaccine program, the age group assessed and by geographic region.
- With some exceptions, Ontario falls short of most immunization coverage goals.
- Immunization coverage may be underestimated if students have been immunized and the information has not been captured by the immunization surveillance system.

Introduction

Immunization coverage refers to the proportion of a defined population that is appropriately immunized against a specific vaccine-preventable disease (VPD) at a point in time. Accurate and timely immunization coverage information is required to predict population-level susceptibility to VPDs, assess coverage trends over time, identify sub-populations with inadequate coverage that may be at risk of VPD outbreaks and evaluate immunization programs. Maintaining high immunization coverage is essential for the effective prevention and control of VPDs.

Publicly-funded immunization programs in Ontario include universal programs targeting infants, children, adolescents and adults (Table 1), as well as programs targeting high-risk individuals with particular medical conditions, behavioural risk factors or high-risk exposures. In Ontario, vaccines administered in infancy and early childhood are predominantly delivered by community-based health care providers (HCPs), while adolescent vaccines are largely delivered through school-based immunization programs (i.e., hepatitis B, quadrivalent meningococcal conjugate (MCV4) and human papillomavirus (HPV) vaccines). A notable exception is the adolescent booster of tetanus-diphtheria-acellular pertussis (Tdap) vaccine, which is delivered primarily by HCPs to adolescents 14 to 16 years of age. Influenza vaccine is delivered in Ontario by a range of providers including public health unit (PHU) staff, HCPs and pharmacists. The current publicly-funded immunization schedule for Ontario can be found on the Ministry of Health and Long-Term Care's website.[1] Coverage was assessed for all vaccines included within the schedule with the exceptions of influenza and rotavirus vaccines. Once the first cohort of children eligible for rotavirus vaccine reaches 7 years of age, coverage assessment for this program will commence.

In Ontario, immunization coverage assessment is conducted annually for school pupils within each board of health jurisdiction.[2] Under the *Immunization of School Pupils Act* (*ISPA*),[3,4] local medical officers of health (MOHs) maintain a record of immunization for each pupil attending school in their jurisdiction. Students may face suspension if immunizations against select diseases (i.e., *ISPA*-designated diseases) are not received by a certain date or if documentation of medical exemption or religious/conscientious objection is not provided.[3,4] In addition, un-immunized and under-immunized students can be excluded from school if there is an outbreak or an immediate risk of an outbreak of an *ISPA*-designated disease. Prior to legislative amendments to the *ISPA* in 2013, six diseases were designated by the *ISPA*: diphtheria, tetanus, polio, measles, mumps and rubella. Following *ISPA* amendments, this list was expanded to include: pertussis (whooping cough), meningococcal disease and varicella (chickenpox).[3] These changes came into effect during the 2014–15 school year, although the requirement for varicella only applies to children born in 2010 or later and therefore is not in effect for the cohorts of students assessed for this report.

The National Standards for Immunization Coverage Assessment specifies that antigen-level coverage should be reported annually for 2-, 7- and 17-year-olds as well as for school-age programs.[5] The enabling legislation supporting immunization information collection is the *ISPA*, as such we are not able to

provide timely assessments of coverage for children before school-entry (i.e., among 2-year-olds); however, Ontario's provincial Digital Health Immunization Repository (DHIR), accessible to PHUs through the web-based application Panorama, allows us to assess antigen-level coverage for school-aged children. Concerns regarding the completeness of the school grade field in the DHIR resulted in the assessment of age cohorts to approximate the grades at which students are eligible for school-based immunization programs. For more information about the DHIR, Panorama, immunization data collection and the methodology used to calculate coverage estimates for this report, please see the Technical Annex of this report.

Table 1. Publicly-funded immunization schedule for Ontario: Routine schedule for children beginning immunization in early infancy applicable to age cohorts assessed within this report (with the exception of influenza and rotavirus vaccines)[1]

Age at immunization	2 mo.	4 mo.	6 mo.	12 mo.	15 mo.	18 mo.	4-6 y.	Grade 7	Grade 8 females*	14-16 y.†	Every year (in autumn)
DTaP-IPV-Hib	■	■	■			■					
Pneu-C-13	■	■		■							
Rot-1	■	■									
Men-C-C				■							
MMR				■							
Var					■						
MMRV							■				
Tdap-IPV							■				
Men-C-ACYW								■			
HB								■			
HPV-4									■		
Tdap										■	
Inf											■

*Since September 2016, the HPV vaccine program has been offered to all students in grade 7 (males and females). In the 2016-17 school year, the HPV vaccine will also be offered to the final cohort of grade 8 females.
†10 years after 4- to 6-year-old booster

Abbreviations: Diphtheria, Tetanus and Acellular Pertussis-Inactivated Polio (DTaP-IPV); *Haemophilus influenza*e type b (Hib); Pneumococcal Conjugate 13-valent (Pneu-C-13); Rotavirus (Rot-1); Meningococcal-C Conjugate (Men-C-C); Measles, Mumps, Rubella (MMR); Varicella (Var); Measles, Mumps, Rubella, Varicella (MMRV); Tetanus, Diphtheria and Acellular Pertussis-Inactivated Polio (Tdap-IPV); Meningococcal Conjugate ACYW-135 (Men-C-ACYW); Hepatitis B (HB); Human Papillomavirus (HPV); Tetanus, Diphtheria and Acellular Pertussis (Tdap); Seasonal influenza (Inf).

Report objectives and scope

This report has several objectives related to the assessment of immunization coverage for the 2013–14, 2014–15 and 2015–16 school years:

1) To present provincial and PHU-specific immunization coverage estimates for publicly-funded childhood immunization programs started in infancy and early childhood. Coverage estimates are presented for: measles, mumps, rubella, diphtheria, tetanus, polio, pertussis for 7- and 17-year-olds; and *Haemophilus influenzae* type b (Hib), pneumococcal conjugate, meningococcal-C-conjugate (MCC) and varicella for 7-year-olds.

2) To present provincial and PHU-specific coverage estimates for Ontario's school-based immunization programs: hepatitis B (12-year-olds), quadrivalent meningococcal conjugate (MCV4; 12-year-olds) and human papillomavirus (HPV; 13-year-old females).

3) To describe trends in provincial immunization coverage since the implementation of Panorama and to compare these with nationally defined coverage goals.

Methods

For a detailed description of the provincial immunization repository and methods for the assessment of student immunization status, please see the Technical Annex of this report.

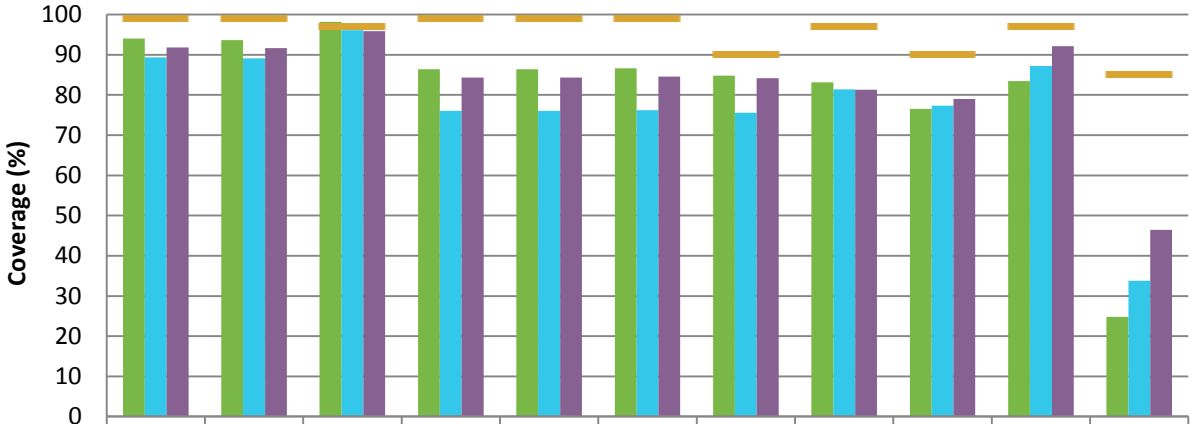
Results

Immunization coverage among 7-year-olds

Provincial estimates of immunization coverage for publicly-funded childhood immunization programs at age 7 for the 2013–14 to 2015–16 school years are presented in Figure 1. Provincial coverage for each of measles, mumps and rubella were all greater than 89% for all three school years. Coverage estimates among 7-year-olds for tetanus, diphtheria, pertussis and polio were as low as 75.6% (pertussis in 2014–15) and as high as 86.6% (polio in 2013–14). Notably, the coverage estimates for these antigens were approximately 10% lower for the 2014–15 school year when compared with estimates for the 2013–14 and 2015–16 school years. Coverage estimates for 7-year-olds were relatively consistent for Hib (81.3% to 83.1%) and for pneumococcal vaccine (76.6% to 79.0%) over the three school years. A stepwise increase in coverage estimates is seen with MCC and two-dose varicella coverage by year, with MCC increasing from 83.5% to 92.1% and varicella increasing from 24.8% to 46.4% over the three year period. One-dose coverage for varicella for these same cohorts was 82.3%, 83.4% and 86.1% for school years 2013–14, 2014–15 and 2015–16 respectively. Among vaccines started in infancy and early childhood and

assessed in 7-year-olds, only the provincial coverage estimate for rubella in the 2013–14 school year met the national coverage goal. For PHU-specific estimates, please see the Appendix of this report.

Figure 1. *Up-to-date* immunization coverage (%) in Ontario among children 7 years old: 2013–14, 2014–15 and 2015–16 school years



	Meas	Mumps	Rubella	Dip	Tet	Polio	Pertuss	Hib	Pneum	MCC	Var
2013-14	94.0	93.6	98.2	86.4	86.4	86.6	84.8	83.1	76.6	83.5	24.8
2014-15	89.4	89.1	96.1	76.1	76.1	76.2	75.6	81.4	77.3	87.2	33.8
2015-16	91.8	91.6	95.9	84.3	84.3	84.5	84.1	81.3	79.0	92.1	46.4
Goal	99.0	99.0	97.0	99.0	99.0	99.0	90.0	97.0	90.0	97.0	85.0

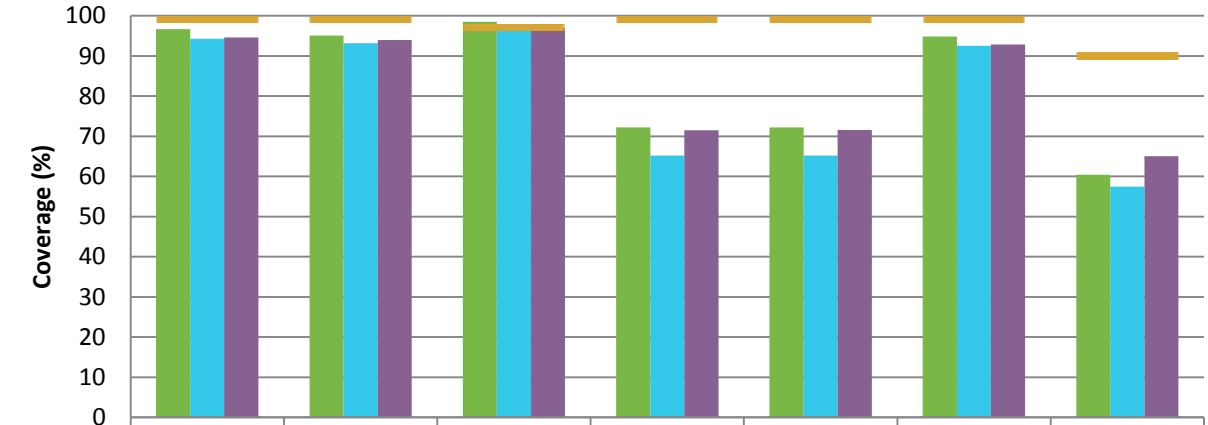
Notes:

1. Coverage goals for diphtheria (Dip), tetanus (Tet), polio, measles (Meas), mumps, and *Haemophilus influenzae (*Hib) from: Canadian national report on immunization, 1996. Can Comm Dis Report. 1997;23(S4).
2. Coverage goals for pertussis (Pertuss), pneumococcal (Pneum), rubella, meningococcal (MCC) and varicella (Var) from: Final report on outcomes from the National Consensus Conference for Vaccine-Preventable Diseases in Canada, June 12-14, 2005 – Quebec City, Quebec. Can Comm Dis Report. 2008;34 Suppl 2:1-56.

Immunization coverage among 17-year-olds

Figure 2 shows provincial immunization coverage estimates for 17-year-olds for the 2013–14 to 2015–16 school years, for which each of measles, mumps and rubella coverage estimates were greater than 93% for all school years. Compared to 7-year-olds, coverage estimates were consistently lower by at least 10% for tetanus, diphtheria and pertussis. There is no adolescent dose in the vaccine series for polio, therefore the 17-year-old coverage estimates for polio does not show the same decrease. As with the 7-year-old cohort, the only provincial coverage estimate that met the national coverage goal among 17-year-olds was rubella in the 2013–14 school year. For PHU-specific estimates, please see the Appendix of this report.

Figure 2. *Up-to-date* immunization coverage (%) in Ontario among children 17 years old: 2013–14, 2014–15 and 2015–16 school years



	Measles	Mumps	Rubella	Diphtheria	Tetanus	Polio	Pertussis
2013-14	96.7	95.0	98.5	72.2	72.2	94.9	60.4
2014-15	94.3	93.2	96.7	65.2	65.2	92.5	57.4
2015-16	94.6	94.0	96.9	71.5	71.5	92.9	65.0
Goal	99.0	99.0	97.0	99.0	99.0	99.0	90.0

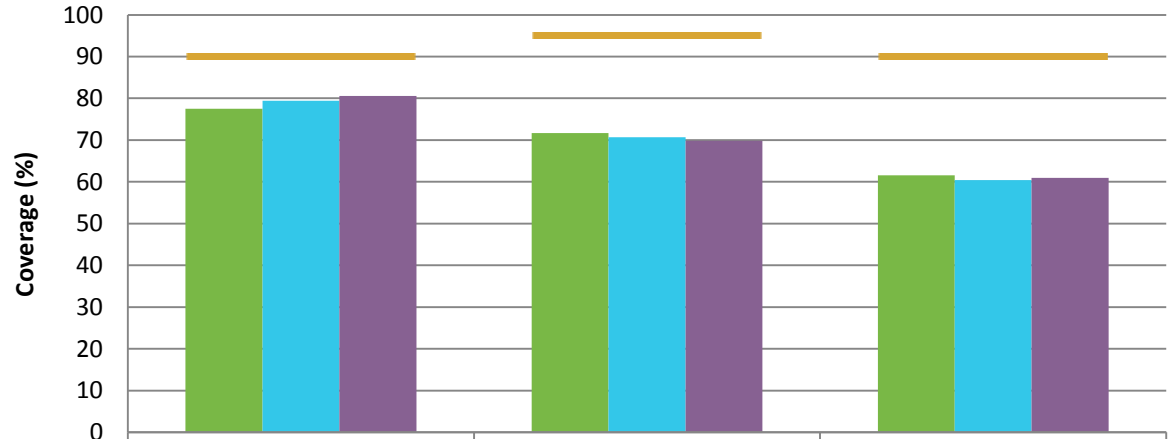
Notes:

1. Coverage goals for diphtheria, tetanus, polio, measles and mumps from: Canadian national report on immunization, 1996. Can Comm Dis Report. 1997;23(S4).
2. Coverage goals for pertussis and rubella from: Final report on outcomes from the National Consensus Conference for Vaccine-Preventable Diseases in Canada, June 12-14, 2005 – Quebec City, Quebec. Can Comm Dis Report. 2008;34 Suppl 2:1-56.

School-based immunization programs

Figure 3 presents provincial coverage estimates for the three vaccines administered through Ontario's school-based immunization programs for the 2013–14 to 2015–16 school years. In the most recent school year of 2015–16, school-based immunization coverage ranged from 61% (HPV) to 80.6% (MCV4). Across the three school years assessed in this report, HPV had the lowest measured coverage with estimates from 60.4% to 61.5%, followed by hepatitis B (69.9% to 71.7%), with estimates for MCV4 from 77.5% to 80.6%. Series initiation for hepatitis B and HPV, which is the proportion of each cohort who received at least one dose of the vaccine series, was considerably higher for these programs (Figure 4). For all three school years, at least 71% of grade 8 females received their first dose of HPV vaccine, and between 84.8-85.8% of those who started the series, completed it. Similarly, approximately 84% of grade 7 students initiated the hepatitis B vaccine series and between 84.5-86.9% of those starting the series, completed it. Coverage for MCV4, for which only one dose is required, showed a slight increase over the three school years, reaching 80.6% in 2015–16. For PHU-specific estimates, please see the Appendix of this report.

Figure 3. *Up-to-date* immunization coverage (%) in Ontario for school-based immunization programs among children 12 and 13 years old: 2013–14, 2014–15 and 2015–16 school years

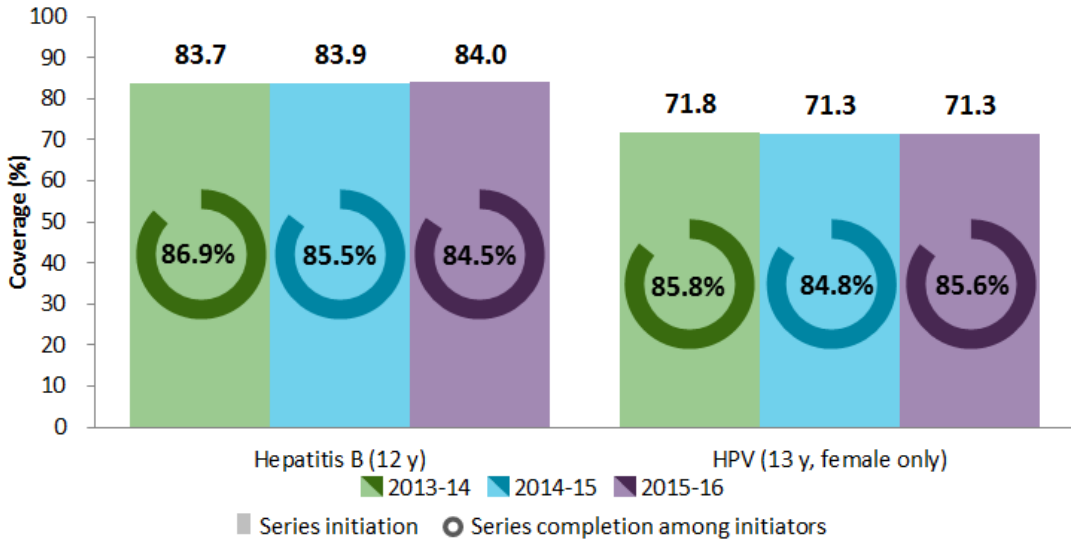


	MCV4 (12 y)	Hepatitis B (12 y)	HPV (13 y, female only)
2013-14	77.5	71.7	61.5
2014-15	79.4	70.7	60.4
2015-16	80.6	69.9	61.0
Goal	90.0	95.0	90.0

Notes:

1. Coverage goal for MCV4 from: Final report on outcomes from the National Consensus Conference for Vaccine-Preventable Diseases in Canada, June 12-14, 2005 – Quebec City, Quebec. Can Comm Dis Report. 2008;34 Suppl 2:1-56.
2. Coverage goal for Hepatitis B from: Canadian national report on immunization, 1996. Can Comm Dis Report. 1997;23(S4).
3. Coverage goal for HPV from: Canadian Immunization Committee. Recommendations on a human papillomavirus immunization program. Her Majesty the Queen in Right of Canada, represented by the Minister of Health; 2008.

Figure 4. Series initiation* and series completion among initiators† in Ontario for Hepatitis B and HPV immunization programs among children 12 and 13 years old: 2013–14, 2014–15 and 2015–16 school years



*Received at least one valid dose of the vaccine series
†Completion of the vaccine series among series initiators

Geographic distribution

Figures 5, 6 and 7 show maps of PHU-specific coverage estimates for select antigens and age cohorts for the 2015–16 school year. It should be noted that the legend varies between the maps.

Figure 5 shows the geographic distribution of coverage estimates for diphtheria among 7-year-olds by PHU for the 2015–16 school year, with PHU-specific coverage estimates ranging from 49.7% to 99.4%. Most of the PHU estimates were towards the upper limit of the range, with 23 of the 36 PHUs having coverage estimates of 90% or higher. The majority of PHUs (83.3%; n=30) met or exceeded the 84.3% provincial coverage estimate for 7-year-olds, while one PHU exceeded the provincial coverage goal of 99%. See Table 4 of the Appendix for diphtheria coverage estimates by PHU for all school years for 7- and 17-year-olds.

Figure 5. *Up-to-date* immunization coverage (%) in Ontario for diphtheria among children 7 years old by public health unit: 2015–16 school year

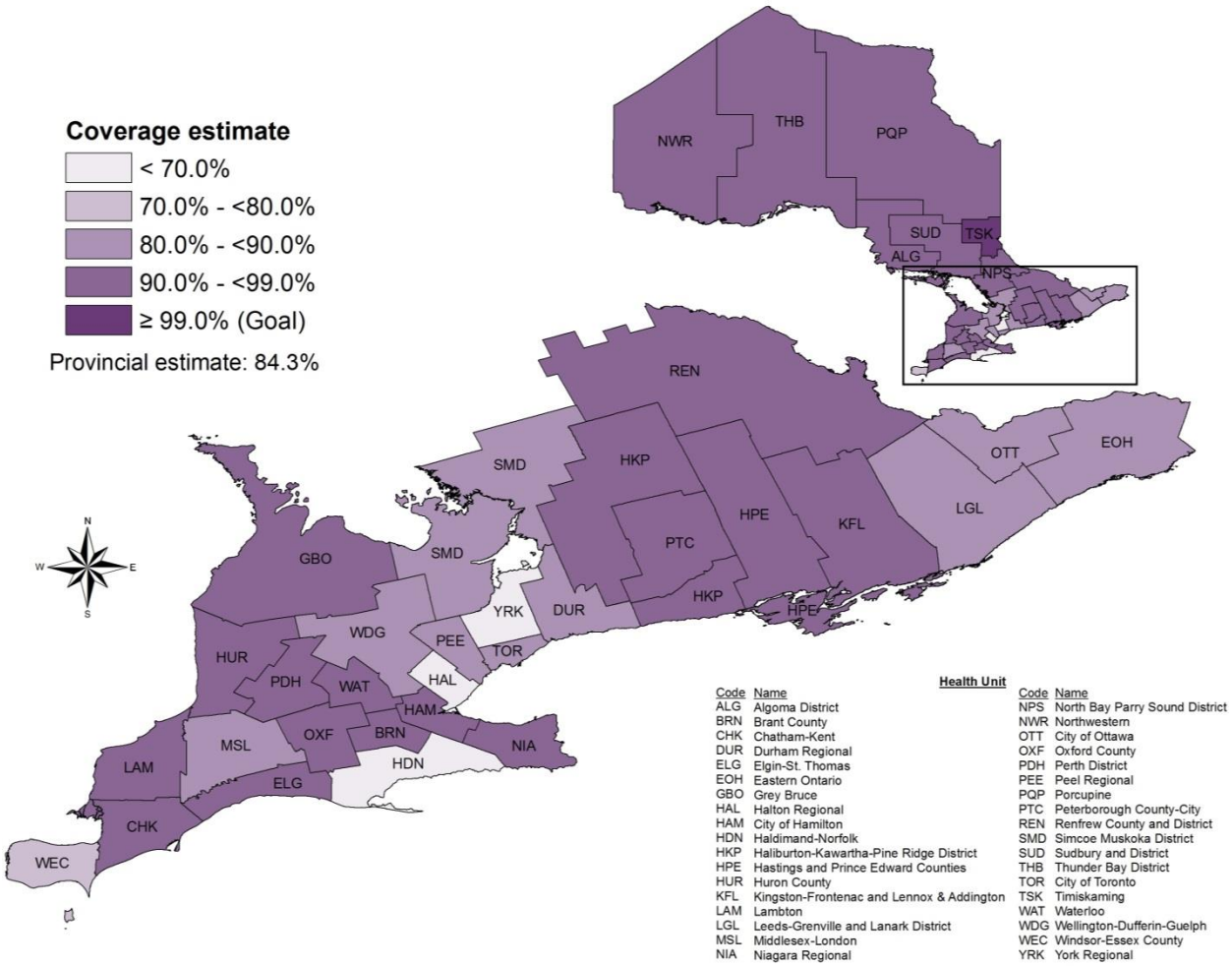
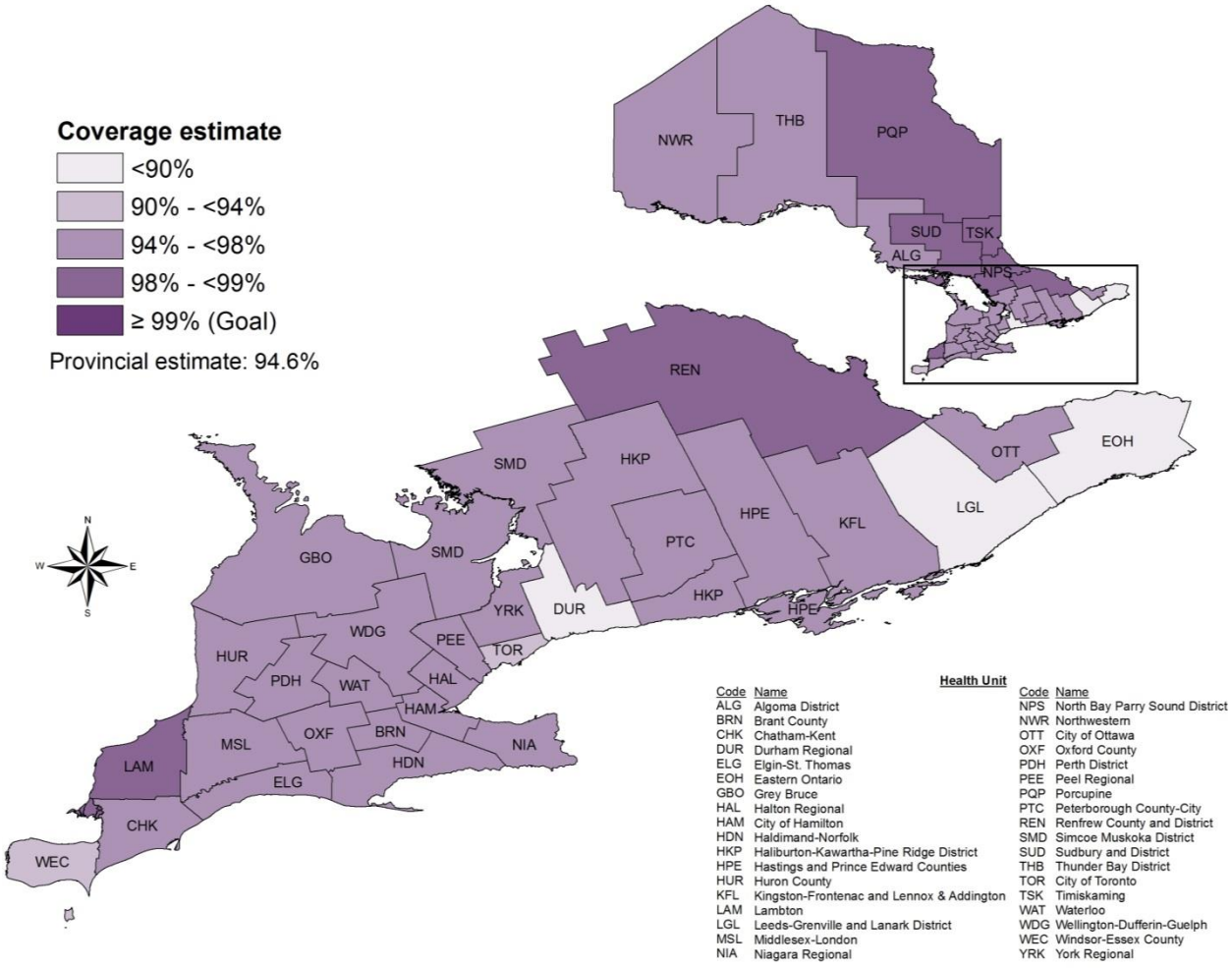


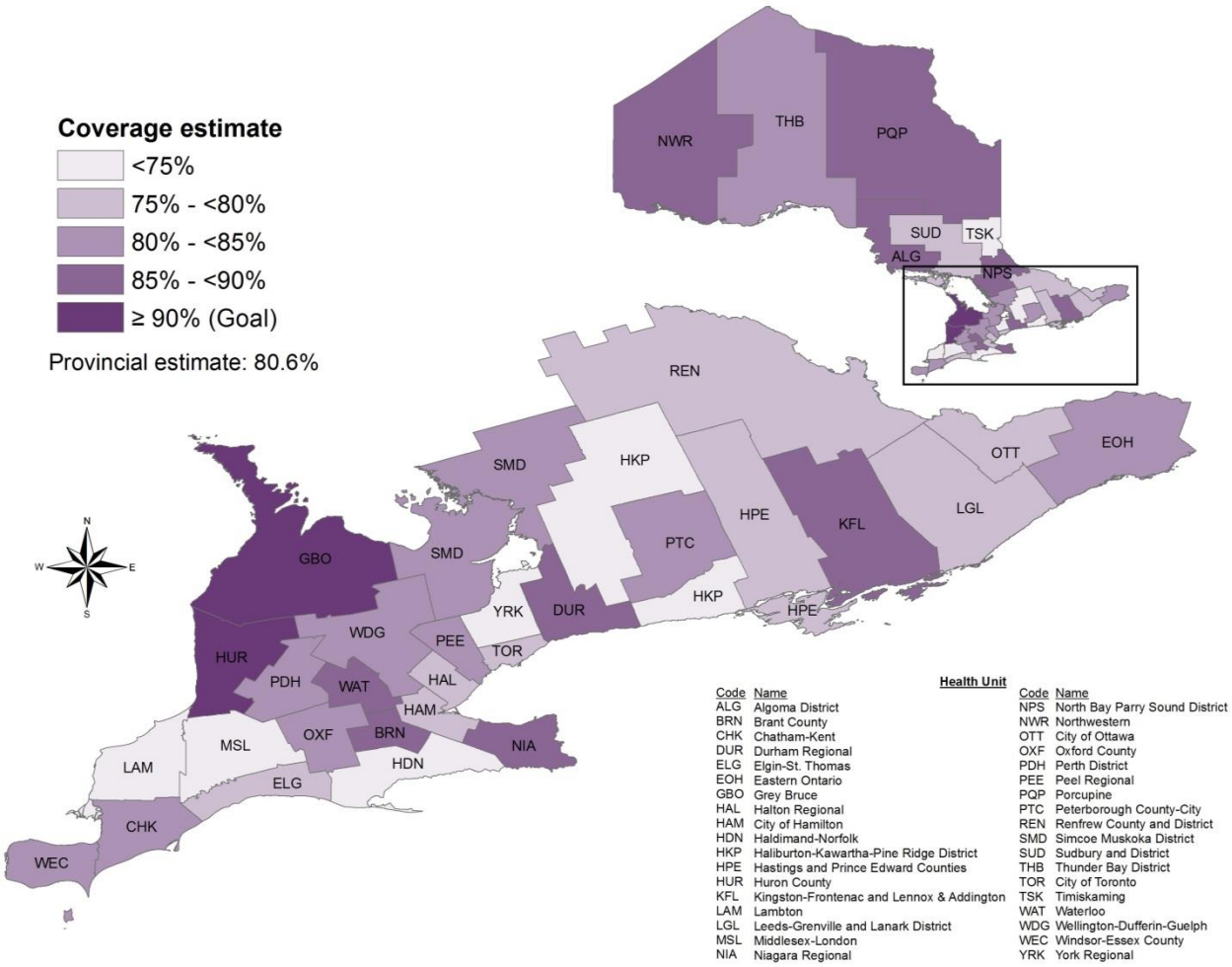
Figure 6 displays coverage estimates for measles among 17-year-olds by PHU for the 2015–16 school year. Coverage estimates among PHUs have a more narrow distribution, ranging from 84.7% to 98.7%. While no PHUs met the coverage goal of 99%, 33 of 36 have coverage estimates of at least 90%. The majority of PHUs (80.6%; n=29) met or exceeded the 94.6% provincial coverage estimate for 17-year-olds. See Table 1 of the Appendix for measles coverage estimates by PHU for all school years for 7- and 17-year-olds.

Figure 6. *Up-to-date* immunization coverage (%) in Ontario for measles among children 17 years old by public health unit: 2015–16 school year



In Figure 7, coverage estimates for MCV4 among 12-year-olds are shown. Coverage varied by PHU for the 2015–16 school year, with PHU-specific coverage estimates ranging from 70.6% to 93.3%. The majority of PHUs (55.6%; n=20) met or exceeded the overall provincial coverage estimate for 12-year-olds of 80.6%, while two PHUs exceeded the coverage goal of 90% (Figure 7). See Table 13 of the Appendix for MCV4 coverage estimates by PHU for all school years for 12-year-olds.

Figure 7. *Up-to-date* immunization coverage (%) in Ontario for quadrivalent meningococcal conjugate (MCV4) among children 12 years old by public health unit: 2015–16 school year

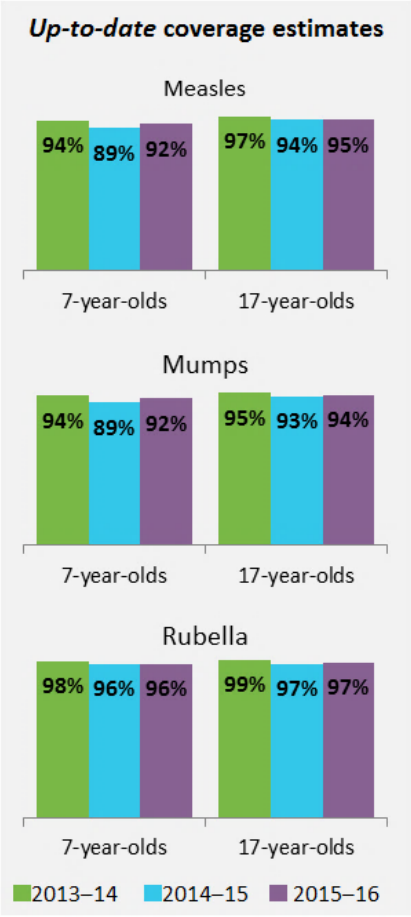


Discussion

The immunization coverage assessment of the 2013–14, 2014–15 and 2015–16 school years shows that immunization coverage among school pupils varies greatly by vaccine, age groups and notably by PHU. These *up-to-date* coverage estimates create a new baseline of measurements, replacing the *complete-for-age* methods used in previous reports, to more accurately assess immunization coverage trends in Ontario from the perspective of population protection.

Childhood immunization programs started in infancy and early childhood

Measles, mumps and rubella



Measles is the most communicable of VPDs, requiring very high immunization coverage for effective control and elimination. Endemic measles virus transmission was declared eliminated from the World Health Organization (WHO) Region of the Americas in 2002;[6] however, large imported outbreaks resulted in the re-establishment of endemic transmission in Brazil from 2013 to 2015. In September 2016, the Region of the Americas was once again declared measles-free, along with the elimination of rubella and congenital rubella syndrome.[7] The last case of endemic measles in Canada occurred in 1997;[8] however, as is evident from the resurgence of endemic transmission in Brazil, vigilant immunization adherence is needed to minimize the risk of transmission from imported cases as measles still circulates in other parts of the world.

Immunization against measles, mumps and rubella is accomplished in Ontario with the use of measles, mumps, rubella (MMR) vaccine at 12 months of age and quadrivalent measles, mumps, rubella, varicella (MMRV) vaccine between four and six years of age. Prior to August 2011, the second dose was administered using MMR at 18 months. Based on the present assessment, most students at 7- and 17-years of age have *up-to-date* immunizations for measles, mumps, and rubella; however, there is substantial variability across PHUs, particularly among 7-year-olds. The level at which immunization coverage is adequate to prevent measles transmission, the herd immunity threshold, is between 96% and 99%.[9] In 2015–16, 9 of 36 PHUs had measles coverage estimates among 7-year-olds that met or exceeded 96%. A total of 20 of 36 PHUs achieved this threshold of coverage among 17-year-old students. The provincial measles coverage

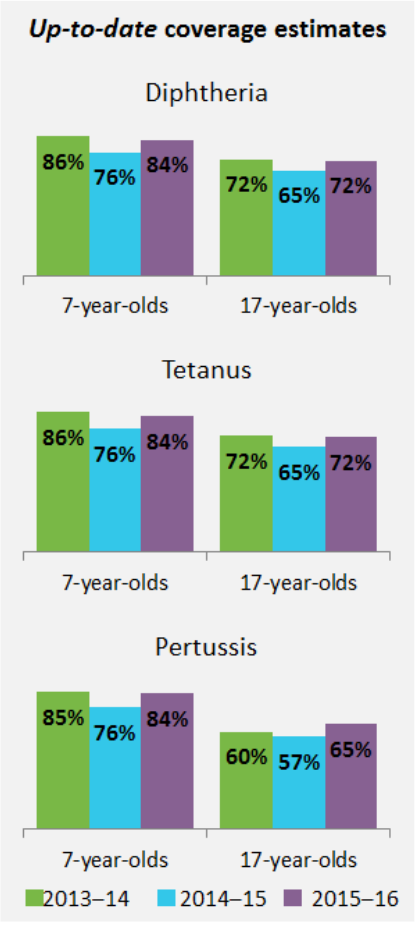
estimates observed for both 7- and 17-year-old students failed to meet the very ambitious, nationally defined coverage goal of 99%.

Endemic measles, rubella and congenital rubella syndrome were declared eliminated from the WHO Region of the Americas in 2016.[13]

The Pan American Health Organization (PAHO) has recommended a two-dose mumps coverage goal of 95% or greater[6] while the national goal for mumps is more ambitious at 99%. Ontario's provincial two-dose mumps coverage ranged between 89.1%-93.6% for 7-year-olds and 93.2%-95.0% for 17-year-olds over the school years assessed. Imported cases of measles and mumps outbreaks continue to occur in Canada and efforts should be made to improve Ontario's measles and mumps immunization coverage in order to best protect the population. Ontario's coverage for rubella is slightly higher than for measles or mumps, as only one dose is required for protection and to be considered *up-to-date*. Ontario met the national coverage goal for rubella of 97%[10] for both 7- and 17-year-olds in 2013–14 (98.2% and 98.5%, respectively) and closely approached the coverage goal in the 2014–15 and 2015–16 school years.

Diphtheria, tetanus and pertussis

Diphtheria, tetanus and pertussis antigens are administered together as part of multivalent vaccines (i.e., DTaP-IPV, DTaP-IPV-Hib, Tdap-IPV and Tdap vaccines). Although these three antigens are currently specified within the *ISPA*, pertussis only became a designated disease in the 2014–15 school year.[3] Pertussis estimates among 17-year-olds are lower than estimates for diphtheria and tetanus, a trend not observed among 7-year-olds. We hypothesize that there may be incomplete data capture of pertussis information among older birth cohorts as there is no monovalent pertussis vaccine available in Canada and pertussis was only recently added to the *ISPA*.



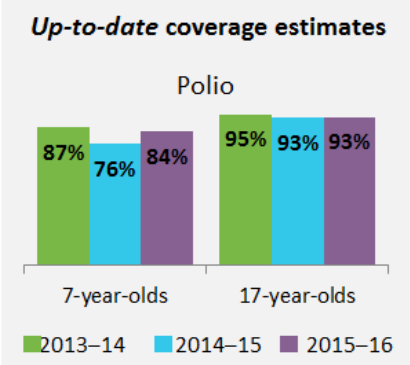
Immunization coverage estimates for diphtheria, tetanus and pertussis are 10% to 20% lower among 17-year-olds, as compared to estimates for 7-year-olds. It is unclear whether this reflects the prioritization of younger age cohorts for local immunization coverage assessment leading to reduced data capture in the DHIR or a true difference in coverage between 7-year-old and 17-year-old cohorts, as an additional dose is required to be considered *up-to-date* at 17 years of age. In contrast, for each of measles, mumps and rubella, all 17-year-old cohorts had higher coverage estimates compared to 7-year-olds, as the routine schedule was completed

by the earlier age milestone, giving more time (10 years) for completion and documentation of the series in the DHIR.

The provincial coverage estimates for diphtheria, tetanus and polio are higher than the Ontario-specific coverage estimates reported by the 2013 National Immunization Coverage Survey administered by the Public Health Agency of Canada (PHAC) which used a sampling methodology but a similar definition of '*up-to-date*' coverage (requiring 6 doses of these antigens by the 17th birthday). For example, the PHAC coverage estimate for diphtheria among 17-year-olds in Ontario was 55.3% (95% Confidence Interval: 50.7%-59.8%).[11]

An additional pattern seen in this report is consistently lower coverage estimates for diphtheria, tetanus and pertussis in the 2014–15 school year among 7-year-olds and 17-year-olds compared to the 2013–14 and 2015–16 school years. Most PHUs in Ontario were in the process of implementing Panorama in the 2014–15 school year and the expanded list of *IPSA* designated diseases came into effect starting in the 2014–15 school year.[3] We hypothesize that the reduced coverage estimates observed may reflect the increased demand on resources during that school year, resulting in decreased focus on assessment activities.

Polio



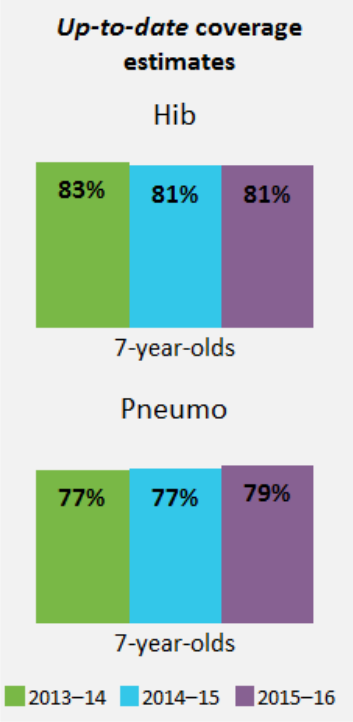
The inactivated polio vaccine (IPV) is typically administered through DTaP-IPV-Hib, DTaP-IPV and Tdap-IPV vaccines. Due to the use of combination vaccines, children typically receive up to five doses of polio if they follow the routine immunization schedule in Ontario. Four doses of polio-containing vaccines are generally required to be considered *up-to-date* at the age of 7 years; however, one of these must be administered on or after four years of age regardless of previous immunizations against polio. Polio coverage in Ontario is much higher among 17-year-olds than 7-year-olds, likely explained by the fact that no further doses of polio-containing vaccine are recommended following the receipt of the previously mentioned pre-school booster. Additionally, there would be increased opportunities to be vaccinated over time given the ten-year period between the age of the last recommended dose and the age of assessment. A relative reduction in polio coverage at the age of 7 years was observed in 2014–15 school year, similar to what has been described for diphtheria, tetanus and pertussis.

Although there has been great progress towards the goal of polio eradication, continued cases in Afghanistan and Pakistan in early 2017,[12] in addition to circulating vaccine-derived poliovirus cases detected in 2016 from Laos, Pakistan and Nigeria[13,14] serve as important reminders that Canada must remain vigilant with regards to the uptake of polio-containing vaccines.

In 1994, the WHO declared Canada free of wild poliovirus.[15] Nonetheless, continuing to

maintain high coverage for polio is essential to upholding Canada's polio elimination status and to minimize the risk of disease transmission should poliovirus importation occur. The WHO 2010 Polio Position Paper considers a country to have a low potential for transmission of imported polio if the country is of high socioeconomic status, has tertiary water treatment and has three-dose inactivated polio vaccine (IPV) coverage between 90% and 95%.[15]

Canadian benchmarks for polio immunization coverage were set to achieve and maintain 97% immunization with three doses of polio vaccine by two years of age, and to achieve and maintain *up-to-date* poliomyelitis immunization (four doses) by the seventh birthday in 99% of children, by 1997.[16] These coverage goals are still applicable and are higher than those set by WHO. Although polio coverage estimates for 7-year-olds fall short of targets set by both WHO and nationally, estimates among 17-year-olds in Ontario (92.5% to 94.9% over the three school years) exceed the WHO criteria, but fall short of the Canadian benchmark.



Hib and pneumococcal conjugate vaccines

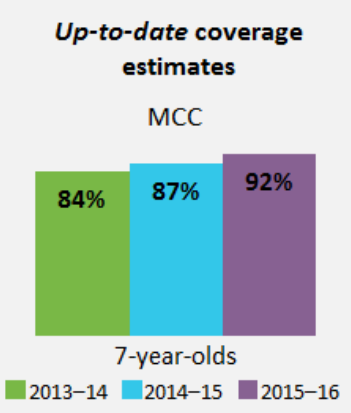
Infants and children under five years of age are at the highest risk of invasive disease caused by Hib. Protection against Hib is provided by the pentavalent DTaP-IPV-Hib vaccine administered at ages 2, 4, 6 and 18 months of age. Hib vaccine is not routinely recommended for children five years of age and older, unless they have one of a number of pre-defined medical conditions that places them at higher risk of infection.[17] Although a nationally defined coverage goal for Hib has been set only for children at two years of age, the Canadian National Standards for Immunization Coverage Assessment include methods on how to assess Hib coverage at 7 years and the National Immunization Coverage Survey of PHAC also measures Hib coverage at this age.[5,18]

In Ontario, children are immunized against invasive pneumococcal disease using a 13-valent pneumococcal conjugate vaccine (PCV-13) given at 2, 4 and 12 months of age, that was introduced into the schedule in November 2010. Prior to this, 10-valent and 7-valent vaccines were used. Similar to Hib, infants and children under five years of age are at greatest risk of invasive pneumococcal disease (IPD) and consequently, older children (five years of age and older) who were not previously immunized are not recommended to be vaccinated. Infants with medical conditions that put them at higher risk of IPD are recommended to receive an additional dose of PCV-13 before 12 months of age.

Neither Hib nor IPD are *ISPA*-designated diseases. Provincial coverage for these programs at 7 years of age, ranged from 81.3% to 83.1% for Hib and from 76.6% to 79.0% for pneumococcal over the 2013–14 to 2015–16 school years. Due to the absence of medical risk factor information, we were not able to assess *up-to-date* coverage among children at higher risk for Hib or IPD.

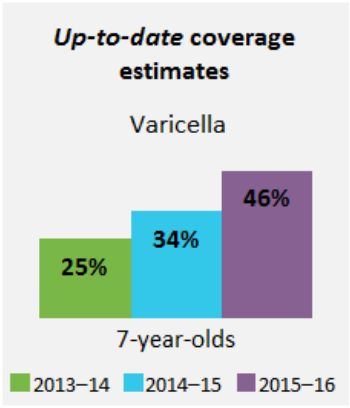
Meningococcal C conjugate vaccine

The MCC program in Ontario provides one dose of vaccine to toddlers at 12 months of age. Immunization coverage for this program shows an increasing trend, with a gain of 8.6 percentage points over the three school years assessed to an estimated coverage of 92.1% in 2015–16. This is likely due to several factors including: a high degree of public acceptance for meningococcal vaccine programs, the addition of invasive meningococcal disease to the list of *ISPA*-designated antigens effective September 2014, and typical trends of increased coverage following the introduction of new vaccine programs. Ontario's toddler MCC program was implemented in the fall of 2004, making 7-year-old students in the 2013–14 school year only the third birth cohort eligible for this program.



Varicella

In August 2011, a two-dose varicella program was introduced to Ontario's publicly-funded immunization schedule through the use of MMRV vaccine at four to six years, following a single-dose of varicella vaccine at 15 months. Children born on or after January 1, 2000 are eligible for two doses of varicella vaccine; however, most children in the birth cohorts captured in the 2013–14, 2014–15 and 2015–16 coverage estimates would have received the two requisite doses of MMR vaccine at 12 and 18 months of age as per the previous schedule, and therefore would have no indication to receive MMRV. The relatively low two-dose coverage over the school years compared to the relatively high one-dose coverage (over 80% in a three school years) likely reflects limited immunization with monovalent varicella vaccine to cohorts eligible for two doses of varicella but who had previously received two doses of MMR. Although varicella was added to the *ISPA* list of designated diseases in the 2014–15 school year,[3] it is applicable only to children born in 2010 or later; therefore the first 7-year-old cohort to which the *ISPA* requirement for varicella will apply will be in the 2017-18 school year. We anticipate that two dose coverage for varicalla will continue to improve in the coming years based on the *ISPA* change and the assessment of birth cohorts who received MMRV as part of the routine publicly-funded immunization schedule.



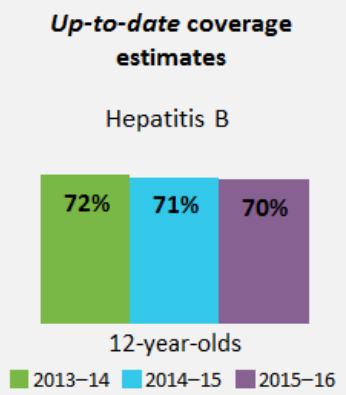
Stepwise increases in two-dose varicella coverage estimates are encouraging, indicating acceptance of the two-dose schedule. One-dose coverage for varicella was more than 80% in all three school years assessed.

Vaccines administered in school-based programs

School-based vaccine delivery serves as an important platform to achieve high immunization coverage among adolescents who tend to have a low frequency of HCP visits for preventive care.[19,20] By removing potential barriers to access, school-based immunization delivery may also be more effective in achieving equity in immunization uptake.[21,22]

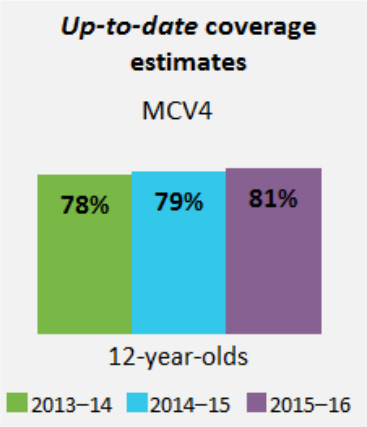
Hepatitis B

The hepatitis B vaccine program includes two doses of the vaccine given four to six months apart, depending on the vaccine product. The extended eligibility component of the program allows any grade 7 student who missed one or both doses of the vaccine to receive publicly-funded vaccines until the end of their grade 8 year. For the 2013–14 to 2015–16 school years, provincial hepatitis B coverage estimates ranged from 69.9% to 71.7%.



While these estimates are lower than the *complete-for-age* coverage estimate of 86.9% from IRIS for the 2012–13 school year, there are important methodologic differences which explain the disparities. In IRIS, unvaccinated students were considered *complete-for-age* if they had not yet reached the overdue age of 15 years. As coverage for this program is calculated for particular birth years (i.e., those who are 12 years of age by December 31st of the school year), no student was 15 years at the time of assessment. Consequently, all unvaccinated students were considered to be *complete-for-age* at the time of assessment and would have been included in the numerator of the provincial estimates. In contrast, an unvaccinated student assessed at the end of the school year would not be *up-to-date* for hepatitis B, regardless of age.

Ontario is currently below the national coverage goal of 95% identified for universal hepatitis B programs;[16] however, our estimates do not include doses delivered as part of extended eligibility. Across the three school years assessed in this report, approximately 84% of students received at least one dose of hepatitis B vaccine and approximately 85% of those who initiated the series, also completed the series at the time of this assessment, suggesting that coverage may be higher if future doses (following program eligibility) were included in the assessment. Many children receive hepatitis B-containing vaccine prior to grade 7 as part of pre-travel immunization, due to risk factors or parental preference. The extent to which these doses are reported to local PHUs for subsequent data entry into the DHIR is unknown as hepatitis B is not an *ISPA*-designated disease, and may be an important influence on the coverage estimates for this program.



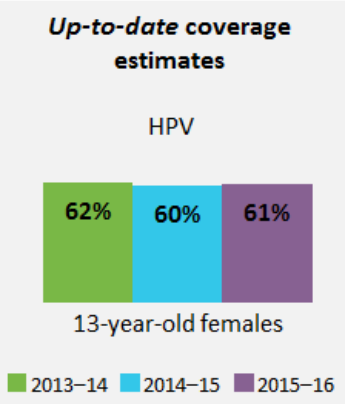
Quadrivalent meningococcal conjugate vaccine

In September 2009, the MCV4 vaccine replaced the MCC vaccine used in the Ontario program. Once students become eligible for the provincial school-based MCV4 immunization program for invasive meningococcal disease in grade 7, they remain eligible until the vaccine is received (i.e., eligibility in perpetuity). In Canada, there is a considerable diversity in immunization programs to prevent invasive meningococcal disease. Programs are offered at different ages during adolescence, and provinces and territories use either MCC or MCV4 vaccine, depending on their local epidemiology.[23,24] In 2005, a nationally defined coverage goal for MCC vaccine for 17-year-olds was set at 90% to be achieved by 2012;[10] at the time this goal was set, no province or territory had yet to implement an adolescent MCV4 program.

Ontario's coverage estimate for MCV4 ranged from 77.5% to 80.6% for the school years of 2013–14 to 2015–16. Immunization coverage for MCV4 is the highest among all school-based immunization programs. This is likely explained by the vaccine series requiring only one dose and high acceptability for this vaccine as invasive meningococcal disease is associated with a high degree of public concern. In addition, this is the only school-based immunization against an *ISPA*-designated disease.

With the implementation of Panorama, analyses of coverage can now differentiate between meningococcal vaccine products, which were not possible in IRIS. For example, IRIS *complete-for-age* estimates for the school-based meningococcal program would have included both the MCV4 vaccine used for adolescents as well as other meningococcal vaccines that may have been administered to children prior to adolescence (e.g., MCC vaccine administered in infancy or second year of life). The *up-to-date* coverage estimates for this report include only the receipt of MCV4. IRIS also considered unvaccinated students as *complete-for-age* for meningococcal disease if they had not yet reached the overdue age of 13 years by the time of assessment. In contrast, an unvaccinated student would not be considered *up-to-date* for MCV4, regardless of age. Both these factors likely contributed to the approximately 10% decrease from the 89.4% *complete-for-age* measure previously reported for the 2012–13 school year and the estimates presented in this report.

Human Papillomavirus



Significant changes to the HPV vaccine schedule have occurred in Canada over the time-period captured by this report. When Ontario's HPV program was first introduced in the 2007-08 school year, the HPV vaccine series required three doses of quadrivalent HPV (HPV4) vaccine, which protects against four types of HPV – types 6, 11, 16 and 18;[25] however, on July 3, 2014 Health Canada approved a two-dose HPV4 schedule for use in adolescents[26] which was implemented by Ontario PHUs in the 2015–16 school year. To accommodate the changes in the provincial HPV program, our methodology for HPV *up-to-date* coverage considered students who had two doses of HPV vaccine separated by a period of at least five to six months (depending on the vaccine), as well as those students who have satisfied the requirements for the three-

dose HPV schedule as *up-to-date* regardless of the school year. Having a uniform approach to measurement across the three school years explains the consistency in coverage estimates, despite the change in schedule over this period.

The *up-to-date* HPV coverage estimates in this report do not include doses administered as part of the extended eligibility program in which students who did not receive or complete the vaccine series in grade 8 are eligible to initiate or complete the series until the end of their grade 12 year.[27] Across the three school years assessed within this report, approximately 71% of 13-year-old females initiated the HPV vaccine series by receiving at least one dose at the time of assessment. Furthermore, more than 84% of those who started the HPV series had completed the series by the end of the school year of assessment.

HPV immunization coverage in Ontario is noticeably different using the *up-to-date* coverage methodology, as compared to the *complete-for-age* coverage estimates included in previous reports. For the 2012–13 school year, *complete-for-age* HPV coverage in Ontario was 80.2%, while *up-to-date* coverage for the school years of 2013–14 to 2015–16 ranged between 60.4% and 61.5%. An important distinction between the two methodologies is that in IRIS, unvaccinated students were considered *complete-for-age* if they had not yet reached the overdue age of 14 years. Therefore, a grade 8 female who had not yet turned 14 years of age at the end of the school year and had received no doses of HPV vaccine was considered *complete-for-age*. In contrast, an unvaccinated student would not be considered *up-to-date*, regardless of age in the current (*up-to-date*) assessment. Although the coverage estimates for 2013–14, 2014–15 and 2015–16 are approximately 20% lower than the *complete-for-age* estimate reported for 2012–13, *up-to-date* coverage estimates provide a more accurate representation of the HPV vaccination program's reach. The report summarizing coverage for the 2012–13 school year demonstrated an important trend in increased uptake since the program's implementation in 2007–08, assessed using the *complete-for-age* measure. The *up-to-date* coverage estimates for HPV summarized in this report should not be interpreted as a reversal of these trends. Instead, they provide new baseline data to inform ongoing program monitoring. We anticipate that with the launch of a gender-neutral HPV program administered in Grade 7 in the 2016–2017 school year, we may see future increases in *up-to-date* HPV coverage in Ontario.

Public Health Unit variability in coverage estimates

PHU-specific coverage estimates by antigen and by school year are available in the Appendix of this report. There was wide variation in coverage between PHUs by both age and antigen. For example, pertussis coverage for 17-year-olds in 2014–15 was as low as 12.9% for one PHU and as high as 90.2% for another PHU. Even more striking was the variability observed within individual PHUs. For example, one PHU had some of the lowest diphtheria coverage estimates for 7-year-olds, as low as 24.6%; while in contrast, rubella coverage for the same PHU's 17-year-olds was as high as 98.4%. Among diphtheria coverage estimates for 17-year-old students, one PHU had estimates as low as 15.3%, in contrast to coverage up to 91.1% among 7-year-olds. These differences could be influenced by variability in assessment activities by PHUs (in other words, prioritizing certain age cohorts, whether 7-year-olds over

17-year-olds, or vice versa, for immunization coverage assessment), or other community level influences on immunization acceptance and, or delivery. However, communities with large numbers of children who are under-immunized or un-immunized may also contribute to low coverage estimates in certain PHUs.

The provincial data show apparent declines in coverage estimates in the 2014–15 school year for many antigens. Further analyses suggest that the provincial estimates for this school year may have been influenced by a small number of PHUs with particularly low coverage in this school year. This may be reflective of the strain on PHU resources limiting the amount of assessment activities due to the increased workload associated with the implementation of Panorama or the addition of 3 new designated diseases under the *ISPA*. Similar to the variability between age groups within PHUs discussed above, notable decreases in coverage for the 2014–15 year were not consistent across age groups within individual PHUs. For example, one PHU saw a decrease in their pertussis coverage estimates for 7-year-olds of 45.2 percentage points from the school year 2013–14 to 2014–15, while coverage for 17-year-olds changed by only 2.9 percentage points during the same time period. Conversely, another PHU saw a decrease in their diphtheria coverage estimates by 51.7 percentage points among 17-year-olds from 2013–14 to 2014–15, while coverage among 7-year-olds only decreased by 7.3 percentage points.

Past and present: measures for coverage assessment

With the implementation of Panorama and the availability of individual-level immunization information, PHO was able to calculate *up-to-date* coverage, as opposed to estimating coverage using the *complete-for-age* measure that was applied to student records within IRIS. For some vaccine programs, the change in measurement definitions contribute to important differences between *up-to-date* coverage calculated for the 2013–14 to 2015–16 school years and the *complete-for-age* coverage estimates summarized in previous reports. The direction and magnitude of the change in coverage estimates vary by antigen and age group; however, for the school-based programs in particular, *up-to-date* coverage is substantially lower than previous complete-for age estimates. The reasons for this are detailed above. It is important to emphasize that the uptake of these programs has not declined since the introduction of Panorama. Instead, the change in measurement to *up-to-date* coverage now provides a more accurate assessment of the reach of these programs and new baseline information to inform future program monitoring. Key differences between the previous methods and those used for this report are summarized below for the school-based programs.

Notes on interpretation

The coverage estimates summarized within this report should be considered in the context of Ontario's immunization system, which is complex and involves multiple providers, organizations and both the primary care and public health sectors. With the exception of the three school-based adolescent programs primarily delivered by local PHUs, the vast majority of infant and childhood immunizations are delivered by community-based HCPs. However, the responsibility for immunization surveillance activities rests with local PHUs. At the time of this report, it was the responsibility of parents and

guardians to provide the required immunization information to local PHUs. Many parents only become aware of their responsibility to report immunization information after receiving a letter from their local PHU indicating that their child's immunizations status has been reviewed and that vaccine doses are outstanding. Thus, both PHU assessment activities and the actions of parents and guardians are important contributors to the data completeness of immunization information within the DHIR. Owing to this complexity, it is possible that some coverage estimates may be lower than reality if not all doses that have been administered to children have been captured by the system and in the data analyzed for this report. Amendments to the *ISPA*[28,29] are currently under review that would require immunization providers to report immunization information to local PHUs. We anticipate that coverage will improve as the data completeness of immunization information within the DHIR improves.

In addition to the immunization system's complexity, there are several other important influences on immunization coverage surveillance that deserve mention. In Ontario, the focus of immunization coverage surveillance activities is on school-age children, due to the *ISPA* providing the legislative under-pinning for the collection of immunizations by local PHUs. This has two important consequences. The first is that since the population lists uploaded into the DHIR to identify local school children are based on school board and other school attendance lists, children who do not attend traditional schools (e.g. are home-schooled or have dropped out of school) may not be fully represented in the numerator or denominator for this report. The second consequence is that the reliance on school assessment processes results in our current inability to report on immunization coverage at two years-of-age, an important national and international age milestone for coverage assessment. Although the *Child Care and Early Years Act*[30,31] sets out the requirement for day care operators to receive proof of immunization for children who are enrolled in their child care program as defined in the Act, not all Ontario children attend child care facilities.

For further details about the limitations of the data presented within this report, please see the Technical Annex.

Conclusions

Immunization coverage assessment in Ontario is supported by provincial legislation and the dedication and commitment of public health professionals across Ontario's 36 PHUs, immunization providers, schools, parents and families. This report demonstrates that Ontario, with rare exceptions, is not meeting established benchmarks for immunization coverage whether defined by national coverage goals or herd immunity thresholds. High immunization coverage is essential for preventing vaccine-preventable disease outbreaks and robust immunization information systems are required to ensure immunization coverage estimates are timely and accurate.

With the implementation of a centralized provincial repository of immunization information, Ontario has gained the ability to calculate *up-to-date* coverage, aligning our methodology with the best practices recommended by the Canadian Immunization Registry Network (CIRN).[5] PHO is confident that the methodology implemented for this 2013–14 to 2015–16 report has made significant advances in the accuracy of Ontario's coverage estimates by moving beyond *complete-for-age* assessments (which include children who may not be *up-to-date* for recommended vaccines). In addition, the calculation of *up-to-date* coverage has resulted in improved alignment with methods used nationally and by other Canadian provinces and territories. The implementation of a provincial immunization repository is a tremendous opportunity for Ontario to improve our ability to evaluate and monitor immunization programs, and to inform solutions to increase the number of Ontarians protected from vaccine-preventable diseases.

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Appendix: Immunization coverage by Public Health Unit

Table 1. Measles immunization coverage estimates (%) among children 7 and 17 years old by Public Health Unit: 2013–14, 2014–15 and 2015–16 school years

Public Health Unit	7 y 2013–14	7 y 2014–15	7 y 2015–16	17 y 2013–14	17 y 2014–15	17 y 2015–16
Algoma Public Health Unit	97.5	93.1	96.4	98.7	97.4	97.8
Brant County Health Unit	95.1	93.1	95.3	97.4	96.6	96.6
Chatham-Kent Public Health Unit	94.4	95.8	95.8	97.7	97.1	97.5
Durham Region Health Department	97.4	95.3	92.0	98.1	95.8	89.3
Eastern Ontario Health Unit	94.0	91.8	91.6	96.7	93.6	88.8
Elgin-St. Thomas Health Unit	95.9	95.3	94.7	97.9	98.4	97.7
Grey Bruce Health Unit	94.9	96.4	96.1	96.6	95.4	95.4
Haldimand-Norfolk Health Unit	82.3	57.3	78.0	96.7	96.3	94.7
Haliburton, Kawartha, Pine Ridge District Health Unit	92.7	90.9	95.1	98.0	94.1	96.7
Halton Region Health Department	88.8	84.7	82.9	96.0	92.6	95.7
Hamilton Public Health Services	91.8	84.6	94.0	97.6	96.3	94.9
Hastings and Prince Edward Counties Health Unit	97.2	93.9	96.0	97.5	97.2	97.8
Huron County Health Unit	95.7	94.4	95.9	96.2	95.2	95.9
Kingston, Frontenac and Lennox & Addington Public Health	96.9	96.4	97.4	96.4	95.4	97.7
Lambton Public Health	94.6	95.4	94.9	98.1	97.6	98.2
Leeds, Grenville and Lanark District Health Unit	94.8	94.4	95.2	90.9	84.1	84.7
Middlesex-London Health Unit	92.6	85.7	92.7	97.6	96.5	95.6
Niagara Region Public Health Unit	93.2	96.0	94.6	96.5	96.8	97.1
North Bay Parry Sound District Health Unit	98.1	97.9	97.5	98.4	98.2	98.1
Northwestern Health Unit	98.1	97.4	97.5	98.5	98.6	97.8
Ottawa Public Health	92.1	91.9	93.6	97.6	95.4	96.2
Oxford County Public Health	90.8	93.0	91.3	95.4	94.2	95.7
Peel Public Health	94.3	94.2	93.4	97.1	97.1	96.9
Perth District Health Unit	95.3	96.9	94.6	96.5	96.1	96.0
Peterborough Public Health	92.5	94.3	95.2	94.4	92.2	96.4
Porcupine Health Unit	97.7	96.5	96.7	98.3	98.4	98.2
Region of Waterloo, Public Health	96.5	94.4	95.2	97.3	95.5	96.6
Renfrew County and District Health Unit	98.6	95.5	96.1	98.1	97.7	98.2
Simcoe Muskoka District Health Unit	96.3	91.3	92.7	97.1	93.9	94.4
Sudbury and District Health Unit	97.0	96.8	97.3	98.5	98.5	98.4
Thunder Bay District Health Unit	96.2	94.7	94.2	97.5	97.0	96.9
Timiskaming Health Unit	97.3	97.1	99.7	99.0	98.7	98.7
Toronto Public Health	94.2	84.3	93.4	95.1	89.0	91.1
Wellington-Dufferin-Guelph Public Health	89.4	87.6	93.3	96.5	94.6	95.2
Windsor-Essex County Health Unit	90.5	80.0	86.4	95.9	93.5	93.3
York Region Public Health Services	95.5	83.5	80.3	96.6	94.5	94.3
ONTARIO	94.0	89.4	91.8	96.7	94.3	94.6

Table 2. Mumps immunization coverage estimates (%) among children 7 and 17 years old by Public Health Unit: 2013–14, 2014–15 and 2015–16 school years

Public Health Unit	7 y 2013–14	7 y 2014–15	7 y 2015–16	17 y 2013–14	17 y 2014–15	17 y 2015–16
Algoma Public Health Unit	97.5	93.1	96.4	98.7	97.4	97.8
Brant County Health Unit	95.1	93.0	95.3	97.1	96.5	96.6
Chatham-Kent Public Health Unit	94.4	95.8	95.7	97.5	96.8	97.5
Durham Region Health Department	97.2	95.0	91.9	97.5	95.1	88.6
Eastern Ontario Health Unit	94.0	91.8	91.6	96.3	93.2	88.7
Elgin-St. Thomas Health Unit	95.9	95.2	94.7	97.2	97.9	97.6
Grey Bruce Health Unit	94.8	96.4	96.1	96.4	95.3	95.4
Haldimand-Norfolk Health Unit	82.3	57.2	78.0	96.4	96.3	94.7
Haliburton, Kawartha, Pine Ridge District Health Unit	92.7	90.9	95.1	97.7	93.8	96.7
Halton Region Health Department	88.5	84.4	82.6	94.8	91.4	95.3
Hamilton Public Health Services	91.4	84.5	93.9	96.7	95.4	94.6
Hastings and Prince Edward Counties Health Unit	97.1	93.8	96.0	96.5	96.5	97.1
Huron County Health Unit	95.7	94.4	95.7	96.1	95.2	95.9
Kingston, Frontenac and Lennox & Addington Public Health	96.8	96.4	97.4	95.9	94.8	97.5
Lambton Public Health	94.4	95.4	94.9	97.7	97.6	98.2
Leeds, Grenville and Lanark District Health Unit	94.7	94.4	95.1	90.8	83.8	84.6
Middlesex-London Health Unit	92.4	85.5	92.7	97.0	95.7	95.3
Niagara Region Public Health Unit	93.1	95.9	94.6	96.2	96.4	96.6
North Bay Parry Sound District Health Unit	98.1	97.8	97.5	98.0	97.8	97.7
Northwestern Health Unit	97.9	97.4	97.5	98.1	98.3	97.7
Ottawa Public Health	91.8	91.6	93.5	95.8	93.8	95.9
Oxford County Public Health	90.8	93.0	91.3	96.4	96.5	96.5
Peel Public Health	93.8	94.0	93.2	95.1	96.4	96.4
Perth District Health Unit	95.1	96.9	94.6	96.1	96.0	95.7
Peterborough Public Health	92.5	94.2	95.1	94.0	91.8	96.3
Porcupine Health Unit	97.7	96.5	96.7	98.1	98.4	98.2
Region of Waterloo, Public Health	96.3	94.3	95.1	96.2	94.3	96.3
Renfrew County and District Health Unit	98.6	95.5	96.1	97.7	97.6	98.0
Simcoe Muskoka District Health Unit	96.2	91.2	92.7	96.5	93.6	94.3
Sudbury and District Health Unit	97.0	96.8	97.3	98.5	98.5	98.4
Thunder Bay District Health Unit	96.2	94.7	94.2	97.3	97.0	96.9
Timiskaming Health Unit	97.3	97.1	99.7	98.7	98.7	98.7
Toronto Public Health	93.1	83.5	93.2	91.5	86.9	89.8
Wellington-Dufferin-Guelph Public Health	89.1	87.3	93.3	95.8	94.4	94.8
Windsor-Essex County Health Unit	90.4	79.8	86.3	94.8	93.0	92.8
York Region Public Health Services	95.0	83.1	80.0	93.8	92.1	93.0
ONTARIO	**93.6**	**89.1**	**91.6**	**95.0**	**93.2**	**94.0**

Table 3. Rubella immunization coverage estimates (%) among children 7 and 17 years old by Public Health Unit: 2013–14, 2014–15 and 2015–16 school years

Public Health Unit	7 y 2013–14	7 y 2014–15	7 y 2015–16	17 y 2013–14	17 y 2014–15	17 y 2015–16
Algoma Public Health Unit	99.1	98.6	99.1	99.4	98.1	98.6
Brant County Health Unit	97.3	97.0	97.1	98.6	97.8	97.7
Chatham-Kent Public Health Unit	97.9	98.3	97.7	99.2	98.7	98.6
Durham Region Health Department	98.7	98.5	98.0	99.3	99.0	98.6
Eastern Ontario Health Unit	97.7	96.0	95.5	98.3	95.1	90.4
Elgin-St. Thomas Health Unit	97.4	96.8	96.3	98.6	98.5	98.5
Grey Bruce Health Unit	97.6	97.4	97.6	98.3	96.7	96.6
Haldimand-Norfolk Health Unit	95.3	71.8	85.6	98.4	97.7	96.6
Haliburton, Kawartha, Pine Ridge District Health Unit	98.3	94.4	97.0	99.0	95.5	97.9
Halton Region Health Department	97.8	96.4	95.2	98.5	96.8	97.4
Hamilton Public Health Services	98.1	96.1	96.6	98.9	97.9	97.2
Hastings and Prince Edward Counties Health Unit	98.4	97.1	97.7	98.7	98.2	98.7
Huron County Health Unit	97.2	96.3	97.0	97.8	95.8	96.3
Kingston, Frontenac and Lennox & Addington Public Health	99.1	98.8	98.4	99.1	98.0	99.1
Lambton Public Health	98.0	98.0	96.5	99.2	98.6	99.0
Leeds, Grenville and Lanark District Health Unit	98.2	98.0	97.3	97.5	92.9	91.4
Middlesex-London Health Unit	98.3	95.8	95.9	98.9	97.9	97.0
Niagara Region Public Health Unit	97.8	98.1	97.2	97.8	98.4	98.7
North Bay Parry Sound District Health Unit	98.7	98.7	98.3	99.2	98.8	98.9
Northwestern Health Unit	98.9	98.3	98.3	99.4	99.1	98.5
Ottawa Public Health	98.5	97.8	97.3	99.0	97.2	98.1
Oxford County Public Health	94.2	93.8	92.8	97.6	97.6	97.3
Peel Public Health	98.9	98.7	98.1	98.9	98.7	98.6
Perth District Health Unit	96.6	97.2	95.8	97.7	97.0	96.6
Peterborough Public Health	96.4	97.4	96.7	96.2	93.8	97.8
Porcupine Health Unit	98.9	97.8	97.8	98.7	98.8	98.6
Region of Waterloo, Public Health	98.2	97.5	97.3	98.5	97.0	97.6
Renfrew County and District Health Unit	99.3	98.9	98.1	99.0	98.3	98.6
Simcoe Muskoka District Health Unit	97.9	96.7	96.2	98.7	97.4	97.2
Sudbury and District Health Unit	98.3	98.5	98.3	99.3	99.3	99.0
Thunder Bay District Health Unit	98.0	97.7	97.2	98.2	97.6	97.9
Timiskaming Health Unit	99.1	97.7	99.7	99.5	98.9	99.5
Toronto Public Health	98.3	96.1	96.2	97.7	93.3	94.0
Wellington-Dufferin-Guelph Public Health	97.5	95.6	96.4	98.3	96.4	97.0
Windsor-Essex County Health Unit	96.8	90.9	93.3	99.1	96.5	96.4
York Region Public Health Services	98.3	89.8	87.5	98.3	96.7	96.0
ONTARIO	**98.2**	**96.1**	**95.9**	**98.5**	**96.7**	**96.9**

Table 4. Diphtheria immunization coverage estimates (%) among children 7 and 17 years old by Public Health Unit: 2013–14, 2014–15 and 2015–16 school years

Public Health Unit	7 y 2013–14	7 y 2014–15	7 y 2015–16	17 y 2013–14	17 y 2014–15	17 y 2015–16
Algoma Public Health Unit	89.3	74.7	91.8	88.2	83.0	85.5
Brant County Health Unit	90.2	82.4	92.9	82.4	79.6	82.4
Chatham-Kent Public Health Unit	90.0	95.5	94.8	88.1	85.3	87.5
Durham Region Health Department	95.3	89.7	80.1	83.2	76.3	60.8
Eastern Ontario Health Unit	89.1	81.5	82.6	72.5	54.4	34.0
Elgin-St. Thomas Health Unit	92.5	91.5	92.5	87.3	89.7	88.3
Grey Bruce Health Unit	89.3	95.3	95.2	86.4	82.2	87.9
Haldimand-Norfolk Health Unit	55.9	24.6	67.0	78.9	77.5	68.5
Haliburton, Kawartha, Pine Ridge District Health Unit	61.6	79.4	91.6	69.2	51.3	72.8
Halton Region Health Department	67.4	53.5	49.7	69.0	61.4	78.1
Hamilton Public Health Services	80.0	41.3	91.1	17.5	15.3	64.7
Hastings and Prince Edward Counties Health Unit	93.9	81.1	93.7	85.9	81.6	86.2
Huron County Health Unit	92.5	92.9	94.6	86.1	86.7	87.4
Kingston, Frontenac and Lennox & Addington Public Health	91.8	94.3	95.6	57.2	56.7	84.1
Lambton Public Health	88.0	92.8	92.1	77.4	68.6	81.8
Leeds, Grenville and Lanark District Health Unit	80.7	89.5	88.6	61.6	54.1	59.8
Middlesex-London Health Unit	79.4	53.5	88.9	80.0	71.8	70.4
Niagara Region Public Health Unit	87.4	94.8	93.9	79.2	82.7	84.4
North Bay Parry Sound District Health Unit	96.0	96.3	95.6	83.0	87.8	87.4
Northwestern Health Unit	95.9	94.8	96.3	89.7	90.4	88.3
Ottawa Public Health	81.5	83.4	87.1	71.3	58.9	77.7
Oxford County Public Health	78.6	92.3	90.5	87.7	86.1	88.3
Peel Public Health	91.0	90.2	84.9	75.2	76.7	78.9
Perth District Health Unit	84.2	95.2	92.9	92.7	90.2	91.2
Peterborough Public Health	80.5	87.0	91.8	69.1	59.5	79.2
Porcupine Health Unit	92.2	94.4	94.3	88.1	90.8	90.7
Region of Waterloo, Public Health	94.1	89.1	92.2	78.3	77.6	82.9
Renfrew County and District Health Unit	94.8	83.5	94.1	79.6	82.6	87.4
Simcoe Muskoka District Health Unit	86.3	79.0	89.2	73.0	21.3	47.2
Sudbury and District Health Unit	85.0	95.0	95.0	78.7	85.6	84.2
Thunder Bay District Health Unit	92.4	91.0	91.5	88.9	82.6	71.7
Timiskaming Health Unit	96.2	96.8	99.4	92.7	89.2	90.6
Toronto Public Health	89.9	68.4	89.8	69.8	61.5	60.7
Wellington-Dufferin-Guelph Public Health	69.9	74.5	89.9	73.7	64.8	80.3
Windsor-Essex County Health Unit	76.2	31.0	78.9	45.0	47.8	54.7
York Region Public Health Services	91.2	73.4	63.7	77.6	69.1	73.0
ONTARIO	**86.4**	**76.1**	**84.3**	**72.2**	**65.2**	**71.5**

Table 5. Tetanus immunization coverage estimates (%) among children 7 and 17 years old by Public Health Unit: 2013–14, 2014–15 and 2015–16 school years

Public Health Unit	7 y 2013–14	7 y 2014–15	7 y 2015–16	17 y 2013–14	17 y 2014–15	17 y 2015–16
Algoma Public Health Unit	89.3	74.7	91.8	88.1	83.0	85.6
Brant County Health Unit	90.2	82.4	92.9	82.4	79.7	82.4
Chatham-Kent Public Health Unit	90.0	95.5	94.8	88.1	85.3	87.5
Durham Region Health Department	95.3	89.7	80.2	83.2	76.3	60.8
Eastern Ontario Health Unit	89.1	81.5	82.6	72.6	54.3	34.0
Elgin-St. Thomas Health Unit	92.5	91.5	92.5	87.4	89.7	88.3
Grey Bruce Health Unit	89.3	95.3	95.2	86.4	82.2	87.9
Haldimand-Norfolk Health Unit	55.9	24.6	67.0	78.9	77.5	68.5
Haliburton, Kawartha, Pine Ridge District Health Unit	61.6	79.4	91.6	69.3	51.5	72.8
Halton Region Health Department	67.4	53.5	49.7	69.0	61.5	78.2
Hamilton Public Health Services	79.9	41.3	91.1	17.5	15.3	64.7
Hastings and Prince Edward Counties Health Unit	93.9	81.1	93.7	85.9	81.5	86.2
Huron County Health Unit	92.5	92.9	94.6	86.1	86.7	87.4
Kingston, Frontenac and Lennox & Addington Public Health	91.8	94.3	95.6	57.3	56.7	84.1
Lambton Public Health	88.0	92.8	92.1	77.4	68.6	81.8
Leeds, Grenville and Lanark District Health Unit	80.7	89.5	88.6	61.6	54.1	59.8
Middlesex-London Health Unit	79.4	53.5	88.9	80.0	71.8	70.4
Niagara Region Public Health Unit	87.4	94.8	93.9	79.2	82.7	84.4
North Bay Parry Sound District Health Unit	96.0	96.3	95.6	83.0	87.8	87.4
Northwestern Health Unit	95.9	94.8	96.3	89.7	90.4	88.2
Ottawa Public Health	81.5	83.4	87.1	71.3	59.0	77.8
Oxford County Public Health	78.6	92.3	90.5	87.8	86.1	88.3
Peel Public Health	91.0	90.2	84.8	75.2	76.8	78.9
Perth District Health Unit	84.2	95.2	92.9	92.8	90.3	91.0
Peterborough Public Health	80.5	87.0	91.8	69.2	59.5	79.3
Porcupine Health Unit	92.2	94.4	94.3	88.1	90.8	90.6
Region of Waterloo, Public Health	94.1	89.1	92.2	78.3	77.7	82.9
Renfrew County and District Health Unit	94.8	83.5	94.1	79.6	82.6	87.5
Simcoe Muskoka District Health Unit	86.3	79.0	89.2	73.0	21.4	47.3
Sudbury and District Health Unit	85.0	95.0	95.0	78.7	85.6	84.3
Thunder Bay District Health Unit	92.4	91.0	91.5	88.9	82.6	71.7
Timiskaming Health Unit	96.2	96.8	99.4	92.7	89.2	90.6
Toronto Public Health	89.8	68.3	89.8	69.8	61.5	60.7
Wellington-Dufferin-Guelph Public Health	69.9	74.5	89.9	73.7	64.8	80.3
Windsor-Essex County Health Unit	76.2	31.0	78.9	45.1	47.8	54.7
York Region Public Health Services	91.2	73.4	63.6	77.6	69.1	73.0
ONTARIO	**86.4**	**76.1**	**84.3**	**72.2**	**65.2**	**71.5**

Table 6. Pertussis immunization coverage estimates (%) among children 7 and 17 years old by Public Health Unit: 2013–14, 2014–15 and 2015–16 school years

Public Health Unit	7 y 2013–14	7 y 2014–15	7 y 2015–16	17 y 2013–14	17 y 2014–15	17 y 2015–16
Algoma Public Health Unit	89.3	74.5	91.8	85.4	80.2	77.7
Brant County Health Unit	90.2	82.4	92.8	78.9	76.3	75.8
Chatham-Kent Public Health Unit	90.0	95.5	94.8	83.8	83.5	85.5
Durham Region Health Department	95.1	89.6	80.1	78.4	71.8	57.1
Eastern Ontario Health Unit	89.0	81.5	82.6	70.8	53.2	33.1
Elgin-St. Thomas Health Unit	92.5	91.5	92.5	85.5	87.5	85.2
Grey Bruce Health Unit	89.2	95.2	95.2	84.6	79.0	81.0
Haldimand-Norfolk Health Unit	55.9	24.6	67.0	77.5	76.7	67.6
Haliburton, Kawartha, Pine Ridge District Health Unit	61.5	79.4	91.5	65.5	49.3	65.8
Halton Region Health Department	66.3	53.0	49.4	65.0	58.5	74.2
Hamilton Public Health Services	79.7	41.2	91.1	15.0	12.9	57.5
Hastings and Prince Edward Counties Health Unit	93.3	80.8	93.7	80.6	76.9	82.0
Huron County Health Unit	92.5	92.9	94.6	83.6	82.0	82.7
Kingston, Frontenac and Lennox & Addington Public Health	91.8	94.2	95.6	55.3	53.1	82.3
Lambton Public Health	88.0	92.8	92.1	72.2	65.4	77.9
Leeds, Grenville and Lanark District Health Unit	80.6	89.4	88.5	59.9	52.6	58.5
Middlesex-London Health Unit	78.9	53.3	88.9	72.5	67.2	66.8
Niagara Region Public Health Unit	87.4	94.8	93.8	74.1	75.5	77.5
North Bay Parry Sound District Health Unit	96.0	96.3	95.6	77.8	79.1	78.1
Northwestern Health Unit	95.7	94.8	96.3	85.2	87.8	84.2
Ottawa Public Health	81.2	83.2	87.1	57.0	50.4	70.3
Oxford County Public Health	78.5	92.3	90.5	85.4	83.5	84.7
Peel Public Health	87.2	89.4	84.4	42.6	58.3	66.3
Perth District Health Unit	84.2	95.1	92.9	90.2	88.6	89.4
Peterborough Public Health	80.2	86.9	91.8	63.6	56.0	75.3
Porcupine Health Unit	92.2	94.3	94.2	85.3	87.7	86.8
Region of Waterloo, Public Health	93.8	89.0	92.1	70.9	71.0	78.4
Renfrew County and District Health Unit	94.8	83.5	94.1	77.3	80.9	86.0
Simcoe Muskoka District Health Unit	86.1	78.9	89.2	69.0	20.2	45.6
Sudbury and District Health Unit	85.0	94.9	95.0	74.4	77.0	78.2
Thunder Bay District Health Unit	92.4	91.0	91.5	85.7	80.3	69.2
Timiskaming Health Unit	96.2	96.8	99.4	89.4	83.9	66.0
Toronto Public Health	85.1	66.9	89.6	47.5	47.4	50.6
Wellington-Dufferin-Guelph Public Health	69.7	74.2	89.8	70.4	60.8	75.6
Windsor-Essex County Health Unit	76.0	30.8	78.7	42.3	45.2	52.4
York Region Public Health Services	90.9	73.1	63.3	71.2	65.5	68.9
ONTARIO	**84.8**	**75.6**	**84.1**	**60.4**	**57.4**	**65.0**

Table 7. Polio immunization coverage estimates (%) among children 7 and 17 years old by Public Health Unit: 2013–14, 2014–15 and 2015–16 school years

Public Health Unit	7 y 2013–14	7 y 2014–15	7 y 2015–16	17 y 2013–14	17 y 2014–15	17 y 2015–16
Algoma Public Health Unit	89.2	74.5	91.8	98.0	96.9	97.4
Brant County Health Unit	90.2	82.0	93.3	96.7	95.3	95.5
Chatham-Kent Public Health Unit	90.7	95.8	95.2	97.0	96.1	96.4
Durham Region Health Department	95.5	89.9	80.0	96.9	94.5	88.3
Eastern Ontario Health Unit	88.8	80.5	82.8	94.6	91.4	86.2
Elgin-St. Thomas Health Unit	92.6	91.8	92.6	97.2	97.3	97.2
Grey Bruce Health Unit	89.1	95.3	95.5	96.7	95.4	95.1
Haldimand-Norfolk Health Unit	55.7	24.5	67.2	87.6	91.3	89.5
Haliburton, Kawartha, Pine Ridge District Health Unit	61.7	79.5	91.9	97.8	93.2	96.5
Halton Region Health Department	66.8	53.5	49.2	94.2	90.4	93.5
Hamilton Public Health Services	80.2	41.5	91.7	96.3	95.2	89.7
Hastings and Prince Edward Counties Health Unit	94.1	81.2	93.7	96.7	96.4	96.9
Huron County Health Unit	92.5	93.0	95.2	96.2	94.3	95.3
Kingston, Frontenac and Lennox & Addington Public Health	92.0	94.4	95.9	93.0	91.7	96.1
Lambton Public Health	88.5	93.2	92.1	97.0	96.1	97.7
Leeds, Grenville and Lanark District Health Unit	80.8	89.7	88.8	85.5	81.2	82.8
Middlesex-London Health Unit	79.8	53.5	89.3	96.1	94.7	94.4
Niagara Region Public Health Unit	87.6	94.7	93.9	96.2	96.8	96.8
North Bay Parry Sound District Health Unit	96.3	96.5	95.8	97.4	97.3	97.5
Northwestern Health Unit	96.7	95.0	96.7	97.8	98.2	97.3
Ottawa Public Health	81.8	83.7	87.6	93.8	91.9	94.3
Oxford County Public Health	78.6	92.5	90.5	94.8	92.7	94.9
Peel Public Health	91.2	90.5	85.0	95.7	95.6	95.5
Perth District Health Unit	84.1	95.2	93.1	95.4	94.9	94.9
Peterborough Public Health	80.5	87.6	92.1	93.4	90.8	95.9
Porcupine Health Unit	93.0	94.2	94.2	97.6	96.7	97.7
Region of Waterloo, Public Health	94.3	89.3	92.5	94.9	93.1	95.2
Renfrew County and District Health Unit	95.1	83.6	94.5	97.4	96.6	97.6
Simcoe Muskoka District Health Unit	86.5	79.5	89.6	96.0	92.7	93.3
Sudbury and District Health Unit	85.2	95.1	95.2	97.0	97.4	97.3
Thunder Bay District Health Unit	92.9	91.2	92.4	97.4	96.4	96.2
Timiskaming Health Unit	96.2	96.8	99.4	98.7	98.5	98.7
Toronto Public Health	90.7	68.5	90.2	92.5	86.6	88.7
Wellington-Dufferin-Guelph Public Health	69.8	74.6	90.3	96.0	94.2	94.5
Windsor-Essex County Health Unit	76.1	31.6	79.2	94.5	91.8	91.6
York Region Public Health Services	91.4	73.4	63.7	95.2	93.4	92.8
ONTARIO	**86.6**	**76.2**	**84.5**	**94.9**	**92.5**	**92.9**

Table 8. *Haemophilus influenzae* type b (Hib) immunization coverage estimates (%) among children 7 years old by Public Health Unit: 2013–14, 2014–15 and 2015–16 school years

Public Health Unit	2013–14	2014–15	2015–16
Algoma Public Health Unit	95.5	93.5	93.5
Brant County Health Unit	89.5	89.6	88.9
Chatham-Kent Public Health Unit	88.1	91.1	88.4
Durham Region Health Department	86.2	84.5	85.1
Eastern Ontario Health Unit	87.0	84.7	83.7
Elgin-St. Thomas Health Unit	88.7	91.8	86.4
Grey Bruce Health Unit	89.4	90.1	91.3
Haldimand-Norfolk Health Unit	85.9	60.7	72.7
Haliburton, Kawartha, Pine Ridge District Health Unit	90.2	83.2	85.9
Halton Region Health Department	86.8	84.2	83.2
Hamilton Public Health Services	81.2	80.3	79.5
Hastings and Prince Edward Counties Health Unit	89.6	87.0	86.5
Huron County Health Unit	85.3	86.3	87.5
Kingston, Frontenac and Lennox & Addington Public Health	91.3	88.4	89.3
Lambton Public Health	86.3	85.1	85.2
Leeds, Grenville and Lanark District Health Unit	92.8	90.2	88.3
Middlesex-London Health Unit	85.7	82.4	82.1
Niagara Region Public Health Unit	87.5	88.2	88.0
North Bay Parry Sound District Health Unit	88.4	90.3	91.1
Northwestern Health Unit	87.0	87.2	86.8
Ottawa Public Health	86.9	84.7	83.2
Oxford County Public Health	82.2	86.2	85.0
Peel Public Health	78.3	79.6	79.4
Perth District Health Unit	92.5	92.3	90.8
Peterborough Public Health	86.7	88.2	88.0
Porcupine Health Unit	89.6	86.1	88.0
Region of Waterloo, Public Health	83.6	83.3	83.2
Renfrew County and District Health Unit	89.8	90.9	90.0
Simcoe Muskoka District Health Unit	83.9	83.3	81.9
Sudbury and District Health Unit	85.3	82.9	83.2
Thunder Bay District Health Unit	84.0	83.5	82.9
Timiskaming Health Unit	89.3	90.3	91.6
Toronto Public Health	76.1	75.4	76.6
Wellington-Dufferin-Guelph Public Health	85.3	81.4	82.8
Windsor-Essex County Health Unit	85.0	78.7	77.0
York Region Public Health Services	82.9	76.0	74.9
ONTARIO	**83.1**	**81.4**	**81.3**

Table 9. Pneumococcal immunization coverage estimates (%) among children 7 years old by Public Health Unit: 2013–14, 2014–15 and 2015–16 school years

Public Health Unit	2013–14	2014–15	2015–16
Algoma Public Health Unit	87.2	88.1	90.4
Brant County Health Unit	84.0	84.2	85.9
Chatham-Kent Public Health Unit	79.1	80.6	82.1
Durham Region Health Department	80.0	82.7	84.2
Eastern Ontario Health Unit	84.6	85.2	83.6
Elgin-St. Thomas Health Unit	82.0	85.6	86.2
Grey Bruce Health Unit	84.9	87.6	88.2
Haldimand-Norfolk Health Unit	72.5	52.9	69.7
Haliburton, Kawartha, Pine Ridge District Health Unit	83.1	81.6	85.3
Halton Region Health Department	74.5	75.5	78.3
Hamilton Public Health Services	78.2	79.4	79.1
Hastings and Prince Edward Counties Health Unit	78.8	82.4	82.2
Huron County Health Unit	85.1	84.5	85.7
Kingston, Frontenac and Lennox & Addington Public Health	82.1	85.6	87.8
Lambton Public Health	68.9	71.8	73.3
Leeds, Grenville and Lanark District Health Unit	79.6	83.7	84.8
Middlesex-London Health Unit	69.7	72.3	78.7
Niagara Region Public Health Unit	84.4	85.5	85.9
North Bay Parry Sound District Health Unit	83.5	86.2	88.6
Northwestern Health Unit	84.5	84.4	84.0
Ottawa Public Health	79.6	79.7	81.1
Oxford County Public Health	77.1	79.7	77.9
Peel Public Health	71.1	74.7	75.5
Perth District Health Unit	83.9	85.1	85.4
Peterborough Public Health	75.3	78.4	77.6
Porcupine Health Unit	84.9	86.3	88.1
Region of Waterloo, Public Health	78.7	81.2	82.6
Renfrew County and District Health Unit	82.1	84.7	85.8
Simcoe Muskoka District Health Unit	80.3	83.1	82.8
Sudbury and District Health Unit	78.5	76.2	76.7
Thunder Bay District Health Unit	74.6	78.0	76.5
Timiskaming Health Unit	88.5	88.0	90.9
Toronto Public Health	69.6	70.8	73.7
Wellington-Dufferin-Guelph Public Health	81.8	81.7	83.2
Windsor-Essex County Health Unit	80.1	77.4	79.3
York Region Public Health Services	80.4	74.3	74.4
ONTARIO	**76.6**	**77.3**	**79.0**

Table 10. Meningococcal C conjugate (MCC) immunization coverage estimates (%) among children 7 years old by Public Health Unit: 2013–14, 2014–15 and 2015–16 school years

Public Health Unit	2013–14	2014–15	2015–16
Algoma Public Health Unit	89.5	93.3	97.4
Brant County Health Unit	90.8	93.3	96.4
Chatham-Kent Public Health Unit	88.2	96.1	95.8
Durham Region Health Department	86.9	91.4	91.6
Eastern Ontario Health Unit	91.8	92.1	93.4
Elgin-St. Thomas Health Unit	91.8	95.1	94.4
Grey Bruce Health Unit	91.3	96.0	95.7
Haldimand-Norfolk Health Unit	81.5	61.4	79.7
Haliburton, Kawartha, Pine Ridge District Health Unit	88.8	90.7	95.6
Halton Region Health Department	80.1	80.7	82.9
Hamilton Public Health Services	84.1	85.1	95.6
Hastings and Prince Edward Counties Health Unit	88.2	88.9	96.7
Huron County Health Unit	93.4	95.3	96.4
Kingston, Frontenac and Lennox & Addington Public Health	88.7	96.6	97.2
Lambton Public Health	86.3	94.3	95.2
Leeds, Grenville and Lanark District Health Unit	84.6	93.8	95.4
Middlesex-London Health Unit	83.7	82.6	94.2
Niagara Region Public Health Unit	88.9	96.2	95.1
North Bay Parry Sound District Health Unit	89.8	97.6	98.1
Northwestern Health Unit	85.4	95.0	97.7
Ottawa Public Health	82.1	85.0	88.5
Oxford County Public Health	86.7	92.2	91.9
Peel Public Health	80.7	93.4	95.3
Perth District Health Unit	90.5	96.2	95.2
Peterborough Public Health	81.6	90.8	95.3
Porcupine Health Unit	85.6	95.3	97.1
Region of Waterloo, Public Health	88.1	91.8	94.5
Renfrew County and District Health Unit	85.7	92.3	96.9
Simcoe Muskoka District Health Unit	86.5	89.9	94.2
Sudbury and District Health Unit	90.5	97.2	98.0
Thunder Bay District Health Unit	86.5	93.1	96.3
Timiskaming Health Unit	94.4	95.1	99.4
Toronto Public Health	77.2	81.6	93.9
Wellington-Dufferin-Guelph Public Health	85.0	86.2	94.4
Windsor-Essex County Health Unit	86.2	80.9	89.5
York Region Public Health Services	83.8	80.1	80.7
ONTARIO	**83.5**	**87.2**	**92.1**

Table 11. Two-dose varicella immunization coverage estimates (%) among children 7 years old by Public Health Unit: 2013–14, 2014–15 and 2015–16 school years

Public Health Unit	2013–14	2014–15	2015–16
Algoma Public Health Unit	39.4	47.2	61.6
Brant County Health Unit	24.9	38.9	54.7
Chatham-Kent Public Health Unit	34.8	51.1	65.4
Durham Region Health Department	23.2	35.6	40.9
Eastern Ontario Health Unit	33.9	44.9	57.7
Elgin-St. Thomas Health Unit	26.6	50.6	60.6
Grey Bruce Health Unit	34.4	55.8	65.5
Haldimand-Norfolk Health Unit	14.7	14.9	43.2
Haliburton, Kawartha, Pine Ridge District Health Unit	14.2	40.3	51.3
Halton Region Health Department	13.4	19.8	19.9
Hamilton Public Health Services	26.3	21.7	54.3
Hastings and Prince Edward Counties Health Unit	24.0	30.5	45.1
Huron County Health Unit	26.2	49.7	61.4
Kingston, Frontenac and Lennox & Addington Public Health	37.4	53.8	66.9
Lambton Public Health	20.9	38.2	44.7
Leeds, Grenville and Lanark District Health Unit	20.7	38.1	61.0
Middlesex-London Health Unit	24.6	28.4	56.9
Niagara Region Public Health Unit	30.3	49.9	63.0
North Bay Parry Sound District Health Unit	36.9	55.0	67.8
Northwestern Health Unit	9.6	20.5	28.5
Ottawa Public Health	32.1	45.8	54.3
Oxford County Public Health	25.4	46.4	53.9
Peel Public Health	18.9	28.2	33.4
Perth District Health Unit	35.1	56.7	63.7
Peterborough Public Health	26.1	42.3	52.7
Porcupine Health Unit	30.0	51.6	66.4
Region of Waterloo, Public Health	22.9	35.1	52.5
Renfrew County and District Health Unit	19.4	43.5	58.0
Simcoe Muskoka District Health Unit	34.7	44.5	60.1
Sudbury and District Health Unit	29.7	48.0	62.8
Thunder Bay District Health Unit	18.5	23.3	49.5
Timiskaming Health Unit	36.4	48.1	65.9
Toronto Public Health	21.1	25.1	41.0
Wellington-Dufferin-Guelph Public Health	34.5	48.7	62.3
Windsor-Essex County Health Unit	33.5	15.0	51.4
York Region Public Health Services	25.9	35.8	36.9
ONTARIO	**24.8**	**33.8**	**46.4**

Table 12. Hepatitis B immunization coverage estimates (%) among children 12 years old by Public Health Unit: 2013–14, 2014–15 and 2015–16 school years

Public Health Unit	2013–14	2014–15	2015–16
Algoma Public Health Unit	78.9	75.5	72.8
Brant County Health Unit	81.2	80.5	77.5
Chatham-Kent Public Health Unit	74.0	71.7	73.3
Durham Region Health Department	75.9	74.3	76.4
Eastern Ontario Health Unit	75.8	75.1	71.9
Elgin-St. Thomas Health Unit	63.4	68.1	62.7
Grey Bruce Health Unit	77.7	76.2	80.1
Haldimand-Norfolk Health Unit	73.2	63.1	63.1
Haliburton, Kawartha, Pine Ridge District Health Unit	63.1	59.2	60.6
Halton Region Health Department	62.6	62.7	62.0
Hamilton Public Health Services	74.7	73.6	69.7
Hastings and Prince Edward Counties Health Unit	63.1	65.1	63.7
Huron County Health Unit	71.1	71.1	71.6
Kingston, Frontenac and Lennox & Addington Public Health	74.1	75.0	75.1
Lambton Public Health	42.8	55.1	48.6
Leeds, Grenville and Lanark District Health Unit	63.9	59.7	59.6
Middlesex-London Health Unit	64.2	67.4	59.9
Niagara Region Public Health Unit	75.1	73.5	71.0
North Bay Parry Sound District Health Unit	74.3	71.8	71.4
Northwestern Health Unit	71.8	72.4	71.3
Ottawa Public Health	72.7	70.1	73.8
Oxford County Public Health	69.9	67.3	62.8
Peel Public Health	66.9	68.3	72.6
Perth District Health Unit	75.1	74.7	77.6
Peterborough Public Health	58.2	69.1	69.7
Porcupine Health Unit	71.4	73.1	75.4
Region of Waterloo, Public Health	76.6	75.7	74.4
Renfrew County and District Health Unit	71.7	69.7	65.8
Simcoe Muskoka District Health Unit	75.2	76.1	72.3
Sudbury and District Health Unit	68.6	67.9	66.3
Thunder Bay District Health Unit	59.8	61.4	59.4
Timiskaming Health Unit	58.7	57.1	60.1
Toronto Public Health	75.0	72.7	71.8
Wellington-Dufferin-Guelph Public Health	71.5	70.9	69.7
Windsor-Essex County Health Unit	74.0	72.7	73.2
York Region Public Health Services	74.8	70.7	63.6
ONTARIO	**71.7**	**70.7**	**69.9**

Table 13. Quadrivalent meningococcal conjugate (MCV4) immunization coverage estimates (%) among children 12 years old by Public Health Unit: 2013–14, 2014–15 and 2015–16 school years

Public Health Unit	2013–14	2014–15	2015–16
Algoma Public Health Unit	85.2	84.1	85.8
Brant County Health Unit	86.2	89.0	88.6
Chatham-Kent Public Health Unit	78.6	83.9	82.6
Durham Region Health Department	87.0	88.4	88.4
Eastern Ontario Health Unit	79.7	81.3	80.4
Elgin-St. Thomas Health Unit	71.8	79.0	78.8
Grey Bruce Health Unit	82.0	90.0	93.3
Haldimand-Norfolk Health Unit	79.5	72.6	70.6
Haliburton, Kawartha, Pine Ridge District Health Unit	55.3	67.6	73.7
Halton Region Health Department	67.3	71.3	77.4
Hamilton Public Health Services	85.5	80.9	77.2
Hastings and Prince Edward Counties Health Unit	71.4	74.2	78.6
Huron County Health Unit	83.2	83.4	90.8
Kingston, Frontenac and Lennox & Addington Public Health	78.3	82.5	87.8
Lambton Public Health	49.4	77.2	74.7
Leeds, Grenville and Lanark District Health Unit	69.9	74.8	77.3
Middlesex-London Health Unit	70.6	78.0	73.7
Niagara Region Public Health Unit	87.4	87.3	86.6
North Bay Parry Sound District Health Unit	78.5	84.7	85.5
Northwestern Health Unit	79.6	83.9	86.7
Ottawa Public Health	77.2	82.0	79.6
Oxford County Public Health	77.6	82.1	82.1
Peel Public Health	70.8	78.2	82.1
Perth District Health Unit	78.0	84.8	84.8
Peterborough Public Health	62.3	78.9	81.0
Porcupine Health Unit	78.0	83.3	86.8
Region of Waterloo, Public Health	87.1	86.9	87.0
Renfrew County and District Health Unit	73.6	76.5	77.5
Simcoe Muskoka District Health Unit	85.7	87.2	82.5
Sudbury and District Health Unit	76.4	77.4	79.9
Thunder Bay District Health Unit	72.0	78.6	81.5
Timiskaming Health Unit	69.5	80.0	74.7
Toronto Public Health	80.0	76.6	79.7
Wellington-Dufferin-Guelph Public Health	79.0	79.5	82.0
Windsor-Essex County Health Unit	79.8	80.0	81.5
York Region Public Health Services	75.6	74.2	73.4
ONTARIO	**77.5**	**79.4**	**80.6**

Table 14. Human papillomavirus (HPV) immunization coverage estimates (%) among females 13 years old by Public Health Unit: 2013–14, 2014–15 and 2015–16 school years

Public Health Unit	2013–14	2014–15	2015–16
Algoma Public Health Unit	63.2	62.0	60.2
Brant County Health Unit	70.5	71.3	64.7
Chatham-Kent Public Health Unit	58.3	56.0	59.2
Durham Region Health Department	70.2	69.6	71.6
Eastern Ontario Health Unit	68.8	64.2	64.5
Elgin-St. Thomas Health Unit	52.0	52.1	45.4
Grey Bruce Health Unit	65.2	65.2	71.5
Haldimand-Norfolk Health Unit	54.3	53.7	55.8
Haliburton, Kawartha, Pine Ridge District Health Unit	64.3	51.2	52.6
Halton Region Health Department	36.8	44.8	49.0
Hamilton Public Health Services	63.4	61.7	61.5
Hastings and Prince Edward Counties Health Unit	58.8	54.0	52.1
Huron County Health Unit	59.9	56.2	46.7
Kingston, Frontenac and Lennox & Addington Public Health	65.3	61.0	63.5
Lambton Public Health	39.2	41.7	35.2
Leeds, Grenville and Lanark District Health Unit	56.8	56.2	50.8
Middlesex-London Health Unit	52.6	50.3	50.6
Niagara Region Public Health Unit	63.0	59.2	58.6
North Bay Parry Sound District Health Unit	62.4	57.3	57.3
Northwestern Health Unit	59.6	54.9	57.7
Ottawa Public Health	57.5	60.1	64.7
Oxford County Public Health	54.6	52.5	54.4
Peel Public Health	60.8	61.8	65.6
Perth District Health Unit	50.1	53.6	63.1
Peterborough Public Health	60.1	56.7	59.9
Porcupine Health Unit	65.2	62.1	63.7
Region of Waterloo, Public Health	61.9	61.4	60.2
Renfrew County and District Health Unit	56.4	57.6	54.7
Simcoe Muskoka District Health Unit	68.8	66.9	65.7
Sudbury and District Health Unit	58.9	54.7	51.4
Thunder Bay District Health Unit	45.9	46.5	44.3
Timiskaming Health Unit	69.5	51.4	50.6
Toronto Public Health	66.4	66.4	66.9
Wellington-Dufferin-Guelph Public Health	62.3	59.1	56.6
Windsor-Essex County Health Unit	61.9	55.8	60.0
York Region Public Health Services	67.9	62.9	55.8
ONTARIO	**61.5**	**60.4**	**61.0**

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