

# Immunization Coverage Report for School Pupils in Ontario

2016–17 School Year



Technical Report  
August 2018

## Public Health Ontario

Public Health Ontario is a Crown corporation dedicated to protecting and promoting the health of all Ontarians and reducing inequities in health. Public Health Ontario links public health practitioners, frontline health workers and researchers to the best scientific intelligence and knowledge from around the world.

Public Health Ontario provides expert scientific and technical support to government, local public health units and health care providers relating to the following:

- communicable and infectious diseases
- infection prevention and control
- environmental and occupational health
- emergency preparedness
- health promotion, chronic disease and injury prevention
- public health laboratory services

Public Health Ontario's work also includes surveillance, epidemiology, research, professional development and knowledge services. For more information, visit [publichealthontario.ca](http://publichealthontario.ca).

How to cite this document:

Ontario Agency for Health Protection and Promotion (Public Health Ontario). Immunization coverage report for school pupils in Ontario: 2016–17 school year. Toronto, ON: Queen's Printer for Ontario; 2018.

ISSN: 2371-9346

ISBN: 978-1-4868-1696-5

©Queen's Printer for Ontario, 2018

Public Health Ontario acknowledges the financial support of the Ontario Government.

## Authors

Andreas Bunko, MPH  
Epidemiologist Lead  
Immunization and Vaccine Preventable Diseases  
Public Health Ontario

Tara Harris, RN, MHSc  
Manager  
Immunization and Vaccine Preventable Diseases  
Public Health Ontario

Chi Yon Seo, MSc  
Epidemiologist  
Immunization and Vaccine Preventable Diseases  
Public Health Ontario

Sarah Wilson, MD, MSc, CCFP, FRCPC  
Medical Epidemiologist  
Immunization and Vaccine Preventable Diseases  
Public Health Ontario

## Acknowledgements

The authors wish to express their sincere appreciation for the effort and dedication of Ontario's 36 Public Health Units (PHUs) in the delivery of immunization programs and in the collection of student immunization information required for immunization coverage assessment. We also thank our colleagues at the Ministry of Health and Long-Term Care in the Immunization Policy and Programs Section and the Digital Health Solutions and Innovation Branch for their collaboration in providing subject matter expertise in relation to the Digital Health Immunization Repository and the Panorama application.

In addition, we would like to acknowledge staff within Knowledge Services at Public Health Ontario for their support with the production of this document as well as materials to support its public release.

## Disclaimer

This document was developed by Public Health Ontario (PHO). PHO provides scientific and technical advice to Ontario's government, public health organizations and health care providers. PHO's work is guided by the current best available evidence at the time of publication.

The application and use of this document is the responsibility of the user. PHO assumes no liability resulting from any such application or use.

This document may be reproduced without permission for non-commercial purposes only and provided that appropriate credit is given to PHO. No changes and/or modifications may be made to this document without express written permission from PHO.

## Contents

Key Messages.....	1
Introduction .....	2
Report Objectives and Scope .....	5
Methods.....	5
Results.....	6
Immunization Coverage for the 2016–17 School Year .....	6
7-year-olds .....	6
17-year-olds .....	7
School-Based Immunization Programs .....	9
Geographic Distribution.....	12
Temporal Trends.....	15
Discussion.....	19
Childhood Immunization Programs Started in Infancy and Early Childhood.....	19
Measles, Mumps and Rubella .....	19
Diphtheria, Tetanus and Pertussis .....	20
Polio .....	21
<i>Haemophilus Influenzae</i> Type b and Pneumococcal Conjugate Vaccines .....	21
Meningococcal C Conjugate Vaccine .....	22
Varicella.....	22
Vaccines Administered in School-Based Programs.....	22
Hepatitis B.....	22
Quadrivalent Meningococcal Conjugate Vaccine .....	23
Human Papillomavirus .....	23
Public Health Unit Variability in Coverage Estimates .....	24
Notes on Interpretation.....	24
Conclusions .....	25
References .....	26
Appendix 1: Public Health Unit Abbreviations.....	30
Appendix 2: Immunization Coverage by Public Health Unit.....	31
Measles .....	31

Mumps .....	33
Rubella .....	35
Diphtheria .....	37
Tetanus.....	39
Pertussis.....	41
Polio .....	43
<i>Haemophilus influenzae</i> type b.....	45
Pneumococcal .....	47
Meningococcal C conjugate .....	49
Varicella.....	51
Hepatitis B.....	53
Quadrivalent meningococcal conjugate .....	55
Human papillomavirus .....	57

## Key messages from the immunization coverage assessment of school pupils for the 2016-17 school year



**Immunization coverage among school pupils varies greatly** by vaccine, age and health unit.



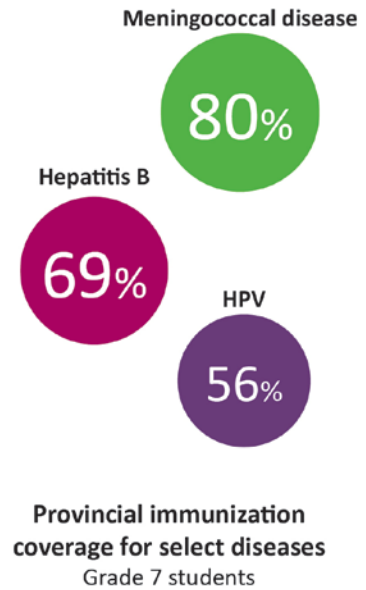
**Coverage estimates are dependent on the information recorded in the provincial immunization repository.** Not all immunizations given to children may be captured in this system, which may result in underestimates of coverage.



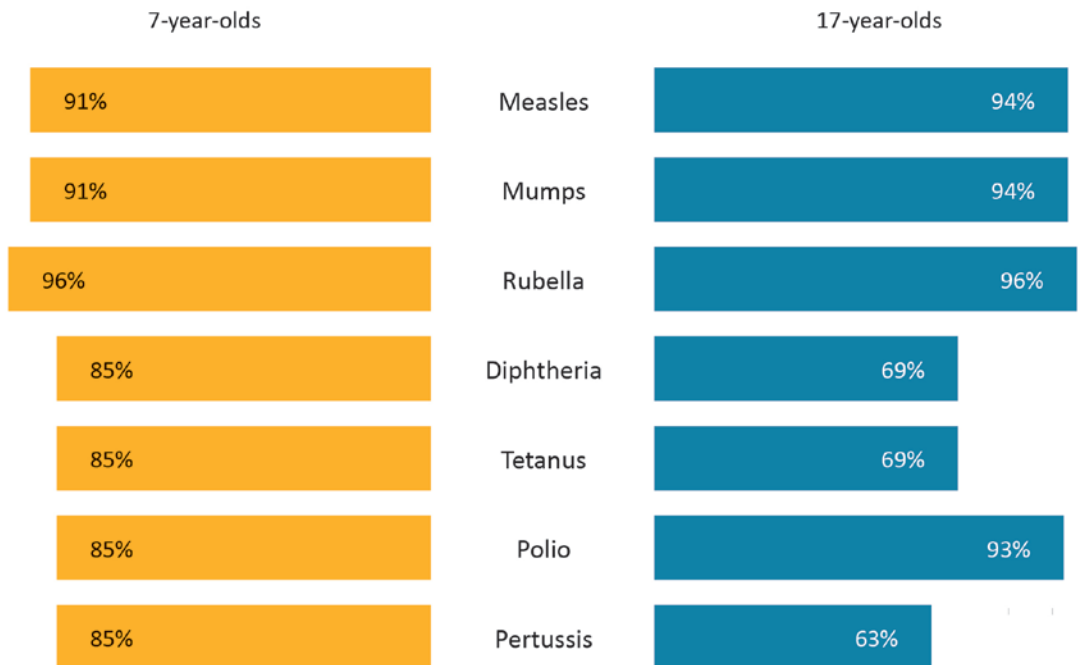
**For most antigens, provincial-level coverage estimates do not meet Canada's national coverage goals.** However, some health units have local coverage estimates that surpass the national goals.



Many children who are not up-to-date **have received some, but not all,** recommended doses in a vaccine series.



### Provincial immunization coverage for select diseases



# 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. They also target high-risk individuals with particular medical conditions, behavioural risk factors or high-risk exposures. [Table 1](#) shows the routine schedule for publicly-funded vaccines administered in infancy and childhood as of December 2016, although the schedule in effect for the children assessed in this report may have varied at the time of their immunizations. Schedules for all [publicly-funded immunizations in Ontario](#) can be found on the Ministry of Health and Long-Term Care’s website.<sup>1</sup>

**Table 1. Publicly-funded immunization schedule for Ontario: Routine schedule for children starting immunization in infancy by age, December 2016<sup>1</sup>**

Vaccine	2 m	4 m	6 m	12 m	15 m	18 m	4-6 y	Grade 7*	14-16 y†	Annually
DTaP-IPV-Hib	■	■	■			■				
Pneu-C-13	■	■		■						
Rot-1	■	■								
Men-C-C				■						
MMR				■						
Var					■					
MMRV							■			
Tdap-IPV							■			
Men-C-ACYW								■		
HB								■‡		
HPV-4								■‡		
Tdap									■	
Inf										■



\* In the 2016–17 school year, the HPV vaccine was also offered to grade 8 females.

† 10 years after 4- to 6-year-old booster

‡ Administered as a 2 dose series

**Abbreviations:** m=month, y=year; Diphtheria, Tetanus and Acellular Pertussis-Inactivated Polio (DTaP-IPV); *Haemophilus influenzae* 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).

In Ontario, vaccines administered in infancy and early childhood are predominantly delivered by community-based primary health care providers (HCPs). Adolescent vaccines are largely delivered by public health units (PHUs) 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 annually to individuals aged 6 months or older in Ontario<sup>2</sup> by a range of providers including PHU staff, HCPs and pharmacists.

Starting in the 2016–17 school year, the HPV immunization program was expanded to include boys as well as girls, and was delivered in Grade 7 instead of Grade 8. Grade 8 females were also offered HPV vaccine in the 2016–17 school year so that this cohort would not be missed in the transition from Grade 8 to Grade 7 delivery.<sup>3</sup> There have been many changes to the publicly funded HPV program in recent years, including a change in 2015 from a three-dose to a two-dose schedule for healthy individuals.<sup>4</sup> For this report, all students were assessed using both the two- and three-dose schedules and were considered up-to-date if at least one schedule was satisfied.

Immunization coverage is assessed annually for school pupils within each board of health jurisdiction in Ontario.<sup>5</sup> Under the *Immunization of School Pupils Act (ISPA)*,<sup>6,7</sup> 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 *ISPA*-designated diseases are not received by a certain date or if documentation of a medical exemption or religious/conscientious exemption is not provided.<sup>6,7</sup> 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
- rubella

Following *ISPA* amendments which came into effect in the fall of 2014, this list was expanded to include:

- pertussis (whooping cough)
- meningococcal disease
- varicella (chickenpox)<sup>6</sup>

The requirement for varicella only applies to children born in 2010 or later and is not in effect for any of the cohorts of students assessed for this report.

Additional legislation in the *Child Care and Early Years Act (CCYEA)*<sup>8,9</sup> 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. However, it should be noted that not all Ontario children attend child care facilities.

Ontario immunization records are maintained in the Digital Health Immunization Repository (DHIR), which is accessible to PHUs through the web-based application Panorama. The [National Standards for Immunization Coverage Assessment](#) recommended by the Canadian Immunization Registry Network specify that antigen-level coverage should be reported annually for 2-, 7- and 17-year-olds as well as for school-age programs.<sup>10</sup> Since the collection of immunization information in Ontario is driven by the *ISPA* and the *CCYEA*, the DHIR may not contain information for all immunizations administered to Ontario residents. As such, we are not currently able to provide timely assessments of coverage for children before school-entry (i.e., among 2-year-olds) or in adults in Ontario.

It should also be noted that while eligibility for school-based programs is based on grade, there are concerns regarding the completeness of the school grade field in the DHIR. Therefore, selected age cohorts are used in this assessment to approximate the grades at which students are eligible for school-based immunization programs (12-year-olds for grade 7, 13-year-olds for grade 8). For more information about the DHIR, Panorama, immunization data collection and the methodology used to calculate the coverage estimates presented in this report, please refer to the [Technical Annex](#).

In this report, Ontario's provincial coverage estimates are compared to Canada's national vaccination coverage goals, which were updated in 2017 as part of the National Immunization Strategy objectives for 2016-2021.<sup>11</sup> Vaccination coverage goals were set to be achieved by 2025 and were developed based on international standards and best practices.

## Report Objectives and Scope

For this report, coverage was assessed for all publicly-funded vaccines included within the routine schedule with the exception 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.

The objectives of this report are:

- 1) To present provincial and PHU-specific immunization coverage estimates for Ontario's publicly-funded childhood immunization programs started in infancy and early childhood. This includes: measles, mumps, rubella, diphtheria, tetanus, polio and pertussis for 7- and 17-year-olds; and *Haemophilus influenzae* type b, 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 including: hepatitis B (12-year-olds), quadrivalent meningococcal conjugate (MCV4: 12-year-olds) and human papillomavirus (HPV: 12-year-old males and females, and 13-year-old females).
- 3) To describe trends in provincial immunization coverage over the most recent four school years (since the implementation of Panorama) and to compare these with nationally defined coverage goals.

## Methods

---

For a detailed description of the provincial immunization repository (the DHIR) and methods for the assessment of student immunization status, please see the [Technical Annex](#) of this report.

# Results

---

## Immunization Coverage for the 2016–17 School Year

### 7-year-olds

Provincial estimates of immunization coverage for publicly-funded childhood immunization programs at age 7 for the 2016–17 school year are presented in [Figure 1](#). This includes minimum and maximum PHU-specific estimates and national coverage goals. Coverage estimates by PHU are available in [Appendix 2](#) of this report.

Provincial coverage for measles, mumps and rubella among 7-year-olds in the 2016–17 school year were all above 91%, with coverage for rubella (96.2%) exceeding the national goal of 95%.<sup>\*</sup> At the PHU-level, the national goals of 95% coverage for each antigen were met<sup>\*</sup> by 13 PHUs for measles, 13 PHUs for mumps and 28 PHUs for rubella.

Provincial coverage for diphtheria, tetanus and pertussis at 7 years of age were all approximately 85% (84.7%, 84.7% and 84.6%, respectively). The national coverage goals of 95% for each of diphtheria, tetanus and pertussis<sup>\*</sup> were met by few PHUs (5 for diphtheria, 5 for tetanus and 4 for pertussis). The provincial polio coverage estimate of 85.0% for the 7-year-old milestones is below the national goal of 95%;<sup>\*</sup> however six PHU-level estimates exceeded the goal.

There is no nationally defined coverage goal for Hib at 7 years of age, but the national coverage goal for Hib at two years of age is 95%.<sup>\*11</sup> Comparing the 7-year-old cohort with this goal, the provincial coverage estimate of 82.2% was well below the national goal and only one PHU exceeded this standard. Provincial coverage for pneumococcal vaccine was 79.7%; no PHU achieved the national goal set at 95%. Similar to Hib, this coverage goal was set for two-year-old children.<sup>\*</sup>

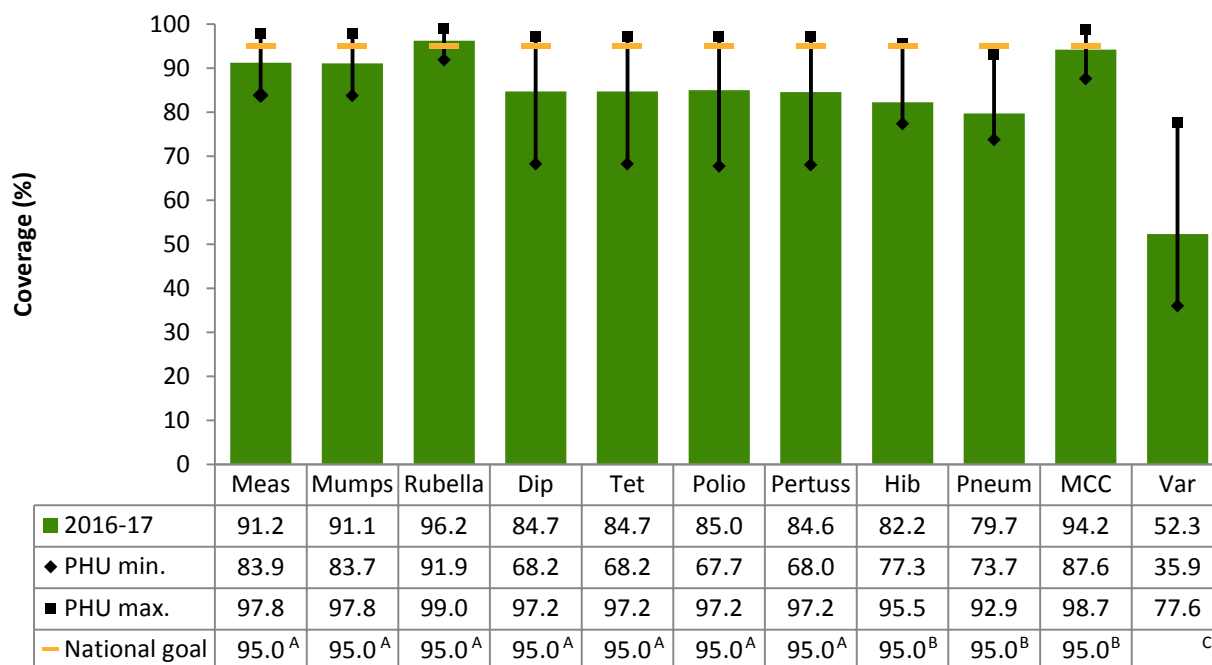
At 94.2%, provincial coverage for MCC is just short of the national coverage goal of 95%.<sup>\*</sup> There were 24 PHU-level coverage estimates that exceed this goal.

Just over half (52.3%) of 7-year-olds assessed were up-to-date for two doses of varicella, and one dose coverage was considerably higher at 88.1% for the 2016–17 school year (one dose coverage not shown in figure). There is no national goal for two dose varicella coverage (which would align with Ontario's current publicly-funded immunization program), but a goal of 95% coverage is established for one dose coverage among two-year-olds.<sup>\*</sup>

---

<sup>\*</sup> National coverage goals are from: Public Health Agency of Canada's Vaccination Coverage Goals and Vaccine Preventable Disease Reduction Targets by 2025. The conditions outlined for the national goals (listed below [Figure 1](#)) may differ from the conditions required to be considered up-to-date as defined in the [Technical Annex](#).

**Figure 1. Up-to-date immunization coverage (%) in Ontario among children 7 years old: 2016–17 school year**



**Notes:**

- Meas=Measles, Dip=Diphtheria, Tet=Tetanus, Pertuss=Pertussis, Hib=*Haemophilus influenzae* type b, Pneum=Pneumococcal, MCC=Meningococcal C conjugate, Var=Varicella
- National coverage goals are defined as:
  - Achieve 95% vaccination coverage by seven years of age for the following childhood vaccines: five doses of diphtheria, tetanus and pertussis vaccine; four doses of polio vaccine; two doses of measles, mumps and rubella vaccine.
  - Achieve 95% vaccine coverage by two years of age for the following childhood vaccines: four doses of *Haemophilus influenzae* type b (Hib) vaccine; three or four doses of pneumococcal vaccine; one dose of meningococcal C vaccine.
  - There is no coverage goal for two dose varicella coverage. A goal of 95% vaccination coverage by two years of age for one dose of varicella has been established.

## 17-year-olds

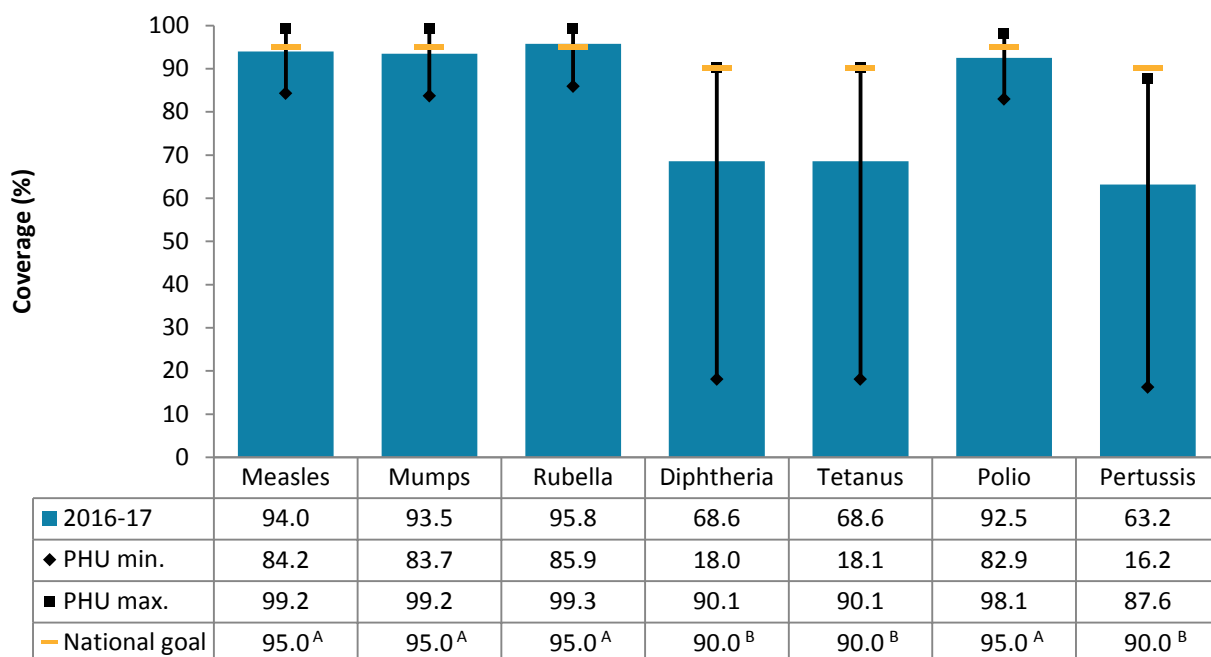
Provincial estimates of immunization coverage, minimum and maximum PHU-specific estimates for publicly-funded childhood immunization programs at age 17 for the 2016–17 school year are presented in [Figure 2](#), along with national coverage goals. Coverage estimates by PHU are available in [Appendix 2](#) of this report.

As shown in [Figure 2](#), provincial immunization coverage estimates for measles, mumps and rubella among 17-year-olds for the 2016–17 school year were 94.0%, 93.5% and 95.8%, respectively. There are no further vaccine doses containing these antigens between 7 years of age and 17 years of age within

the immunization schedule; therefore, comparisons are made using the 95% coverage goals established for 7-year-olds for these antigens.<sup>†11</sup>

There were 26 PHUs that met the coverage goals for each of measles and mumps, and 28 PHUs that met the coverage goal for rubella for local coverage estimates among 17-year-olds. Coverage estimates for diphtheria, tetanus and pertussis, which are typically lower than estimates at age seven due to the requirement of an adolescent dose, were all below 70% (68.6%, 68.6% and 63.2% respectively). All three antigens have a national coverage goal of 90%,<sup>†</sup> which one PHU met for both diphtheria and tetanus and were met by no PHUs for pertussis. Coverage for polio at 17 years of age was 92.5%, which is below the national coverage goal of 95% coverage set for 7-year-olds;<sup>†</sup> however, 20 PHU-level estimates exceed the goal.

**Figure 2. Up-to-date immunization coverage (%) in Ontario among children 17 years old: 2016–17 school year**



**Notes:**

- National coverage goals are defined as:
  - A. Achieve 95% vaccination coverage by seven years of age for the following childhood vaccines: four doses of polio vaccine; two doses of measles, mumps and rubella vaccine.
  - B. Achieve 90% vaccination coverage by 17 years of age for the following adolescent vaccines: one dose of tetanus-diphtheria-pertussis booster vaccine (Tdap) given between 14 and 16 years of age.

<sup>†</sup> National coverage goals are from: Public Health Agency of Canada’s Vaccination Coverage Goals and Vaccine Preventable Disease Reduction Targets by 2025. The conditions outlined for the national goals (listed below [Figure 2](#)) may differ from the conditions required to be considered up-to-date as defined in the [Technical Annex](#).

## School-Based Immunization Programs

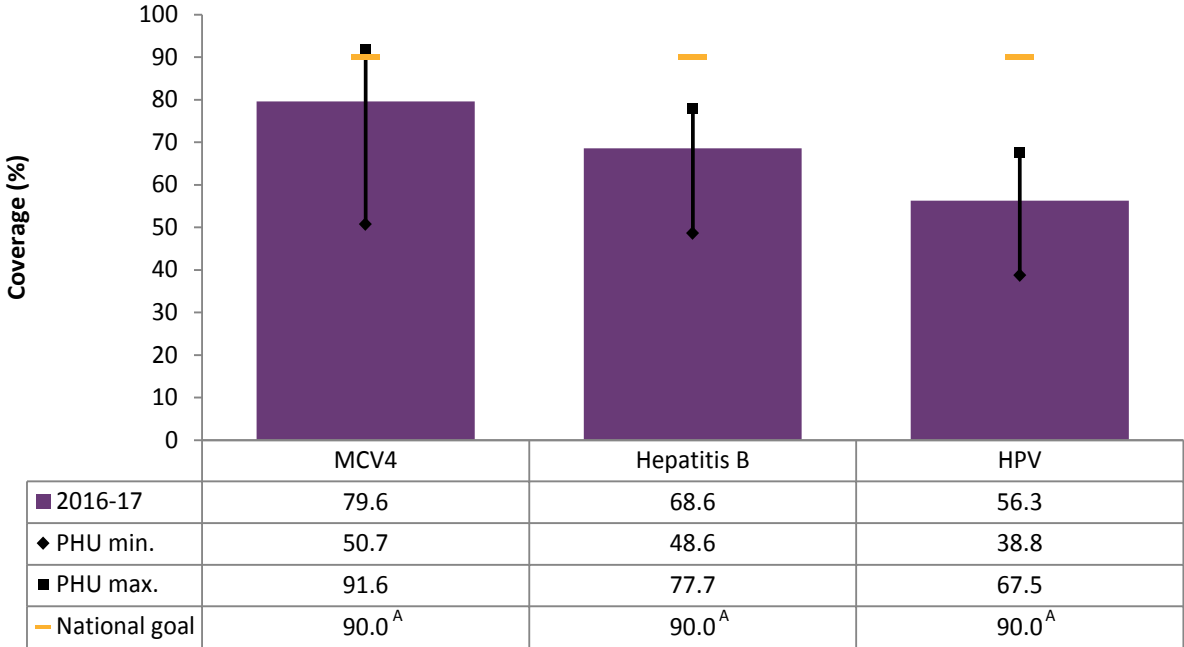
[Figure 3](#) presents provincial and PHU-specific coverage estimates and national coverage goals for the three vaccines administered to students in Grade 7 through Ontario’s school-based immunization programs for the 2016–17 school year. For PHU-specific estimates, see [Appendix 2](#) of this report. Coverage estimates were 56.3% for HPV, 68.6% for hepatitis B and 79.6% for MCV4. The HPV vaccine was also offered to grade 8 females in the 2016–17 school year. [Figure 4](#) shows that HPV coverage was 59.6% for this 13-year-old female cohort, 59.4% for 12-year-old females and was 53.4% for 12-year-old males. National coverage goals for the three antigens delivered via school-based programs in Ontario are 90%.<sup>†11</sup> No provincial coverage estimates met the national goals, however two PHUs met the goal for MCV4 coverage.

Series initiation (the proportion of each cohort who received at least one dose of the vaccine series) and completion (calculated among the students who initiated the vaccine series) were assessed for hepatitis B and HPV, but not for MCV4 which requires only one dose. Series initiation for hepatitis B and HPV was considerably higher than the up-to-date coverage estimates. As shown in [Figure 5](#), of the 82.5% of 12-year-olds who started the hepatitis B series, 83.1% completed it. Initiation of the HPV series was lower than hepatitis B, ranging from 66.9% in the 12-year-old male cohort to 72.0% in the 12-year-old female cohort. Completion among those who initiated the HPV series was also lowest for 12-year-old males at 79.9%, as compared to 84.2% of 13-year-old females.

---

<sup>†</sup>National coverage goals are from: Public Health Agency of Canada’s Vaccination Coverage Goals and Vaccine Preventable Disease Reduction Targets by 2025. The conditions outlined for the national goals (listed below [Figure 3](#)) may differ from the conditions required to be considered up-to-date as defined in the [Technical Annex](#).

**Figure 3. Up-to-date immunization coverage (%) in Ontario for school-based immunization programs among children 12 years old: 2016–17 school year**

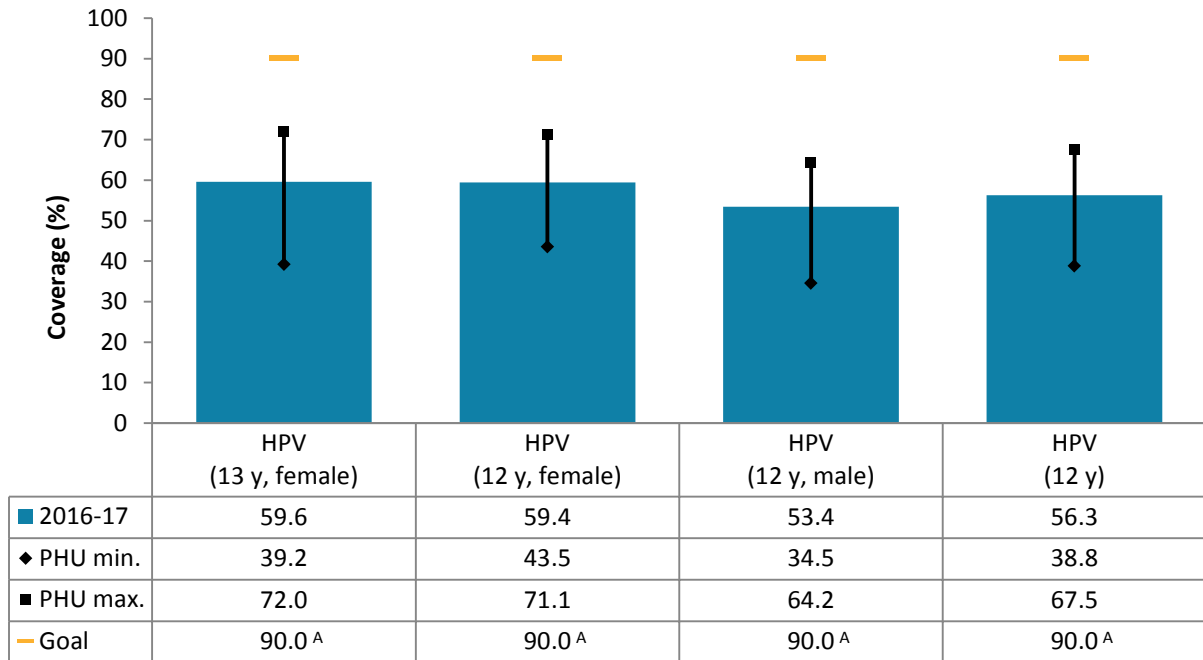


**Notes:**

- National coverage goals are defined as:
  - A. Achieve 90% vaccination coverage by 17 years of age for the following adolescent vaccines: one dose of meningococcal vaccine; one or more doses of hepatitis B vaccine among adolescents; two or more doses of human papillomavirus vaccine (HPV).



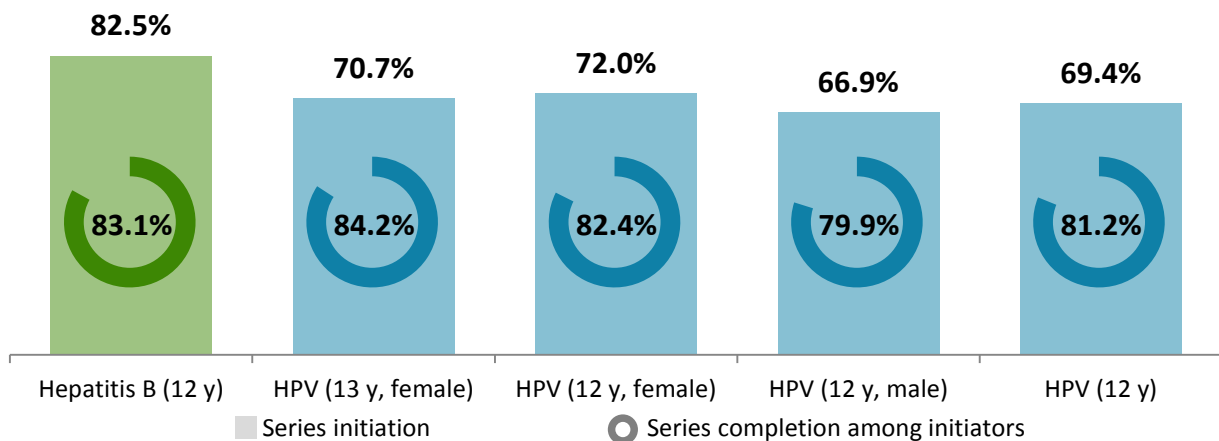
**Figure 4. Up-to-date immunization coverage (%) in Ontario for HPV by gender and age: 2016–17 school year**



**Notes:**

- National coverage are defined as:
  - A. Achieve 90% vaccination coverage by 17 years of age for the following adolescent vaccines: two or more doses of human papillomavirus vaccine (HPV).

**Figure 5. Series initiation\* and series completion among initiators† in Ontario for Hepatitis B‡ and HPV immunization programs among children 12 and 13 years old: 2016–17 school years**



**Notes:**

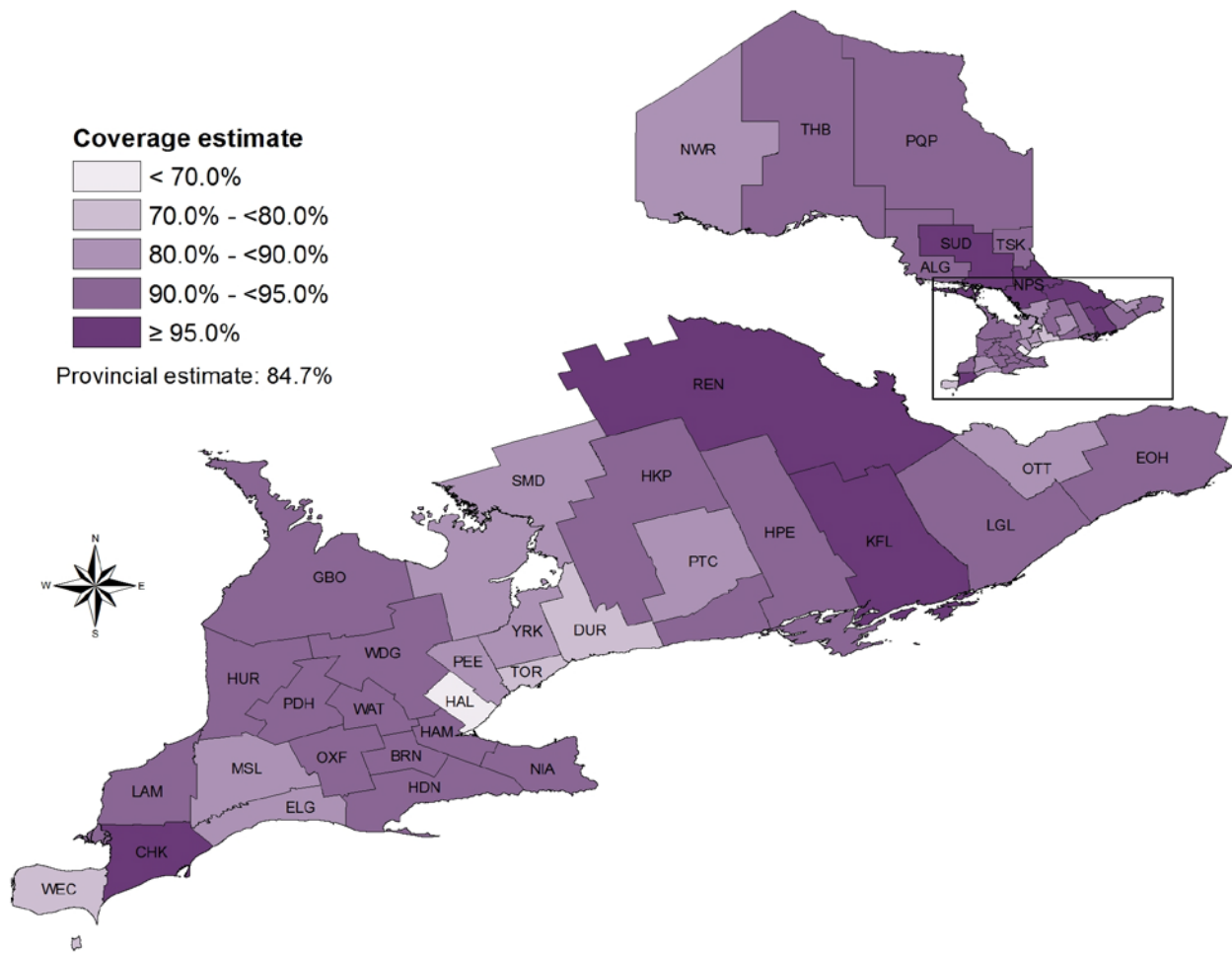
- \*Received at least one valid dose of the vaccine series
- †Completion of the vaccine series among series initiators
- ‡ Those with prior immunity to hepatitis B were excluded from calculations of both initiators and completers.

## Geographic Distribution

Figures 6, 7 and 8 show maps of PHU-specific coverage estimates for select antigens and age cohorts for the 2016–17 school year. It should be noted that the legend varies between the maps.

[Figure 6](#) shows the geographic distribution of coverage estimates for diphtheria among 7-year-olds by PHU for the 2016–17 school year, with PHU-specific coverage estimates ranging from 68.2% to 97.2%. Most of the PHU estimates were towards the upper limit of the range, with 24 of the 36 PHUs having coverage estimates of 90% or higher. The majority of PHUs (80.6%; n=29) met or exceeded the 84.7% provincial coverage estimate for 7-year-olds. See [Table 4 of Appendix 2](#) for diphtheria coverage estimates by PHU for 7- and 17-year-olds.

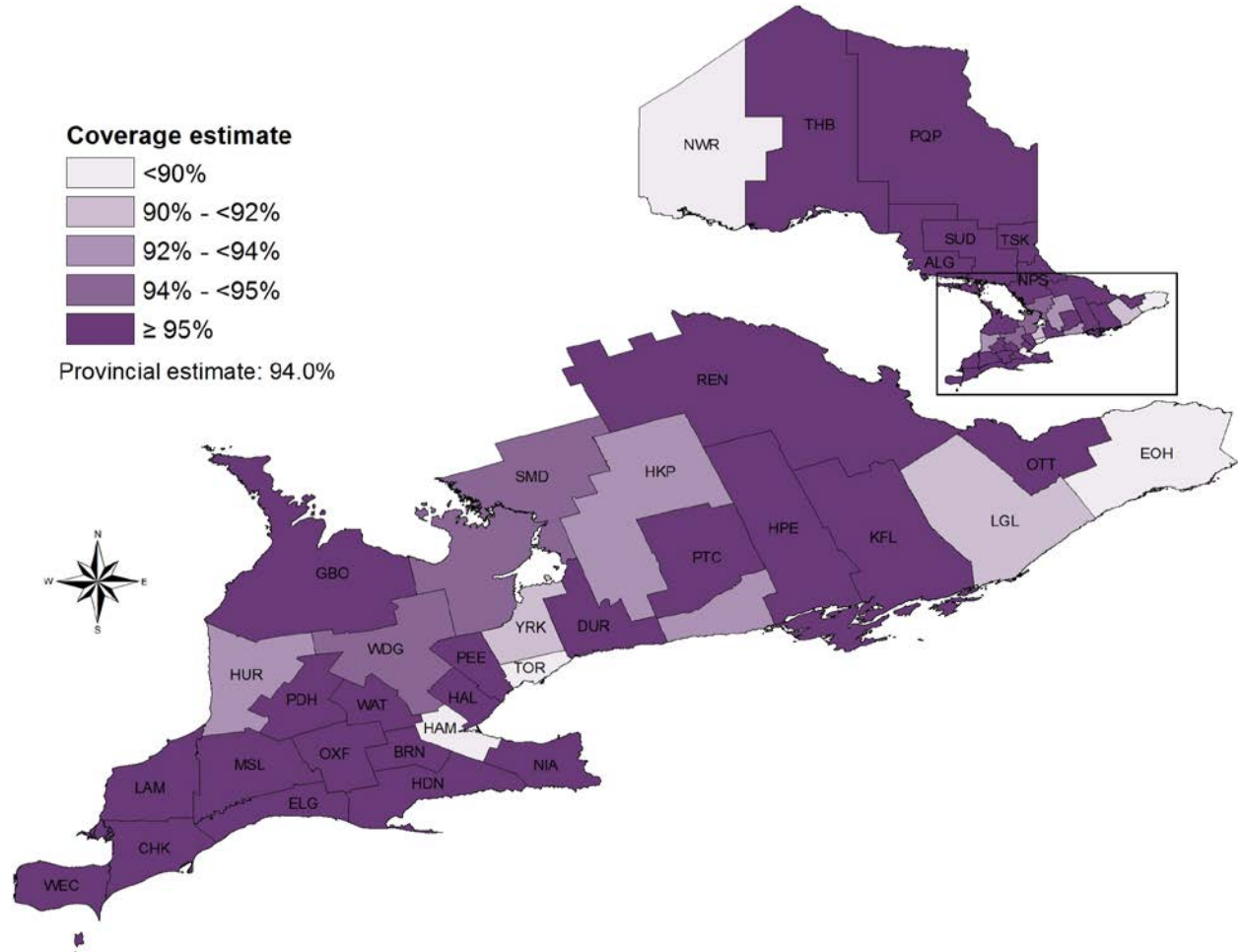
**Figure 6. Up-to-date immunization coverage (%) in Ontario for diphtheria among children 7 years old by public health unit: 2016–17 school year\***



\*Health unit legend available in [Appendix 1](#) of this report.

Figure 7 displays coverage estimates for measles among 17-year-olds by PHU for the 2016–17 school year. Measles coverage estimates among PHUs ranged from 84.2% to 99.2%. The majority of PHUs had estimates exceeding the provincial estimate of 94% (n=28). See Table 1 of Appendix 2 for measles coverage estimates by PHU for 7- and 17-year-olds.

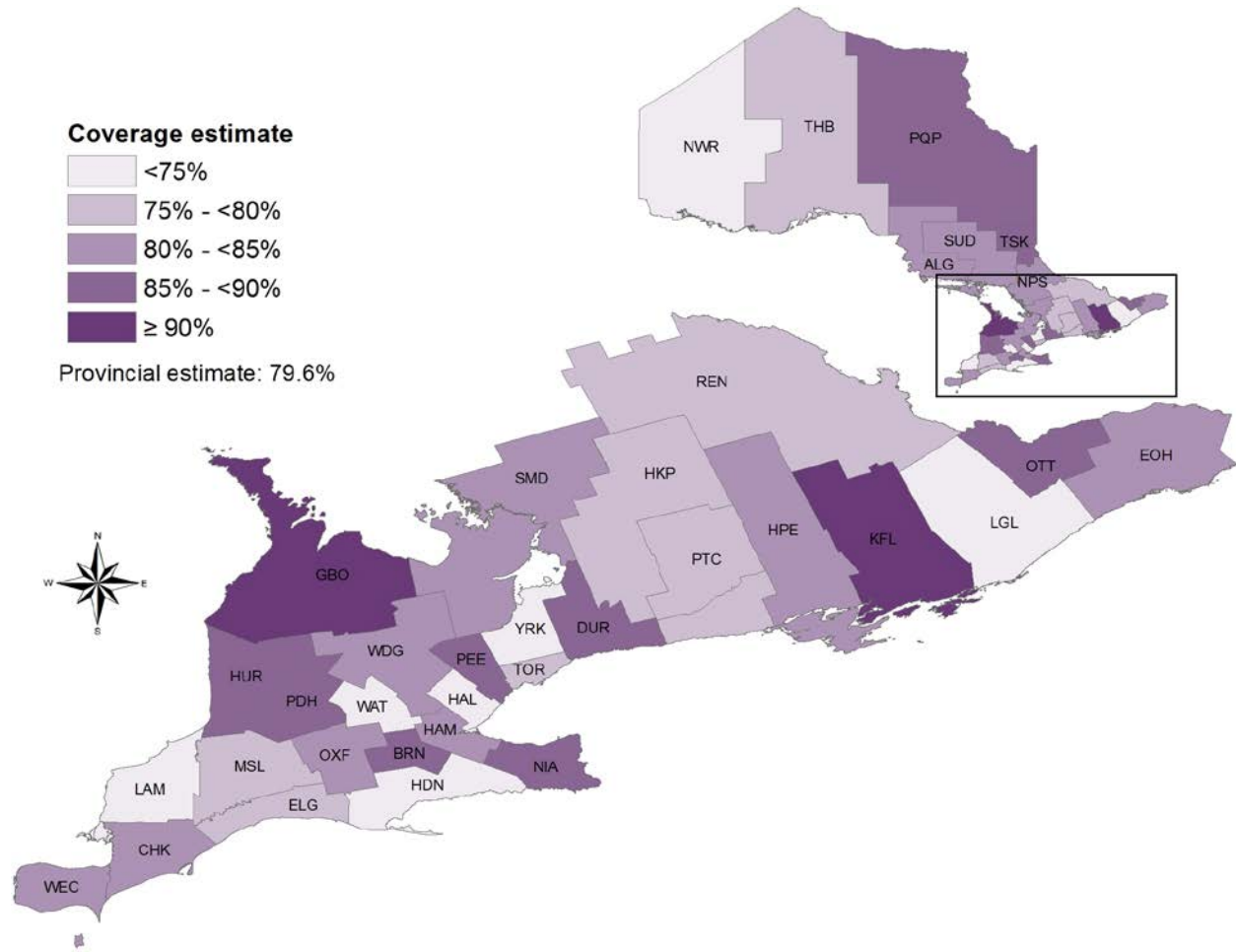
**Figure 7. Up-to-date immunization coverage (%) in Ontario for measles among children 17 years old by public health unit: 2016–17 school year\***



\*Health unit legend available in [Appendix 1](#) of this report

In [Figure 8](#), coverage estimates for MCV4 among 12-year-olds are shown. Coverage varied by PHU for the 2016–17 school year, with PHU-specific coverage estimates ranging from 50.7% to 91.6%. The majority of PHUs (61.1%; n=22) met or exceeded the overall provincial coverage estimate of 79.6% ([Figure 7](#)). See [Table 13 of Appendix 2](#) for MCV4 coverage estimates by PHU for 12-year-olds.

**Figure 8. Up-to-date immunization coverage (%) in Ontario for quadrivalent meningococcal conjugate (MCV4) among children 12 years old by public health unit: 2016–17 school year\***



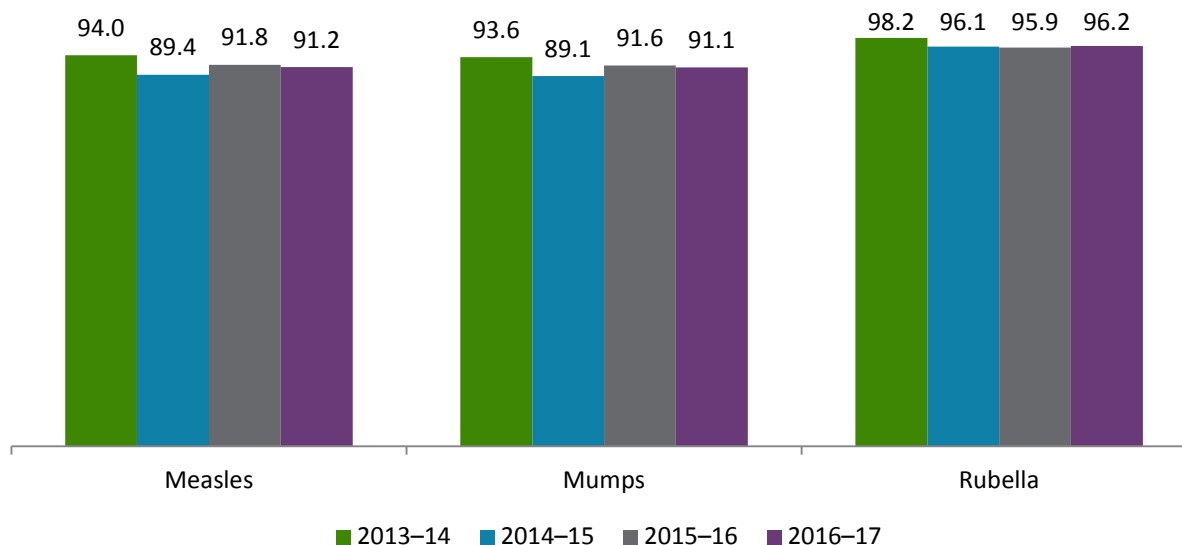
\*Health unit legend available in [Appendix 1](#) of this report.

## Temporal Trends

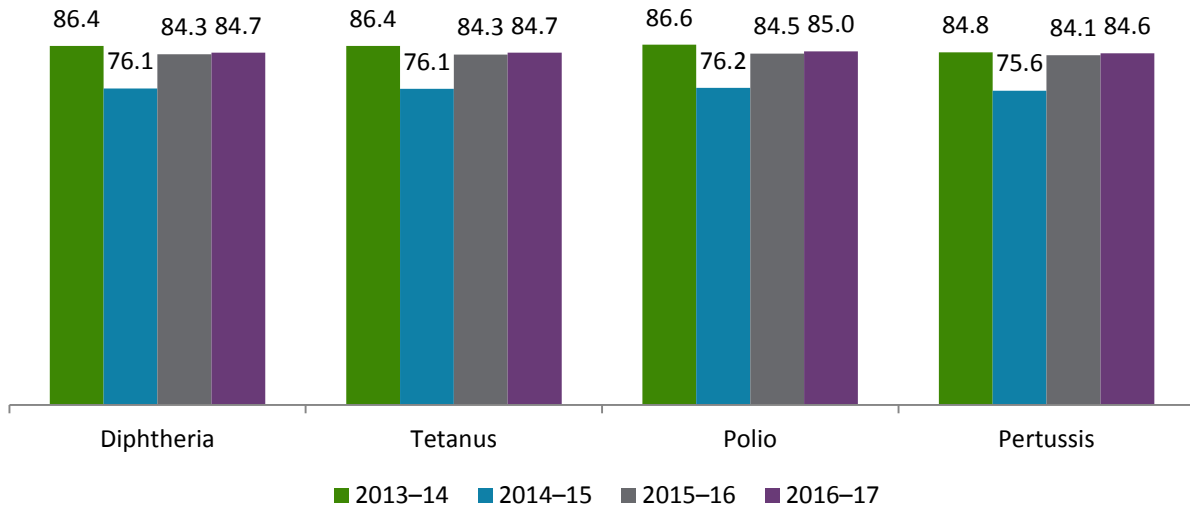
Starting with the 2013–14 school year, Public Health Ontario has produced coverage estimates using up-to-date methodology. Prior to this, complete-for-age methodology was used for coverage assessment in previous school years. For more information, please refer to the [Technical Annex](#). Figures 9a, 9b and 9c present provincial coverage estimates for the 2013–14 through 2016–17 school years among 7-year-olds.

There was a slight decrease in coverage among 7-year-olds in 2014–15 for measles and mumps; however, estimates for measles, mumps and rubella have remained relatively consistent for the past two school years, at approximately 91% for both measles and mumps and 96% for rubella ([Figure 9a](#)). Estimates returned to 2013–14 levels, at 85% for diphtheria, tetanus, polio and pertussis in the 2016–17 school year after a decrease of approximately 10 percentage points in the 2014–15 school year ([Figure 9b](#)). [Figure 9c](#) shows that coverage estimates among 7-year-olds for Hib have remained relatively stable over the past four school years. In contrast, pneumococcal, MCC and two dose varicella coverage have trended upwards over the same time period. Two dose varicella immunization coverage has seen the largest increase with a gain of 27.5 percentage points over the past four school years.

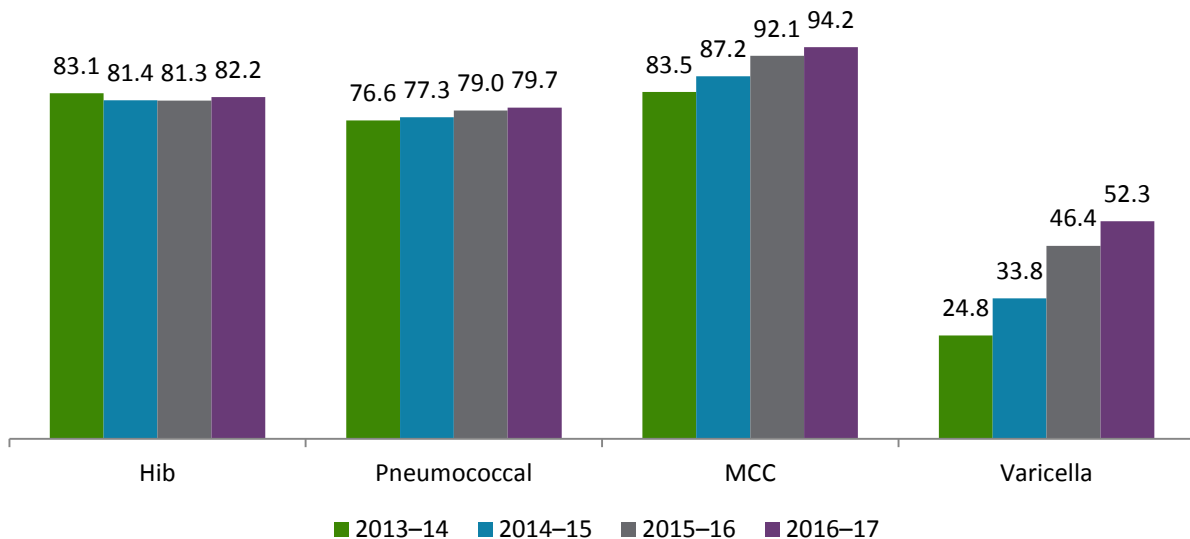
**Figure 9a. Measles, mumps and rubella up-to-date immunization coverage (%) in Ontario among children 7 years old: 2013–14 to 2016–17 school years**



**Figure 9b. Diphtheria, tetanus, polio and pertussis up-to-date immunization coverage (%) in Ontario among children 7 years old: 2013–14 to 2016–17 school years**

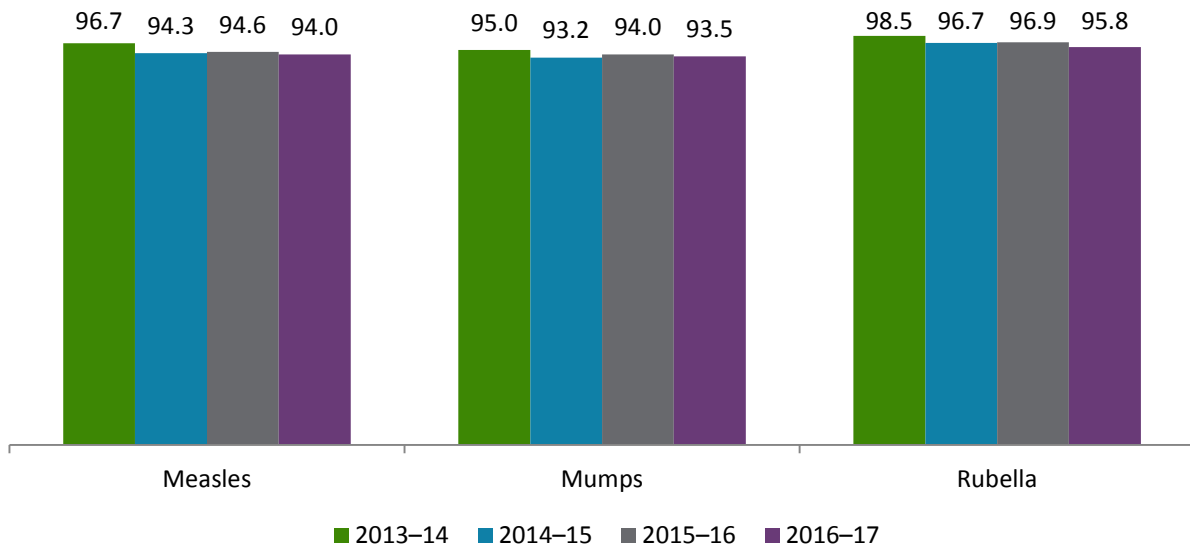


**Figure 9c. *Haemophilus influenzae* type b (Hib), pneumococcal, meningococcal C conjugate (MCC) and varicella up-to-date immunization coverage (%) in Ontario among children 7 years old: 2013–14 to 2016–17 school years**



Among 17-year-olds, relatively stable coverage over the past four school years can be seen for measles, mumps and rubella (Figure 10a) which is similar to trends observed for polio for this age (Figure 10b). In contrast, coverage estimates for diphtheria, tetanus, and pertussis have shown considerably more variability. Coverage estimates for these antigens were all slightly lower in the 2016–17 school year compared to the previous year, but higher than the estimates observed in 2014–15 (Figure 10b).

**Figure 10a. Measles, mumps and rubella up-to-date immunization coverage (%) in Ontario among children 17 years old: 2013–14 to 2016–17 school years**



**Figure 10b. Diphtheria, tetanus, polio and pertussis up-to-date immunization coverage (%) in Ontario among children 17 years old: 2013–14 to 2016–17 school years**

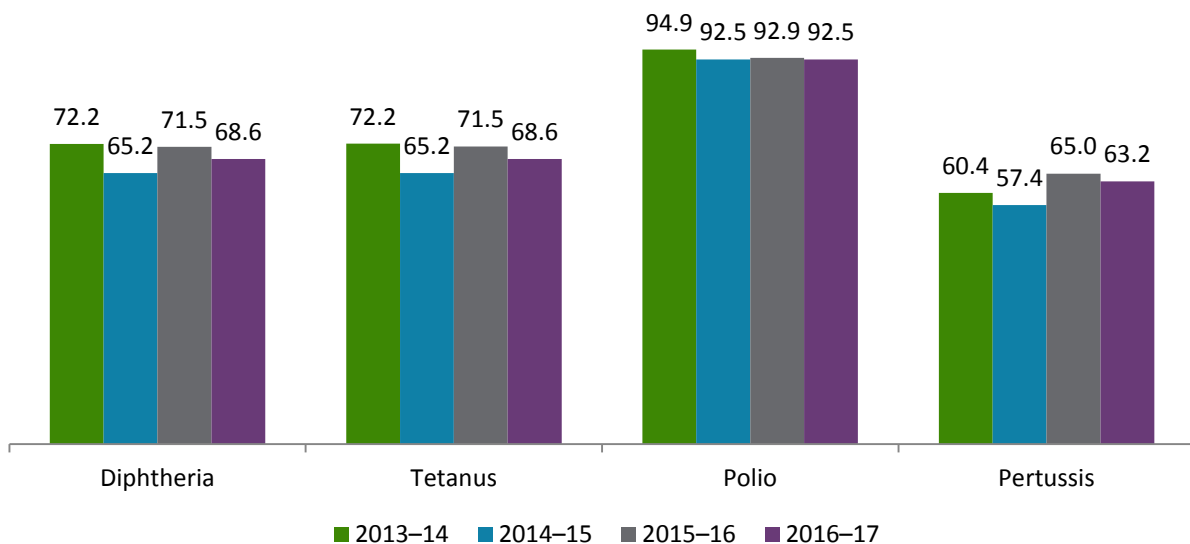
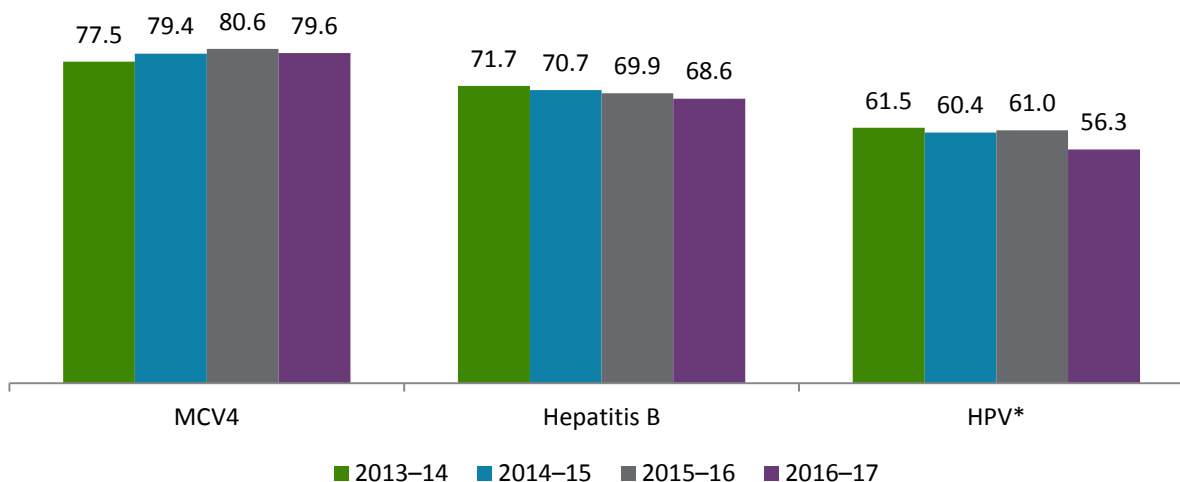


Figure 11 shows trends among the school-based immunization programs. Quadrivalent meningococcal vaccine coverage decreased from the previous year for the first time since coverage was assessed using up-to-date methods, but the change was small with a difference of only one percentage point. Hepatitis B has had small year-to-year changes in coverage, but has decreased by 3.1% since 2013–14. HPV coverage for 2016–17 was the lowest of the past four school years, whether assessed among 13-year-old girls who were the only group eligible for the program prior to 2016–17 (refer to Figure 4 for estimate) or among the group eligible for the program in 2016–17, 12-year-old boys and girls.

**Figure 11. Quadrivalent meningococcal conjugate (MCV4), hepatitis B and human papillomavirus (HPV) up-to-date immunization coverage (%) in Ontario for school-based immunization programs: 2013–14 to 2016–17 school year**



**Notes:**

\*HPV coverage estimates for 2013–14 to 2015–16 school years represent 13-year-old female cohorts. The 2016–17 school year HPV coverage estimate represents 12-year-old male and females combined. Although the recommended HPV series changed over this time period, students who completed either the 2-dose or 3-dose series were considered up-to-date for all assessment years. For further details, please see the HPV up-to-date definition specifications in the [Technical Annex](#).



# Discussion

---

The immunization coverage assessment of the 2016–17 school year shows that immunization coverage among school pupils varies greatly by vaccine, age groups and notably by PHU. These coverage estimates build on the previous report on [coverage in Ontario for the 2013–14 to 2015–16 school years](#) using up-to-date methods, with four years of data now available to track immunization coverage trends.

## Childhood Immunization Programs Started in Infancy and Early Childhood

### Measles, Mumps and Rubella

Since 2011, immunization against measles, mumps and rubella has been carried out 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 4- and 6- years of age. Prior to this, instead of MMRV, a second dose of MMR was given at 18 months of age. Most students at 7- and 17-years of age are up-to-date on their immunizations for measles, mumps, and rubella; however, there is variability in the estimates across PHUs. Following the routine schedules for each of measles, mumps and rubella, these vaccinations would be completed by 7 years of age (and for some cohorts, would have been completed by 18 months of age). Therefore, higher estimates among 17-year-olds are expected as more time has elapsed to complete and document the series in the DHIR for the older age milestone.

Measles is the most communicable VPD, requiring very high immunization coverage for effective control and elimination. The herd immunity threshold for measles, which is the level of population protection (through either immunization or natural immunity) required to prevent widespread disease transmission, is estimated to be between 96% and 99%<sup>12</sup>. In contrast, the newly revised national coverage goal has been set at 95% for two doses<sup>11</sup>, a goal that is used by other countries including those who have achieved measles elimination,<sup>13</sup> which includes Canada. The last case of endemic measles in Canada occurred in 1997.<sup>14</sup> However, high immunization coverage is needed to minimize the risk of transmission from imported cases as measles still circulates in other parts of the world<sup>15</sup> and imported cases of measles continue to occur in Ontario.<sup>16</sup>

In 2017, there were more than 200 cases of mumps identified in Ontario,<sup>17</sup> highlighting the importance of maintaining high two dose mumps immunization coverage, although waning of immunity even after two doses, and other factors also play a role in Ontario's recent mumps activity.

Rubella and congenital rubella syndrome (CRS) were declared eliminated from the World Health Organization (WHO) Region of the Americas in September 2016.<sup>18</sup> Imported cases of rubella are rare in Ontario; there were no cases of rubella reported in 2015 or 2016.<sup>19</sup> However, there was one case of CRS

in 2015,<sup>20</sup> highlighting that endemic rubella continues to circulate outside of the Americas and can present risks to un-immunized Canadians.

## 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). Provincial immunization coverage estimates for diphtheria, tetanus and pertussis are 16.1% to 21.4% lower among 17-year-olds, as compared to estimates for 7-year-olds. An additional dose of these three antigens, in the form of Tdap vaccine, is required to be considered up-to-date at 17 years of age, which likely contributes to the difference in coverage between the two age milestones.

Coverage estimates for diphtheria, tetanus and pertussis were notably lower in the 2014-15 school year among 7-year-olds and 17-year-olds compared to the 2013-14, 2015-16 and 2016-17 school years. Most PHUs in Ontario were in the process of implementing Panorama in the 2014-15 school year and the expanded list of *ISPA* designated diseases also came into effect. It is hypothesized that the reduced coverage estimates observed may reflect the increased demand on resources during that school year, resulting in decreased focus on assessment activities.

Vaccination against diphtheria has significantly decreased the number of diphtheria cases worldwide;<sup>21</sup> no cases of diphtheria have been reported in Ontario since 1995.<sup>22</sup> A small number of isolates of toxigenic *C. diphtheriae* are identified in Canada each year but classic diphtheria illness is extremely rare.<sup>23</sup>

Very few cases of tetanus are reported annually in Ontario; the annual number of cases of tetanus in Ontario has ranged from zero to five over the period of 2005-2016.<sup>24</sup> The causative agent of tetanus, *Clostridium tetani* is ubiquitous in the environment making vaccination an essential measure in preventing the disease.<sup>25</sup> As tetanus is acquired from the environment rather than from other individuals, herd immunity does not offer protection to the population and the goal of immunization is protection at the individual-level.

While vaccination has reduced the incidence of pertussis, cases continue to occur in Ontario, with between 124 and 1,265 cases occurring annually from 2005-2016.<sup>26</sup> The disease is most dangerous for infants under 1-year-old, especially in the first few months of life before infants have completed their primary series of pertussis-containing vaccine. High overall immunization coverage is an important component of pertussis control.<sup>27</sup> In addition, a more targeted immunization strategy (i.e., Tdap during each pregnancy) has been recently recommended by the National Advisory Committee on Immunization (NACI) to provide protection to young infants during this period of increased vulnerability.<sup>28</sup>

## Polio

The inactivated polio vaccine (IPV) is typically administered through DTaP-IPV-Hib, DTaP-IPV and Tdap-IPV vaccines. The routine immunization schedule in Ontario may result in the administration of up to five doses of polio through the use of combination vaccines, which makes it more likely that a child will have received the four doses required to be considered up-to-date at the age of 7 years, assuming immunization begins in infancy.

Provincial polio coverage in Ontario is higher among 17-year-olds than 7-year-olds (92.5% vs. 85.0% respectively), which is expected given that no doses are required after the series is completed with the pre-school booster (administered on or after the 4<sup>th</sup> birthday). Higher estimates among 17-year-olds are likely reflective of the additional time to complete and document the series in the DHIR for the older age milestone, similar to what was described for measles, mumps and rubella.

In 1994, the WHO declared Canada free of wild poliovirus.<sup>29</sup> Nonetheless, continuing to maintain high immunization 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%.<sup>29</sup>

## *Haemophilus Influenzae* Type b and Pneumococcal Conjugate Vaccines

Neither Hib nor pneumococcal disease are *ISPA*-designated, although they are included in the publicly-funded immunization schedule and represent diseases with important morbidity and mortality for children, especially in the pre-vaccine era. Due to their lack of inclusion within the *ISPA*, it is possible that the coverage estimates of 82.2% and 79.7% respectively for these two programs may be underestimated using the DHIR as some PHUs may choose not to collect this information.

Infants and children under five years of age are among those at highest risk of invasive disease caused by Hib and invasive pneumococcal disease (IPD). Protection against Hib is provided by the DTaP-IPV-Hib vaccine administered at ages 2, 4, 6 and 18 months of age. A 13-valent pneumococcal conjugate vaccine (PCV-13) is given to healthy children at 2, 4 and 12 months of age (a "2+1" schedule) to protect against IPD.

As well as routine vaccination in children less than 5 years of age, Hib and PCV-13 vaccine is also recommended for children five years of age and older if they are at higher risk of invasive Hib or IPD.<sup>30</sup> Infants with medical conditions that put them at higher risk of IPD are also recommended to receive an additional dose of PCV-13 before 12 months of age (a "3+1" schedule). Medical risk factor information is not available in the DHIR, so we were not able to determine which children require extra doses and therefore cannot assess up-to-date coverage among children at higher risk for Hib or IPD based on these extra dose requirements.

## Meningococcal C Conjugate Vaccine

The MCC program in Ontario provides one dose of vaccine to toddlers at 12 months of age. Meningococcal disease was added to the list of *ISPA*-designated disease in September 2014 and the continually increasing trend in coverage of MCC from 83.5% in the 2013–14 school year to 94.2% in the 2016–17 school year is likely due to several factors including both its incorporation within the *ISPA* as well as a high degree of public acceptance for meningococcal vaccine programs. Twenty-four PHUs met the national coverage goal to achieve 95% vaccine coverage by two years of age for one dose of meningococcal C vaccine for their 7-year-old cohorts.

## Varicella

Since August 2011, two doses of varicella-containing vaccine has been available through Ontario's publicly-funded immunization program and a catch-up for the second dose was implemented for children born on or after January 1, 2000. Since August 2011, the routine schedule indicates a monovalent varicella vaccine for the first dose at 15 months and MMRV vaccine for the second dose at four to six years. Children in the 7-year-old birth cohort (born in 2009) assessed for the 2016–17 school year coverage estimates are eligible to receive two doses of varicella-containing vaccine, but would likely have received the second dose (if at all) through the catch-up program, rather than through routine immunization. While just over half of 7-year-olds (52.3%) were up-to-date for two doses of varicella, one dose coverage was much higher at 88.1% for the 2016–17 school year.

Although varicella was added to the *ISPA* list of designated diseases in the 2014–15 school year,<sup>6</sup> the designation 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 varicella 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.

## 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.<sup>31,32</sup> By removing potential barriers to access, school-based immunization delivery may also be more effective in achieving equity in immunization uptake.<sup>33,34</sup>

## Hepatitis B

Ontario's school-based hepatitis B immunization program is offered to grade 7 students. A complete immunization schedule consists of 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 hepatitis B vaccine until the end of their grade 8 year.

Although coverage estimates for school-based programs in Ontario are currently below the national coverage goals, our estimates do not include doses delivered as part of extended eligibility (after grade 7). Approximately 83% of students received at least one dose of hepatitis B vaccine and approximately 83% of those who initiated the series also completed the series at the time coverage was assessed, suggesting that coverage may be higher if future doses (administered as part of the extended 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 lack of reporting may contribute to under-estimation of coverage for this program.

## Quadrivalent Meningococcal Conjugate Vaccine

Once students become eligible for the Ontario school-based MCV4 immunization program in Grade 7, they remain eligible until the vaccine is received (i.e., eligibility in perpetuity).

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 with two opportunities to receive it through PHU-led school clinics, when the PHU is in the school to provide the two doses of HPV and hepatitis B vaccines, and the high acceptability of this vaccine as invasive meningococcal disease is associated with a high degree of public concern. In addition, this is the only school-based immunization program that is also an *ISPA*-designated disease.

## Human Papillomavirus

In the 2016–17 school year, the HPV immunization program was expanded to include boys as well as girls, and was changed to being offered in Grade 7 instead of Grade 8. Grade 8 females were also offered HPV vaccine in the 2016–17 school year.<sup>3</sup> The expansion of the HPV program to include boys in the 2016–17 school year allowed for comparisons in HPV coverage by gender. HPV coverage among girls was very similar among 12- and 13-year-olds at 59.4% and 59.6%, respectively. Coverage among 12-year-old boys was lower at 53.4%. We anticipate that the difference between male and female HPV coverage estimates will decrease over time as the gender-neutral HPV program becomes more established.

Coverage estimates in this report do not include doses administered as part of the extended eligibility program which allows students to initiate or complete the series until the end of their grade 12 year, if previously eligible for the Grade 7 or Grade 8 programs.<sup>35</sup> Our data demonstrate that approximately 70% of students eligible for the HPV program in the 2016–17 school year received the first dose in the series, while about 80% of those initiating the series completed it. This suggests that HPV coverage may be higher when assessed at a later point in time (i.e., at the end of high school).

## Public Health Unit Variability in Coverage Estimates

PHU-specific coverage estimates by antigen and by school year are available in [Appendix 2](#) of this report. Variations in coverage were observed between PHUs, with over 70 percentage points between the highest and lowest PHU-level coverage estimates for diphtheria, tetanus and pertussis among 17-year-olds. Other antigens showed much less variability; for example, there was a difference of only 7 and 11 percentage points respectively between the PHUs with the highest and lowest coverage estimates for rubella and MCC among 7-year-olds. Rubella and MCC are examples of vaccine programs that require only one dose to be considered up-to-date, which may partially explain the lower variability.

Differences in coverage estimates within PHUs were also observed. For example, diphtheria coverage for 2016–17 in one PHU was 18.0% for 17-year-olds compared with 92.8% for their 7-year-old population. Some of the observed variability within and between PHUs may in fact be artefact and explained not by true differences in immunization uptake, but instead reflect variability in *ISPA* assessment and enforcement activities within the PHU and other factors that would influence the completeness of immunization information within the DHIR (e.g., PHU delivery of immunizations in infancy and early childhood).

Other reasons for the variability in coverage estimates may be explained by factors such as immunization delivery and community level influences on immunization acceptance. Additionally, communities with large numbers of children who are under-immunized or un-immunized may contribute to lower coverage estimates in certain PHUs.

## 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 and organizations within 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 when their child starts attending school or after receiving a letter from their local PHU indicating that their child's immunizations status has been reviewed and that vaccine doses are outstanding based on information available to the PHU. 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.

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 underpinning 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 outside of school ages, for example at two years-of-age, an important national and international age milestone for coverage assessment. Although the *Child Care and Early Years Act* sets out the requirement for immunizations,<sup>8,9</sup> 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. 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. This report demonstrates that provincial coverage estimates in Ontario, with rare exceptions, do not meet Canada's newly revised national coverage goals. However, it should be noted that many PHUs have local coverage estimates which surpassed the national coverage goals for various antigens and ages of assessment.

With this report, Ontario now has coverage estimates using up-to-date methodology for four consecutive school years. This has allowed us to examine recent temporal trends in coverage using this methodology, and adds to ongoing work by PHUs, PHO and others to better understand immunization acceptance and uptake with the goal of increasing the number of Ontarians protected from vaccine-preventable diseases.

# References

---

1. Ontario. Ministry of Health and Long-Term Care. Publicly funded immunization schedules for Ontario - December 2016 [Internet]. Toronto, ON: Queen's Printer for Ontario; 2016 [cited 2017 Oct 20]. Available from: [http://www.health.gov.on.ca/en/pro/programs/immunization/docs/immunization\\_schedule.pdf](http://www.health.gov.on.ca/en/pro/programs/immunization/docs/immunization_schedule.pdf)
2. Ontario. Ministry of Health and Long-Term Care. Universal Influenza Immunization Program (UIIP) [Internet]. Toronto, ON: Queen's Printer for Ontario; 2017 [updated 2017 Oct 26; cited 2018 Jan 19]. Available from: <http://www.health.gov.on.ca/en/pro/programs/publichealth/flu/uiip/>
3. Ontario. Ministry of Health and Long-Term Care. Ontario expanding HPV vaccine program to include boys [Internet]. Toronto, ON: Queen's Printer for Ontario; 2016 [cited 2018 Apr 21]. Available from: <https://news.ontario.ca/mohltc/en/2016/4/ontario-expanding-hpv-vaccine-program-to-include-boys.html>
4. National Advisory Committee on Immunization; Public Health Agency of Canada. An Advisory Committee Statement (ACS). National Advisory Committee on Immunization (NACI): Update on the recommended human papillomavirus (HPV) vaccine immunization schedule. Ottawa, ON: Her Majesty the Queen in Right of Canada; 2015. Available from: <https://www.canada.ca/en/public-health/services/immunization/national-advisory-committee-on-immunization-naci/amendment-2015-update-on-recommended-human-papillomavirus-hpv-vaccine-immunization-schedule.html>
5. Ontario. Ministry of Health and Long-Term Care. Immunization management protocol, 2016 [Internet]. Toronto, ON: Queen's Printer for Ontario; 2016 [cited 2018 Jan 9]. Available from: [http://www.health.gov.on.ca/en/pro/programs/publichealth/oph\\_standards/docs/immunization\\_management.pdf](http://www.health.gov.on.ca/en/pro/programs/publichealth/oph_standards/docs/immunization_management.pdf)
6. *Immunization of School Pupils Act*, RRO 1990, c Reg.645. Available from: <https://www.ontario.ca/laws/regulation/900645>
7. *Immunization of School Pupils Act*, RSO 1990, c C.I.1. Available from: <https://www.ontario.ca/laws/statute/90i01>
8. *Child Care and Early Years Act, 2014*, SO 2014, c 11, Sched. 1. Available from: <https://www.ontario.ca/laws/statute/14c11>
9. Office of the Auditor General of Ontario. Annual report 2016: follow-up reports on value-for-money audits. Toronto, ON: Queen's Printer for Ontario; 2016. Chapter 1, Section 104. Ministry of Health and Long-Term Care. Immunization: follow-up on VFM section 3.04, 2014 annual report. p. 57-70. Available from: [http://www.auditor.on.ca/en/content/annualreports/arreports/en16/v2\\_104en16.pdf](http://www.auditor.on.ca/en/content/annualreports/arreports/en16/v2_104en16.pdf)
10. Public Health Agency of Canada. National standards for immunization coverage assessment: Recommendations from the Canadian Immunization Registry Network [Internet]. Ottawa, ON: Government of Canada; 2015 [updated 2015 Oct 14; cited 2017 Nov 22]. Available from:



<http://healthycanadians.gc.ca/publications/healthy-living-vie-saine/immunization-national-standards-norme-nationales-immunisation/index-eng.php>

11. Public Health Agency of Canada. Vaccination coverage goals and vaccine preventable disease reduction targets by 2025 [Internet]. Ottawa, ON: Public Health Agency of Canada; 2017 [updated 2017 Dec 8; cited 2017 Dec 12]. Available from: <https://www.canada.ca/en/public-health/services/immunization-vaccine-priorities/national-immunization-strategy/vaccination-coverage-goals-vaccine-preventable-diseases-reduction-targets-2025.html#1.0>

12. Plans-Rubió P. Evaluation of the establishment of herd immunity in the population by means of serological surveys and vaccination coverage. *Human Vaccin Immunother*. 2012;8(2):184-8. Available from: <https://www.tandfonline.com/doi/full/10.4161/hv.18444>

13. U.S. Department of Health and Human Services. Healthy People 2020: immunization and infectious diseases [Internet]. Washington, DC: U.S. Department of Health and Human Services; 2018 [cited 2018 Jan 29]. Available from: <https://www.healthypeople.gov/2020/topics-objectives/topic/immunization-and-infectious-diseases/objectives>

14. Public Health Agency of Canada. Elimination of measles, rubella and congenital rubella syndrome in Canada: documentation and verification report. Executive summary [Internet]. Ottawa, ON: Government of Canada; 2011 [cited 2018 Jan 29]. Available from: <http://www.phac-aspc.gc.ca/im/vpd-mev/measles-rougeole-mrer-eng.php>

15. World Health Organization. Measles and rubella surveillance data [Internet]. Geneva, Switzerland: World Health Organization; 2018 [updated 2017 Dec 7, cited 2018 Jan 19]. Available from: [http://www.who.int/immunization/monitoring\\_surveillance/burden/vpd/surveillance\\_type/active/measles\\_monthlydata/en/](http://www.who.int/immunization/monitoring_surveillance/burden/vpd/surveillance_type/active/measles_monthlydata/en/)

16. Ontario Agency for Health Protection and Promotion (Public Health Ontario). Reportable disease trends in Ontario: measles [Internet]. Toronto, ON: Queen's Printer for Ontario; 2017 [updated 2018 Jan 3, cited 2018 Jan 19]. Available from: <http://www.publichealthontario.ca/en/DataAndAnalytics/pages/rdto2016.aspx#/36>

17. Ontario Agency for Health Protection and Promotion (Public Health Ontario). Mumps [Internet]. Toronto, ON: Queen's Printer for Ontario; 2018 [updated 2018 Jan 10, cited 2018 Jan 20]. Available from: <https://www.publichealthontario.ca/en/BrowseByTopic/InfectiousDiseases/Pages/IDLandingPages/Mumps.aspx>

18. Pan American Health Organization. Elimination of rubella and congenital rubella syndrome in the Americas [Internet]. Washington, DC: Pan American Health Organization; 2015 [cited 2018 Jan 29]. Available from: [http://www.paho.org/hq/index.php?option=com\\_content&view=article&id=10801%3A2015-elimination-rubella-congenital-syndrome-americas&catid=6648%3Afact-sheets&Itemid=40721&lang=en](http://www.paho.org/hq/index.php?option=com_content&view=article&id=10801%3A2015-elimination-rubella-congenital-syndrome-americas&catid=6648%3Afact-sheets&Itemid=40721&lang=en)

19. Ontario Agency for Health Protection and Promotion (Public Health Ontario). Reportable disease trends in Ontario: rubella [Internet]. Toronto, ON: Queen's Printer for Ontario; 2017 [updated 2018 Jan 3, cited 2018 Jan 21]. Available from: <http://www.publichealthontario.ca/en/dataandanalytics/pages/rdto.aspx#/47>
20. Ontario Agency for Health Protection and Promotion (Public Health Ontario). Reportable disease trends in Ontario: congenital rubella syndrome [Internet]. Toronto, ON: Queen's Printer for Ontario; 2017 [updated 2018 Jan 3, cited 2018 Jan 21]. Available from: <http://www.publichealthontario.ca/en/DataAndAnalytics/pages/rdto2016.aspx#/48>
21. World Health Organization. Immunizations, vaccines and biologicals: diphtheria [Internet]. Geneva, Switzerland: 2018 [updated 2015 Aug 14; cited 2018 Jan 21]. Available from: <http://www.who.int/immunization/diseases/diphtheria/en/>
22. Ontario Agency for Health Protection and Promotion (Public Health Ontario). Reportable disease trends in Ontario: diphtheria [Internet]. Toronto, ON: Queen's Printer for Ontario; 2017 [updated 2018 Jan 3, cited 2018 Jan 21]. Available from: <http://www.publichealthontario.ca/en/dataandanalytics/pages/rdto.aspx#/16>
23. Public Health Agency of Canada. Diphtheria: for health professionals [Internet]. Ottawa, ON: Government of Canada; 2014 [updated 2014 Jul 24; cited 2018 Jan 29]. Available from: <http://www.phac-aspc.gc.ca/im/vpd-mev/diphtheria-diphtherie/professionals-professionnels-eng.php>
24. Ontario Agency for Health Protection and Promotion (Public Health Ontario). Reportable disease trends in Ontario: tetanus [Internet]. Toronto, ON: Queen's Printer for Ontario; 2017 [updated 2018 Jan 3, cited 2018 Jan 21]. Available from: <http://www.publichealthontario.ca/en/dataandanalytics/pages/rdto.aspx#/56;>
25. World Health Organization. Immunization, vaccines and biologicals: tetanus [Internet]. Geneva, Switzerland: World Health Organization; c2018 [updated 2017 Feb 27; cited 2018 Jan 21]. Available from: <http://www.who.int/immunization/diseases/tetanus/en/>
26. Ontario Agency for Health Protection and Promotion (Public Health Ontario). Reportable disease trends in Ontario: pertussis [Internet]. Toronto, ON: Queen's Printer for Ontario; 2017 [updated 2018 Jan 3, cited 2018 Jan 21]. Available from: <http://www.publichealthontario.ca/en/dataandanalytics/pages/rdto.aspx#/42>
27. World Health Organization. Immunization, vaccines and biologicals: Pertussis [Internet]. Geneva, Switzerland: World Health Organizations; 2018 [updated 2015 Sep 4; cited 2018 Jan 21]. Available from: <http://www.who.int/immunization/diseases/pertussis/en/>
28. National Advisory Committee on Immunization; Public Health Agency of Canada. An Advisory Committee Statement (ACS). National Advisory Committee on Immunization (NACI): Update on immunization in pregnancy with tetanus toxoid, reduced diphtheria toxoid and reduced acellular pertussis (Tdap) vaccine. Ottawa, ON: Her Majesty the Queen of Canada; 2018 [cited 2018 Feb 06]. Available from: <https://www.canada.ca/en/public-health/services/publications/healthy-living/update-immunization-pregnancy-tdap-vaccine.html>

29. Polio vaccines and polio immunization in the pre-eradication era: WHO position paper. *Wkly Epidemiol Rec.* 2010;85(23):213-28. Available from: <http://www.who.int/wer/2010/wer8523.pdf?ua=1>
30. Ontario. Ministry of Health and Long-Term Care. Publicly funded immunization schedules for Ontario - August 2011: Questions and answers for health care providers. [Internet]. Toronto, ON: Queen's Printer for Ontario; 2011 [cited 2017 Feb 6]. Available from: [http://www.health.gov.on.ca/en/public/programs/immunization/docs/qa\\_schedule.pdf](http://www.health.gov.on.ca/en/public/programs/immunization/docs/qa_schedule.pdf)
31. Guay M, Clouâtre A, Blackburn M, Baron G, De Wals P, Roy C, et al. Effectiveness and cost comparison of two strategies for hepatitis B vaccination of schoolchildren. *Can J Public Health.* 2003;94(1):64-7. Available from: <http://journal.cpha.ca/index.php/cjph/article/view/367/367>
32. Dempsey AF, Freed GL. Health care utilization by adolescents on Medicaid: implications for delivering vaccines. *Pediatrics.* 2010;125(1):43-9.
33. Drolet M, Deeks SL, Kliewer E, Musto G, Lambert P, Brisson M. Can high overall human papillomavirus vaccination coverage hide sociodemographic inequalities? An ecological analysis in Canada. *Vaccine.* 2016;34(16):1874-80.
34. Hughes A, Mesher D, White J, Soldan K. Coverage of the English national human papillomavirus (HPV) immunisation programme among 12 to 17 year-old females by area-level deprivation score, England, 2008 to 2011. *Euro Surveill.* 2014;19(2):1-6. Available from: <http://www.eurosurveillance.org/images/dynamic/EE/V19N02/art20677.pdf>
35. Ontario. Ministry of Health and Long-Term Care. Ontario's HPV vaccination program [Internet]. Toronto, ON: Queen's Printer for Ontario; 2012 [cited 2016 Dec 9]. Available from: <http://www.health.gov.on.ca/en/ms/hpv/immunize.aspx>

## Appendix 1: Public Health Unit Abbreviations

**Table 1. Health Unit abbreviations used in geographic distribution section for [Figures 6, 7, and 8](#).**

<b>Code</b>	<b>Health Unit</b>	<b>Code</b>	<b>Health Unit</b>
<b>ALG</b>	Algoma Public Health Unit	<b>NPS</b>	North Bay Parry Sound District
<b>BRN</b>	Brant County Health Unit	<b>NWR</b>	Northwestern Health Unit
<b>CHK</b>	Chatham-Kent Public Health Unit	<b>OTT</b>	Ottawa Public Health
<b>DUR</b>	Durham Region Health Department	<b>OXF</b>	Oxford County Public Health
<b>ELG</b>	Elgin-St. Thomas Health Unit	<b>PDH</b>	Perth District Health Unit
<b>EOH</b>	Eastern Ontario Health Unit	<b>PEE</b>	Peel Public Health
<b>GBO</b>	Grey Bruce Health Unit	<b>PQP</b>	Porcupine Health Unit
<b>HAL</b>	Halton Region Health Department	<b>PTC</b>	Peterborough Public Health
<b>HAM</b>	Hamilton Public Health Services	<b>REN</b>	Renfrew County and District Health Unit
<b>HDN</b>	Haldimand-Norfolk Health Unit	<b>SMD</b>	Simcoe Muskoka District Health Unit
<b>HKP</b>	Haliburton, Kawartha, Pine Ridge District	<b>SUD</b>	Public Health Sudburey and District
<b>HPE</b>	Hastings and Prince Edward Counties Health Unit	<b>THB</b>	Thunder Bay District Health Unit
<b>HUR</b>	Huron County Health Unit	<b>TSK</b>	Timiskaming Health Unit
<b>KFL</b>	Kingston, Frontenac and Lennox & Addington	<b>TOR</b>	Toronto Public Health
<b>LAM</b>	Lambton Public Health	<b>WAT</b>	Region of Waterloo, Public Health
<b>LGL</b>	Leeds, Grenville and Lanark District	<b>WDG</b>	Wellington-Dufferin-Guelph Public Health
<b>MSL</b>	Middlesex-London Health Unit	<b>WEC</b>	Windsor-Essex County Health Unit
<b>NIA</b>	Niagara Region Public Health Unit	<b>YRK</b>	York Region Public Health Services

## Appendix 2: Immunization Coverage by Public Health Unit

**Table 1. Measles immunization coverage estimates (%) among children 7 and 17 years old by Public Health Unit: 2016–17 school year**

Public Health Unit	7-year-olds	17-year-olds
Algoma Public Health Unit	96.4	98.5
Brant County Health Unit	95.2	96.6
Chatham-Kent Public Health Unit	94.7	97.0
Durham Region Health Department	89.7	96.8
Eastern Ontario Health Unit	93.5	89.7
Elgin-St. Thomas Health Unit	90.4	97.2
Grey Bruce Health Unit	95.3	95.6
Haldimand-Norfolk Health Unit	92.3	95.4
Haliburton, Kawartha, Pine Ridge District Health Unit	94.2	93.1
Halton Region Health Department	83.9	96.3
Hamilton Public Health Services	94.7	84.2
Hastings and Prince Edward Counties Health Unit	96.1	98.2
Huron County Health Unit	94.5	93.5
Kingston, Frontenac and Lennox & Addington Public Health	97.6	97.9
Lambton Public Health	95.3	98.2
Leeds, Grenville and Lanark District Health Unit	93.9	90.9
Middlesex-London Health Unit	89.7	95.9

<b>Public Health Unit</b>	<b>7-year-olds</b>	<b>17-year-olds</b>
Niagara Region Public Health Unit	94.2	96.6
North Bay Parry Sound District Health Unit	97.8	97.9
Northwestern Health Unit	88.2	87.5
Ottawa Public Health	94.5	97.2
Oxford County Public Health	91.0	96.0
Peel Public Health	91.2	97.2
Perth District Health Unit	95.5	95.3
Peterborough Public Health	92.9	95.7
Porcupine Health Unit	96.4	99.2
Renfrew County and District Health Unit	96.6	98.2
Simcoe Muskoka District Health Unit	88.2	94.7
Sudbury and District Health Unit	97.1	99.0
Thunder Bay District Health Unit	94.9	97.4
Timiskaming Health Unit	97.1	98.1
Toronto Public Health	88.1	89.1
Region of Waterloo, Public Health	95.5	96.3
Wellington-Dufferin-Guelph Public Health	94.0	94.4
Windsor-Essex County Health Unit	85.7	96.6
York Region Public Health Services	90.7	90.8
<b>ONTARIO</b>	<b>91.2</b>	<b>94.0</b>

**Table 2. Mumps immunization coverage estimates (%) among children 7 and 17 years old by Public Health Unit: 2016–17 school year**

<b>Public Health Unit</b>	<b>7-year-olds</b>	<b>17-year-olds</b>
Algoma Public Health Unit	96.4	98.5
Brant County Health Unit	95.1	96.5
Chatham-Kent Public Health Unit	94.5	96.7
Durham Region Health Department	89.6	96.7
Eastern Ontario Health Unit	93.5	89.5
Elgin-St. Thomas Health Unit	90.4	96.9
Grey Bruce Health Unit	95.3	95.6
Haldimand-Norfolk Health Unit	92.4	95.8
Haliburton, Kawartha, Pine Ridge District Health Unit	94.2	92.9
Halton Region Health Department	83.7	96.0
Hamilton Public Health Services	94.6	83.7
Hastings and Prince Edward Counties Health Unit	96.1	98.1
Huron County Health Unit	94.5	93.5
Kingston, Frontenac and Lennox & Addington Public Health	97.6	97.8
Lambton Public Health	95.3	98.2
Leeds, Grenville and Lanark District Health Unit	93.9	90.9
Middlesex-London Health Unit	89.7	95.7
Niagara Region Public Health Unit	94.2	96.2
North Bay Parry Sound District Health Unit	97.8	97.9
Northwestern Health Unit	88.2	87.5

<b>Public Health Unit</b>	<b>7-year-olds</b>	<b>17-year-olds</b>
Ottawa Public Health	94.4	97.0
Oxford County Public Health	91.0	96.7
Peel Public Health	90.9	96.8
Perth District Health Unit	95.5	95.0
Peterborough Public Health	92.9	95.7
Porcupine Health Unit	96.4	99.2
Renfrew County and District Health Unit	96.6	98.2
Simcoe Muskoka District Health Unit	88.2	94.4
Sudbury and District Health Unit	97.1	99.0
Thunder Bay District Health Unit	94.9	97.4
Timiskaming Health Unit	97.1	98.1
Toronto Public Health	87.9	88.1
Region of Waterloo, Public Health	95.5	96.2
Wellington-Dufferin-Guelph Public Health	94.0	94.0
Windsor-Essex County Health Unit	85.6	96.5
York Region Public Health Services	90.5	89.4
<b>ONTARIO</b>	<b>91.1</b>	<b>93.5</b>



**Table 3. Rubella immunization coverage estimates (%) among children 7 and 17 years old by Public Health Unit: 2016–17 school year**

Public Health Unit	7-year-olds	17-year-olds
Algoma Public Health Unit	98.3	99.2
Brant County Health Unit	97.3	97.7
Chatham-Kent Public Health Unit	97.0	98.2
Durham Region Health Department	97.4	98.6
Eastern Ontario Health Unit	96.1	93.0
Elgin-St. Thomas Health Unit	93.1	98.2
Grey Bruce Health Unit	97.0	96.9
Haldimand-Norfolk Health Unit	96.5	97.6
Haliburton, Kawartha, Pine Ridge District Health Unit	96.7	94.2
Halton Region Health Department	94.7	97.6
Hamilton Public Health Services	97.3	85.9
Hastings and Prince Edward Counties Health Unit	97.3	98.8
Huron County Health Unit	96.8	94.4
Kingston, Frontenac and Lennox & Addington Public Health	98.8	99.0
Lambton Public Health	97.3	98.8
Leeds, Grenville and Lanark District Health Unit	96.8	92.1
Middlesex-London Health Unit	93.9	97.2
Niagara Region Public Health Unit	97.1	98.6
North Bay Parry Sound District Health Unit	98.7	98.5
Northwestern Health Unit	93.6	94.9

<b>Public Health Unit</b>	<b>7-year-olds</b>	<b>17-year-olds</b>
Ottawa Public Health	98.4	98.5
Oxford County Public Health	91.9	97.4
Peel Public Health	97.7	98.7
Perth District Health Unit	96.5	97.0
Peterborough Public Health	97.2	97.0
Porcupine Health Unit	98.2	99.2
Renfrew County and District Health Unit	97.9	98.9
Simcoe Muskoka District Health Unit	94.3	97.2
Sudbury and District Health Unit	98.3	99.3
Thunder Bay District Health Unit	97.7	98.1
Timiskaming Health Unit	99.0	98.7
Toronto Public Health	95.7	91.9
Region of Waterloo, Public Health	97.4	97.3
Wellington-Dufferin-Guelph Public Health	96.7	96.5
Windsor-Essex County Health Unit	92.5	98.7
York Region Public Health Services	94.1	92.8
<b>ONTARIO</b>	<b>96.2</b>	<b>95.8</b>

**Table 4. Diphtheria immunization coverage estimates (%) among children 7 and 17 years old by Public Health Unit: 2016–17 school year**

<b>Public Health Unit</b>	<b>7-year-olds</b>	<b>17-year-olds</b>
Algoma Public Health Unit	94.4	89.8
Brant County Health Unit	92.6	82.6
Chatham-Kent Public Health Unit	95.0	80.5
Durham Region Health Department	78.6	79.5
Eastern Ontario Health Unit	91.4	45.4
Elgin-St. Thomas Health Unit	89.1	80.6
Grey Bruce Health Unit	94.6	86.8
Haldimand-Norfolk Health Unit	90.1	82.0
Haliburton, Kawartha, Pine Ridge District Health Unit	92.8	18.0
Halton Region Health Department	68.2	80.8
Hamilton Public Health Services	91.7	19.1
Hastings and Prince Edward Counties Health Unit	93.9	82.4
Huron County Health Unit	93.5	85.9
Kingston, Frontenac and Lennox & Addington Public Health	96.5	85.6
Lambton Public Health	94.1	85.5
Leeds, Grenville and Lanark District Health Unit	91.9	71.5
Middlesex-London Health Unit	85.1	79.0
Niagara Region Public Health Unit	93.0	84.5
North Bay Parry Sound District Health Unit	97.2	87.7
Northwestern Health Unit	83.7	74.7

<b>Public Health Unit</b>	<b>7-year-olds</b>	<b>17-year-olds</b>
Ottawa Public Health	87.3	77.5
Oxford County Public Health	90.7	88.1
Peel Public Health	82.5	79.3
Perth District Health Unit	93.8	89.0
Peterborough Public Health	87.7	82.1
Porcupine Health Unit	94.8	90.1
Renfrew County and District Health Unit	95.2	88.3
Simcoe Muskoka District Health Unit	80.8	55.9
Sudbury and District Health Unit	95.6	87.7
Thunder Bay District Health Unit	93.2	86.3
Timiskaming Health Unit	93.9	87.0
Toronto Public Health	78.7	58.4
Region of Waterloo, Public Health	93.3	82.7
Wellington-Dufferin-Guelph Public Health	92.3	78.3
Windsor-Essex County Health Unit	76.9	82.1
York Region Public Health Services	84.8	43.8
<b>ONTARIO</b>	<b>84.7</b>	<b>68.6</b>

**Table 5. Tetanus immunization coverage estimates (%) among children 7 and 17 years old by Public Health Unit: 2016–17 school year**

<b>Public Health Unit</b>	<b>7-year-olds</b>	<b>17-year-olds</b>
Algoma Public Health Unit	94.4	89.8
Brant County Health Unit	92.6	82.6
Chatham-Kent Public Health Unit	95.0	80.4
Durham Region Health Department	78.6	79.6
Eastern Ontario Health Unit	91.4	45.3
Elgin-St. Thomas Health Unit	89.1	80.6
Grey Bruce Health Unit	94.6	86.8
Haldimand-Norfolk Health Unit	90.1	82.0
Haliburton, Kawartha, Pine Ridge District Health Unit	92.8	18.1
Halton Region Health Department	68.2	80.8
Hamilton Public Health Services	91.7	19.2
Hastings and Prince Edward Counties Health Unit	93.9	82.4
Huron County Health Unit	93.5	85.9
Kingston, Frontenac and Lennox & Addington Public Health	96.5	85.6
Lambton Public Health	94.1	85.4
Leeds, Grenville and Lanark District Health Unit	91.9	71.5
Middlesex-London Health Unit	85.1	79.0
Niagara Region Public Health Unit	93.0	84.5
North Bay Parry Sound District Health Unit	97.2	87.7
Northwestern Health Unit	83.7	74.7

<b>Public Health Unit</b>	<b>7-year-olds</b>	<b>17-year-olds</b>
Ottawa Public Health	87.3	77.5
Oxford County Public Health	90.7	88.1
Peel Public Health	82.4	79.3
Perth District Health Unit	93.8	89.0
Peterborough Public Health	87.7	82.1
Porcupine Health Unit	94.8	90.1
Renfrew County and District Health Unit	95.2	88.3
Simcoe Muskoka District Health Unit	80.8	55.9
Sudbury and District Health Unit	95.6	87.8
Thunder Bay District Health Unit	93.4	86.3
Timiskaming Health Unit	93.9	87.0
Toronto Public Health	78.7	58.4
Region of Waterloo, Public Health	93.3	82.7
Wellington-Dufferin-Guelph Public Health	92.3	78.4
Windsor-Essex County Health Unit	76.9	82.1
York Region Public Health Services	84.8	43.8
<b>ONTARIO</b>	<b>84.7</b>	<b>68.6</b>

**Table 6. Pertussis immunization coverage estimates (%) among children 7 and 17 years old by Public Health Unit: 2016–17 school year**

<b>Public Health Unit</b>	<b>7-year-olds</b>	<b>17-year-olds</b>
Algoma Public Health Unit	94.4	82.7
Brant County Health Unit	92.6	76.3
Chatham-Kent Public Health Unit	94.9	74.4
Durham Region Health Department	78.6	73.6
Eastern Ontario Health Unit	91.4	43.6
Elgin-St. Thomas Health Unit	89.0	73.7
Grey Bruce Health Unit	94.5	81.3
Haldimand-Norfolk Health Unit	89.9	80.8
Haliburton, Kawartha, Pine Ridge District Health Unit	92.8	16.2
Halton Region Health Department	68.0	77.3
Hamilton Public Health Services	91.6	17.1
Hastings and Prince Edward Counties Health Unit	93.8	79.6
Huron County Health Unit	93.5	83.8
Kingston, Frontenac and Lennox & Addington Public Health	96.5	84.1
Lambton Public Health	94.1	81.7
Leeds, Grenville and Lanark District Health Unit	91.9	66.9
Middlesex-London Health Unit	85.0	75.0
Niagara Region Public Health Unit	93.0	78.0
North Bay Parry Sound District Health Unit	97.2	77.3
Northwestern Health Unit	83.7	73.0

<b>Public Health Unit</b>	<b>7-year-olds</b>	<b>17-year-olds</b>
Ottawa Public Health	87.3	71.8
Oxford County Public Health	90.7	79.3
Peel Public Health	82.2	69.1
Perth District Health Unit	93.8	87.6
Peterborough Public Health	87.6	78.0
Porcupine Health Unit	94.8	86.1
Renfrew County and District Health Unit	95.2	86.3
Simcoe Muskoka District Health Unit	80.8	52.8
Sudbury and District Health Unit	95.6	81.7
Thunder Bay District Health Unit	93.3	84.2
Timiskaming Health Unit	93.9	82.2
Toronto Public Health	78.4	50.5
Region of Waterloo, Public Health	93.2	79.0
Wellington-Dufferin-Guelph Public Health	92.2	74.3
Windsor-Essex County Health Unit	76.9	80.0
York Region Public Health Services	84.7	41.5
<b>ONTARIO</b>	<b>84.6</b>	<b>63.2</b>



**Table 7. Polio immunization coverage estimates (%) among children 7 and 17 years old by Public Health Unit: 2016–17 school year**

<b>Public Health Unit</b>	<b>7-year-olds</b>	<b>17-year-olds</b>
Algoma Public Health Unit	94.3	97.7
Brant County Health Unit	92.8	95.8
Chatham-Kent Public Health Unit	95.1	96.1
Durham Region Health Department	78.6	96.2
Eastern Ontario Health Unit	91.7	87.4
Elgin-St. Thomas Health Unit	89.5	96.3
Grey Bruce Health Unit	95.3	95.1
Haldimand-Norfolk Health Unit	89.9	93.0
Haliburton, Kawartha, Pine Ridge District Health Unit	93.1	92.4
Halton Region Health Department	67.7	95.1
Hamilton Public Health Services	92.5	82.9
Hastings and Prince Edward Counties Health Unit	94.1	97.1
Huron County Health Unit	93.0	93.5
Kingston, Frontenac and Lennox & Addington Public Health	96.7	96.5
Lambton Public Health	94.7	97.8
Leeds, Grenville and Lanark District Health Unit	92.0	89.9
Middlesex-London Health Unit	85.9	94.5
Niagara Region Public Health Unit	93.4	96.7
North Bay Parry Sound District Health Unit	97.2	97.1
Northwestern Health Unit	84.5	86.4

<b>Public Health Unit</b>	<b>7-year-olds</b>	<b>17-year-olds</b>
Ottawa Public Health	87.8	94.8
Oxford County Public Health	91.0	95.3
Peel Public Health	82.5	95.6
Perth District Health Unit	93.9	94.0
Peterborough Public Health	88.2	94.8
Porcupine Health Unit	94.8	98.1
Renfrew County and District Health Unit	95.6	97.7
Simcoe Muskoka District Health Unit	81.3	93.4
Sudbury and District Health Unit	95.8	97.5
Thunder Bay District Health Unit	94.4	96.5
Timiskaming Health Unit	93.9	98.1
Toronto Public Health	79.1	86.8
Region of Waterloo, Public Health	93.7	95.0
Wellington-Dufferin-Guelph Public Health	93.0	93.6
Windsor-Essex County Health Unit	77.4	94.6
York Region Public Health Services	84.9	89.6
<b>ONTARIO</b>	<b>85.0</b>	<b>92.5</b>

**Table 8. *Haemophilus influenzae* type b immunization coverage estimates (%) among children 7 years old by Public Health Unit: 2016–17 school year**

<b>Public Health Unit</b>	<b>7-year-olds</b>
Algoma Public Health Unit	91.9
Brant County Health Unit	88.9
Chatham-Kent Public Health Unit	88.6
Durham Region Health Department	85.6
Eastern Ontario Health Unit	86.7
Elgin-St. Thomas Health Unit	83.0
Grey Bruce Health Unit	88.8
Haldimand-Norfolk Health Unit	82.9
Haliburton, Kawartha, Pine Ridge District Health Unit	83.1
Halton Region Health Department	82.6
Hamilton Public Health Services	80.0
Hastings and Prince Edward Counties Health Unit	87.7
Huron County Health Unit	88.5
Kingston, Frontenac and Lennox & Addington Public Health	90.9
Lambton Public Health	85.9
Leeds, Grenville and Lanark District Health Unit	87.8
Middlesex-London Health Unit	81.2
Niagara Region Public Health Unit	85.3
North Bay Parry Sound District Health Unit	94.0
Northwestern Health Unit	79.9

<b>Public Health Unit</b>	<b>7-year-olds</b>
Ottawa Public Health	84.3
Oxford County Public Health	82.5
Peel Public Health	79.2
Perth District Health Unit	89.9
Peterborough Public Health	88.0
Porcupine Health Unit	87.4
Renfrew County and District Health Unit	89.4
Simcoe Muskoka District Health Unit	83.0
Sudbury and District Health Unit	80.1
Thunder Bay District Health Unit	82.1
Timiskaming Health Unit	95.5
Toronto Public Health	77.3
Region of Waterloo, Public Health	84.8
Wellington-Dufferin-Guelph Public Health	83.3
Windsor-Essex County Health Unit	79.8
York Region Public Health Services	81.2
<b>ONTARIO</b>	<b>82.2</b>

**Table 9. Pneumococcal immunization coverage estimates (%) among children 7 years old by Public Health Unit: 2016–17 school year**

<b>Public Health Unit</b>	<b>7-year-olds</b>
Algoma Public Health Unit	87.1
Brant County Health Unit	84.3
Chatham-Kent Public Health Unit	83.2
Durham Region Health Department	84.4
Eastern Ontario Health Unit	85.9
Elgin-St. Thomas Health Unit	81.1
Grey Bruce Health Unit	85.6
Haldimand-Norfolk Health Unit	76.1
Haliburton, Kawartha, Pine Ridge District Health Unit	84.1
Halton Region Health Department	78.3
Hamilton Public Health Services	80.0
Hastings and Prince Edward Counties Health Unit	82.2
Huron County Health Unit	85.5
Kingston, Frontenac and Lennox & Addington Public Health	88.2
Lambton Public Health	74.9
Leeds, Grenville and Lanark District Health Unit	83.8
Middlesex-London Health Unit	79.5
Niagara Region Public Health Unit	85.0
North Bay Parry Sound District Health Unit	89.4
Northwestern Health Unit	81.1

<b>Public Health Unit</b>	<b>7-year-olds</b>
Ottawa Public Health	83.7
Oxford County Public Health	76.8
Peel Public Health	76.1
Perth District Health Unit	86.4
Peterborough Public Health	78.7
Porcupine Health Unit	88.3
Renfrew County and District Health Unit	82.7
Simcoe Muskoka District Health Unit	81.8
Sudbury and District Health Unit	77.4
Thunder Bay District Health Unit	79.6
Timiskaming Health Unit	92.9
Toronto Public Health	73.7
Region of Waterloo, Public Health	81.9
Wellington-Dufferin-Guelph Public Health	83.3
Windsor-Essex County Health Unit	77.7
York Region Public Health Services	79.5
<b>ONTARIO</b>	<b>79.7</b>

**Table 10. Meningococcal C conjugate immunization coverage estimates (%) among children 7 years old by Public Health Unit: 2016–17 school year**

<b>Public Health Unit</b>	<b>7-year-olds</b>
Algoma Public Health Unit	98.0
Brant County Health Unit	96.4
Chatham-Kent Public Health Unit	95.1
Durham Region Health Department	94.1
Eastern Ontario Health Unit	95.0
Elgin-St. Thomas Health Unit	90.9
Grey Bruce Health Unit	95.8
Haldimand-Norfolk Health Unit	94.7
Haliburton, Kawartha, Pine Ridge District Health Unit	95.7
Halton Region Health Department	87.6
Hamilton Public Health Services	96.6
Hastings and Prince Edward Counties Health Unit	96.3
Huron County Health Unit	95.5
Kingston, Frontenac and Lennox & Addington Public Health	97.8
Lambton Public Health	96.6
Leeds, Grenville and Lanark District Health Unit	94.4
Middlesex-London Health Unit	92.1
Niagara Region Public Health Unit	95.2
North Bay Parry Sound District Health Unit	98.4
Northwestern Health Unit	91.8

<b>Public Health Unit</b>	<b>7-year-olds</b>
Ottawa Public Health	96.9
Oxford County Public Health	91.2
Peel Public Health	96.0
Perth District Health Unit	96.3
Peterborough Public Health	95.3
Porcupine Health Unit	97.5
Renfrew County and District Health Unit	97.0
Simcoe Muskoka District Health Unit	92.0
Sudbury and District Health Unit	97.7
Thunder Bay District Health Unit	97.2
Timiskaming Health Unit	98.7
Toronto Public Health	93.3
Region of Waterloo, Public Health	96.3
Wellington-Dufferin-Guelph Public Health	95.4
Windsor-Essex County Health Unit	89.8
York Region Public Health Services	92.1
<b>ONTARIO</b>	<b>94.2</b>



**Table 11. Varicella immunization coverage estimates (%) among children 7 years old by Public Health Unit: 2016–17 school year**

<b>Public Health Unit</b>	<b>7-year-olds</b>
Algoma Public Health Unit	72.6
Brant County Health Unit	61.2
Chatham-Kent Public Health Unit	68.3
Durham Region Health Department	46.1
Eastern Ontario Health Unit	69.5
Elgin-St. Thomas Health Unit	63.1
Grey Bruce Health Unit	67.1
Haldimand-Norfolk Health Unit	60.6
Haliburton, Kawartha, Pine Ridge District Health Unit	58.9
Halton Region Health Department	40.9
Hamilton Public Health Services	60.9
Hastings and Prince Edward Counties Health Unit	56.7
Huron County Health Unit	60.8
Kingston, Frontenac and Lennox & Addington Public Health	73.3
Lambton Public Health	53.2
Leeds, Grenville and Lanark District Health Unit	66.9
Middlesex-London Health Unit	61.0
Niagara Region Public Health Unit	63.2
North Bay Parry Sound District Health Unit	72.6
Northwestern Health Unit	39.9

<b>Public Health Unit</b>	<b>7-year-olds</b>
Ottawa Public Health	57.9
Oxford County Public Health	61.4
Peel Public Health	35.9
Perth District Health Unit	72.6
Peterborough Public Health	60.2
Porcupine Health Unit	76.5
Renfrew County and District Health Unit	63.4
Simcoe Muskoka District Health Unit	58.7
Sudbury and District Health Unit	69.5
Thunder Bay District Health Unit	49.8
Timiskaming Health Unit	77.6
Toronto Public Health	44.2
Region of Waterloo, Public Health	60.7
Wellington-Dufferin-Guelph Public Health	67.1
Windsor-Essex County Health Unit	54.0
York Region Public Health Services	48.1
<b>ONTARIO</b>	<b>52.3</b>

**Table 12. Hepatitis B immunization coverage estimates (%) among children 12 years old by Public Health Unit: 2016–17 school year**

<b>Public Health Unit</b>	<b>12-year-olds</b>
Algoma Public Health Unit	73.4
Brant County Health Unit	75.5
Chatham-Kent Public Health Unit	73.1
Durham Region Health Department	73.9
Eastern Ontario Health Unit	70.1
Elgin-St. Thomas Health Unit	63.3
Grey Bruce Health Unit	71.3
Haldimand-Norfolk Health Unit	61.9
Haliburton, Kawartha, Pine Ridge District Health Unit	58.6
Halton Region Health Department	58.4
Hamilton Public Health Services	74.4
Hastings and Prince Edward Counties Health Unit	63.2
Huron County Health Unit	73.2
Kingston, Frontenac and Lennox & Addington Public Health	77.7
Lambton Public Health	48.6
Leeds, Grenville and Lanark District Health Unit	60.6
Middlesex-London Health Unit	59.9
Niagara Region Public Health Unit	71.4
North Bay Parry Sound District Health Unit	65.9
Northwestern Health Unit	53.3

<b>Public Health Unit</b>	<b>12-year-olds</b>
Ottawa Public Health	74.3
Oxford County Public Health	65.4
Peel Public Health	72.2
Perth District Health Unit	76.4
Peterborough Public Health	65.6
Porcupine Health Unit	76.4
Renfrew County and District Health Unit	66.6
Simcoe Muskoka District Health Unit	72.2
Sudbury and District Health Unit	66.5
Thunder Bay District Health Unit	58.3
Timiskaming Health Unit	66.0
Toronto Public Health	69.4
Region of Waterloo, Public Health	71.1
Wellington-Dufferin-Guelph Public Health	65.0
Windsor-Essex County Health Unit	71.7
York Region Public Health Services	62.0
<b>ONTARIO</b>	<b>68.6</b>

**Table 13. Quadrivalent meningococcal conjugate immunization coverage estimates (%) among children 12 years old by Public Health Unit: 2016–17 school year**

<b>Public Health Unit</b>	<b>12-year-olds</b>
Algoma Public Health Unit	84.8
Brant County Health Unit	87.9
Chatham-Kent Public Health Unit	81.9
Durham Region Health Department	89.3
Eastern Ontario Health Unit	81.0
Elgin-St. Thomas Health Unit	75.6
Grey Bruce Health Unit	91.6
Haldimand-Norfolk Health Unit	67.8
Haliburton, Kawartha, Pine Ridge District Health Unit	77.0
Halton Region Health Department	69.7
Hamilton Public Health Services	83.3
Hastings and Prince Edward Counties Health Unit	82.1
Huron County Health Unit	85.8
Kingston, Frontenac and Lennox & Addington Public Health	91.2
Lambton Public Health	61.8
Leeds, Grenville and Lanark District Health Unit	71.0
Middlesex-London Health Unit	76.5
Niagara Region Public Health Unit	86.1
North Bay Parry Sound District Health Unit	81.5
Northwestern Health Unit	68.5

<b>Public Health Unit</b>	<b>12-year-olds</b>
Ottawa Public Health	86.0
Oxford County Public Health	82.6
Peel Public Health	85.7
Perth District Health Unit	85.6
Peterborough Public Health	79.4
Porcupine Health Unit	89.6
Renfrew County and District Health Unit	79.1
Simcoe Muskoka District Health Unit	84.5
Sudbury and District Health Unit	80.1
Thunder Bay District Health Unit	76.5
Timiskaming Health Unit	85.3
Toronto Public Health	79.1
Region of Waterloo, Public Health	50.7
Wellington-Dufferin-Guelph Public Health	81.3
Windsor-Essex County Health Unit	81.6
York Region Public Health Services	73.2
<b>ONTARIO</b>	<b>79.6</b>

**Table 14. Human papillomavirus immunization coverage estimates (%) among children 12 and 13 years old by Public Health Unit: 2016–17 school year**

Public Health Unit	12-year-olds <sup>§</sup>	12-year-old females	12-year-old males	13-year-old females
Algoma Public Health Unit	61.5	65.3	58.0	63.7
Brant County Health Unit	64.1	66.1	62.3	71.6
Chatham-Kent Public Health Unit	59.7	61.8	57.9	63.5
Durham Region Health Department	65.8	68.1	63.5	72.0
Eastern Ontario Health Unit	60.6	63.3	58.0	62.8
Elgin-St. Thomas Health Unit	49.0	52.4	45.9	48.0
Grey Bruce Health Unit	60.9	61.9	59.9	65.5
Haldimand-Norfolk Health Unit	53.7	57.2	50.6	55.0
Haliburton, Kawartha, Pine Ridge District Health Unit	50.0	53.8	46.2	54.9
Halton Region Health Department	44.0	47.1	41.1	43.1
Hamilton Public Health Services	63.4	65.2	61.7	60.2
Hastings and Prince Edward Counties Health Unit	51.3	54.4	48.3	53.6
Huron County Health Unit	55.2	59.6	51.3	57.0
Kingston, Frontenac and Lennox & Addington Public Health	67.5	71.1	64.2	67.3
Lambton Public Health	38.8	43.5	34.5	39.2
Leeds, Grenville and Lanark District Health Unit	54.2	57.1	51.6	58.6
Middlesex-London Health Unit	50.7	53.5	47.9	49.8
Niagara Region Public Health Unit	60.4	60.5	60.2	61.1

<sup>§</sup>Students with unknown gender excluded from the 2016–17 school year HPV (12 y) coverage estimate. For further details, please see the HPV up-to-date definition in the Technical Appendix.

Public Health Unit	12-year-olds <sup>s</sup>	12-year-old females	12-year-old males	13-year-old females
North Bay Parry Sound District Health Unit	58.1	59.8	56.5	56.8
Northwestern Health Unit	44.9	51.9	38.3	44.6
Ottawa Public Health	59.9	64.0	55.9	65.0
Oxford County Public Health	51.7	55.8	47.8	53.1
Peel Public Health	55.2	59.2	51.6	56.2
Perth District Health Unit	62.2	60.8	63.4	57.7
Peterborough Public Health	54.9	57.9	51.8	56.1
Porcupine Health Unit	64.8	65.7	63.9	67.4
Renfrew County and District Health Unit	56.2	62.6	50.1	63.3
Simcoe Muskoka District Health Unit	64.4	66.9	62.0	65.9
Sudbury and District Health Unit	54.8	57.1	52.6	60.1
Thunder Bay District Health Unit	50.7	53.1	48.5	54.0
Timiskaming Health Unit	55.9	53.3	58.3	56.2
Toronto Public Health	59.4	62.8	56.2	66.6
Region of Waterloo, Public Health	57.2	59.7	54.8	63.4
Wellington-Dufferin-Guelph Public Health	50.6	53.3	47.9	58.9
Windsor-Essex County Health Unit	58.1	61.4	55.0	59.7
York Region Public Health Services	46.5	49.5	43.7	50.0
<b>ONTARIO</b>	<b>56.3</b>	<b>59.4</b>	<b>53.4</b>	<b>59.6</b>



**Public Health Ontario**

480 University Avenue, Suite 300

Toronto, Ontario

M5G 1V2

647.260.7100

[communications@oahpp.ca](mailto:communications@oahpp.ca)

[publichealthontario.ca](http://publichealthontario.ca)

