

SURVEILLANCE REPORT

Immunization Coverage Report for School Pupils in Ontario: 2019-20 to 2022-23 School Years

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Purpose

This report describes immunization coverage for Ontario's [publicly-funded routine childhood immunization programs](#).¹ It is a continuation in a series of reports^{2,3,4} that aim to support program recovery for the pandemic-affected school years 2019-20, 2020-21 and 2021-22, and provides new estimates for the 2022-23 school year. In addition, the impact of catch-up activities and/or delayed reporting of immunizations is examined by extending the period of assessment by up to three years.

Further details on Ontario's publicly-funded routine childhood and school-based immunization programs have previously been described. Data sources and methods used for this report can be found in the [Technical Notes](#); this report builds on established methods used by Public Health Ontario (PHO) for up-to-date (UTD) immunization coverage assessment.^{5,6}

Important notes on interpretation:

- Data for this report were obtained from the Digital Health Immunization Repository (DHIR) – Ontario's provincial immunization repository. These data comprise immunizations administered by health care providers that are reported to public health units (PHUs) by parents/guardians for entry into the DHIR and immunizations administered by PHUs. Immunizations not reported to PHUs for entry into the DHIR are not captured in this report.
 - Coverage estimates for 2019-20 to 2022-23 reflect immunizations administered between September 1 and August 31 of each respective school year AND entered into the DHIR as of October 27, 2023 (Figures 1 to 4).
 - Coverage estimates reflecting catch-up activities occurring after the end of the 2019-20 to 2021-22 school years, including immunizations administered and entered into the DHIR by August 31, 2023, are presented in Figures 5 and 6.
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Background

Immunization coverage refers to the proportion of a population that is appropriately immunized against a vaccine preventable disease (VPD) at a point in time. Achieving and maintaining high immunization coverage is essential for effective prevention and control of VPDs. The Canadian [National Standards for Immunization Coverage Assessment](#) recommend that antigen-level coverage should be reported annually for 2-, 7- and 17-year-olds, in addition to coverage for school-age programs.⁷

In Ontario, publicly-funded routine infant and childhood immunization programs are primarily delivered by community-based primary care providers¹, whereas Ontario's three publicly-funded school-based immunization programs — hepatitis B (Hep B), human papillomavirus (HPV) and quadrivalent meningococcal conjugate (MCV4) — are typically delivered by public health units (PHUs) to grade 7 students (12-year-olds), with catch-up programs offered for older students.

Immunization coverage for school-aged children is assessed using data from the Digital Health Immunization Repository (DHIR), Ontario's provincial immunization repository. The collection and entry of immunization information in the DHIR is largely driven by the Immunization of School Pupils Act (ISPA)⁸ for many routine infant and childhood immunizations; among school-based programs, MCV4 is also covered under the ISPA, while Hep B and HPV are not. PHUs rely on parental and/or provider reporting for immunizations administered in primary care, whereas adolescent immunizations administered in school-based immunization programs are entered directly by the PHUs into the DHIR.

The impact of the COVID-19 pandemic on the delivery and reporting of routine childhood and school-based immunizations has been described in previous reports.^{2,3,4} Interim guidance issued by the National Advisory Committee on Immunization and the Ontario Ministry of Health to mitigate some of these impacts by prioritizing certain immunizations were also described.^{9,10,11,12} While in-person school resumed for most children in the 2021-22 school year, most PHUs did not resume ISPA activities until the 2022-23 school year. The extent to which immunization records were collected, assessed and entered in the DHIR during this period was variable. It is therefore important to continue to retrospectively assess progress toward catch-up of pandemic affected cohorts over time.

Highlights

- As previously reported^{1,2,3,4}, the COVID-19 pandemic resulted in large declines in coverage estimates based on reported immunizations for Ontario's routine infant and childhood immunization programs (Figures 1-3) and school-based immunization programs between 2019-20 and 2021-22 (Figure 4).
 - These declines were particularly evident among younger age cohorts (7- and 12-year olds), however diphtheria, tetanus and pertussis coverage among 17-year olds also decreased, suggesting many adolescents missed receiving their adolescent tetanus-diphtheria-pertussis (Tdap) booster dose during the pandemic, which is typically administered between 14-16 years of age.
- Coverage based on reported immunizations for routine infant and childhood programs remained low in 2022-23 (Figures 1 to 3).
 - While small increases in coverage (0.5% to 8.8%) were observed after allowing for delayed reporting of immunizations administered within each given school year, there were smaller increases (0.7% to 3.5%) associated with catch-up immunizations administered in the one to three years following the 2019-20, 2020-21 and 2021-22 school years (Figures 5a-b).

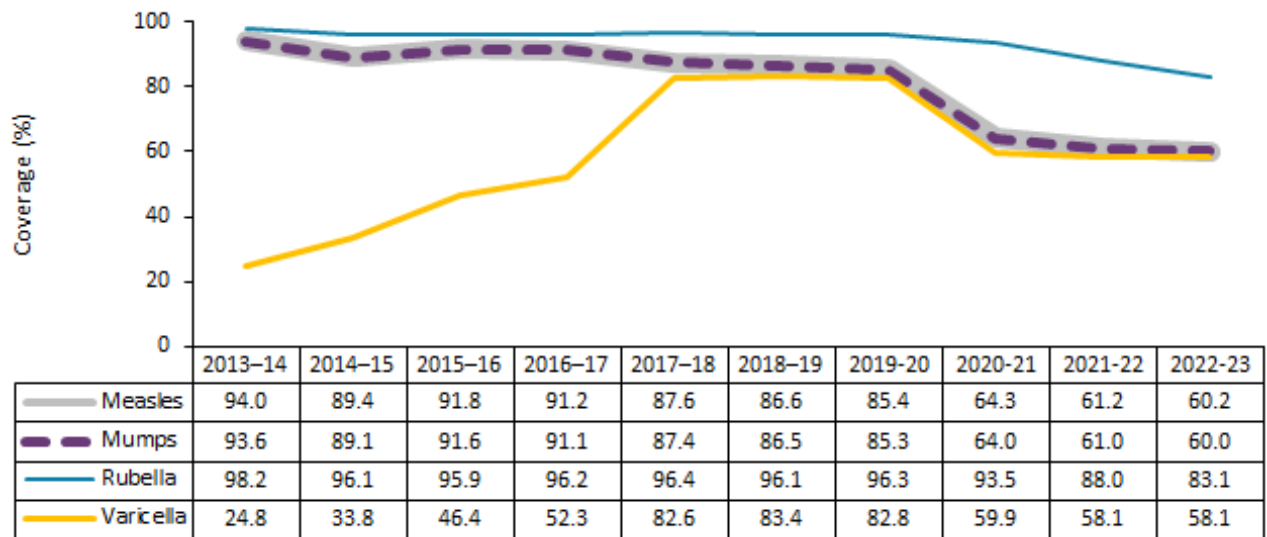
- In contrast, notable increases in coverage for school-based programs were observed in 2021-22 and 2022-23 (Figure 4); despite these increases reflecting some degree of program recovery, estimates remained lower than prior to the pandemic.
 - While delayed reporting of immunizations administered within each given school year had a small impact on coverage (0.2% to 3.8%), large increases in coverage (16.8% to 49.1%) were observed among 12-year olds due to catch-up programs in the one to three years following the end of the respective school years (Figure 6).
- The proportion of 7-year-olds who had no reported doses of measles vaccine increased between 2019-20 and 2022-23 (Figure 7); the same was observed for varicella, pertussis, polio, Hib and pneumococcal vaccines, as shown in the accompanying [Appendix](#). For HPV, the proportion of students who did not have any doses recorded peaked in 2020-21 followed by a decline in this proportion in 2021-22 and 2022-23 (Figure 8); a similar trend was also observed for Hep B ([Appendix](#)).
 - Catch-up activities for school-based immunization programs resulted in reducing the proportion of unimmunized students by up to approximately 50% as of August 31, 2023.
- The proportion of 12-year-olds who initiated but were not reported to have completed Hep B or HPV immunization series declined between 2019-20 and 2022-23 (Figures 9a and 9b). Of note, catch-up programs resulted in almost doubling the proportion of students with records of a complete immunization series as of August 31, 2023.
- Coverage among the youngest age cohorts (5-9 year olds) in the 2022-23 school year remained significantly impacted by the pandemic and were much lower compared to older cohorts for measles, varicella, pertussis and polio vaccines (Figures 10a-d). Among school-based programs, coverage was lowest for 12- to 15-year olds, reflecting those age cohorts most impacted by the pandemic (Figures 11a-11c).
- Coverage was consistently higher (data not shown) among females for all school-based programs across all age cohorts from 12- to 17-year olds (range 0.5% to 4.8% higher); gender differences were not observed among routine infant and childhood immunization programs.
- There was significant geographic variability in coverage among PHUs across all age cohorts and antigens (Figures 10 and 11). Two-dose measles coverage among 7-year-olds ranged from 20.6% to 94.8% across PHUs. Further details on PHU-specific estimates for all antigens can be found in the accompanying [Appendix](#).

Results

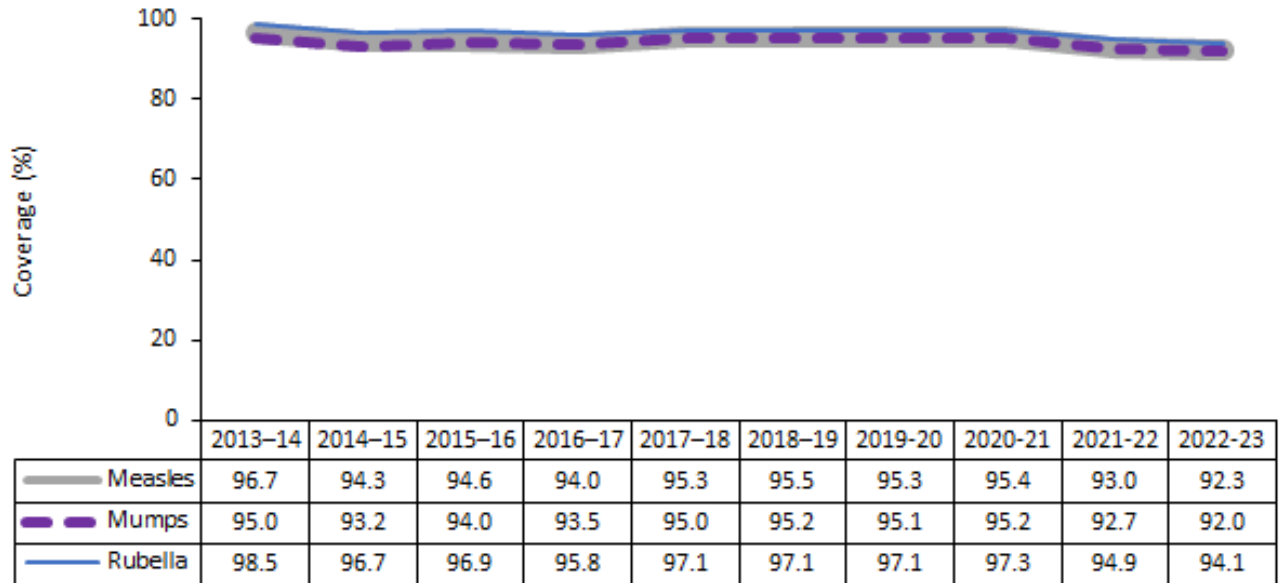
Temporal Trends in Coverage

Figure 1. Measles, mumps, rubella and varicella immunization coverage in Ontario: 2013-14 to 2022-23

a) 7-year-olds



b) 17-year-olds

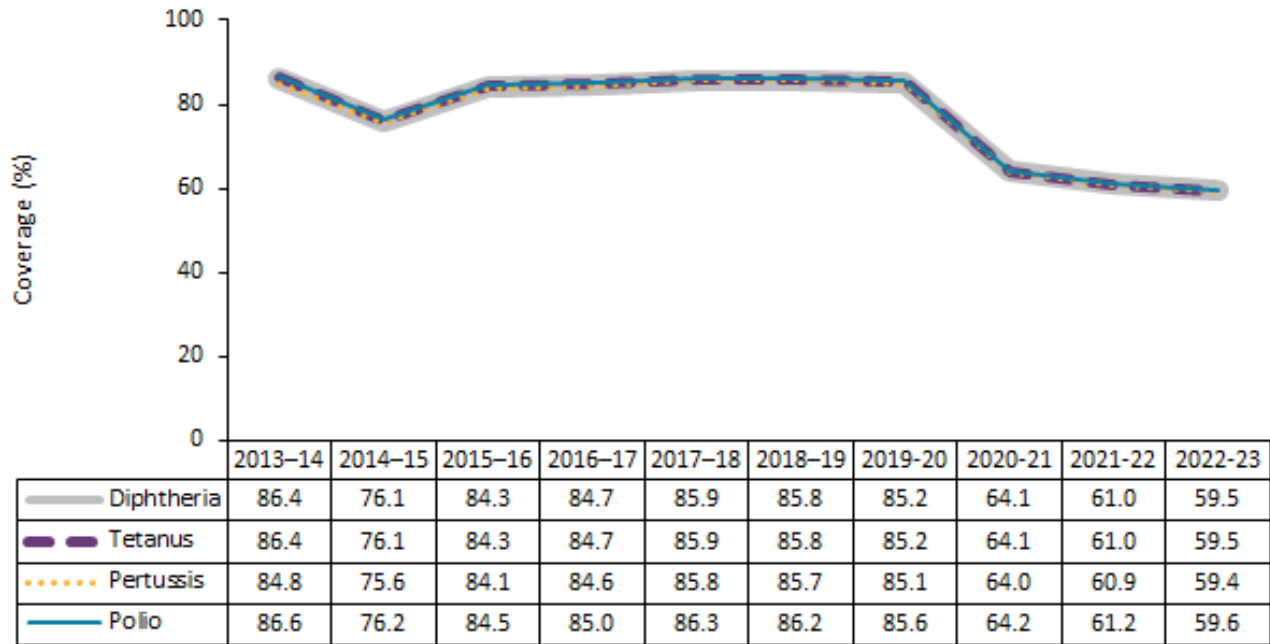


Notes for Figures 1a – 1b:

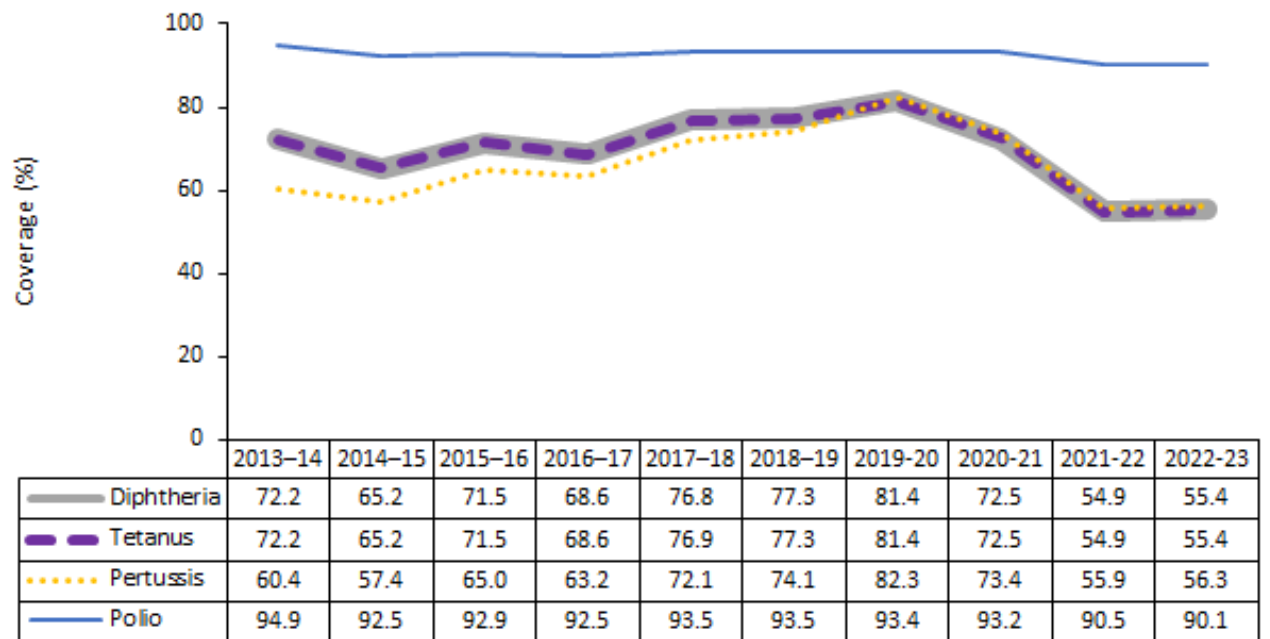
- UTD immunization coverage estimates reflect immunizations received as of August 31st of the respective school years; estimates for 2013-14 to 2018-19 school years reflect point-in-time estimates from previous annual reports and were not re-calculated, as new estimates were added for 2019-20 to 2022-23.
- Antigens included in a multi-component vaccine may have very similar antigen-specific coverage estimates. However in some cases, the number of doses required to be up-to-date may differ among antigens within a multivalent product (e.g., one dose for rubella versus two doses for measles and mumps), thus resulting in different estimates.
- Effective September 2014, the ISPA was amended to include varicella for children born on or after 2010; this accounts for the steep rise in varicella coverage as of the 2017-18 school year among 7-year-olds.

Figure 2. Diphtheria, tetanus, polio and pertussis immunization coverage in Ontario: 2013–14 to 2022–23 school years

a) 7-year-olds



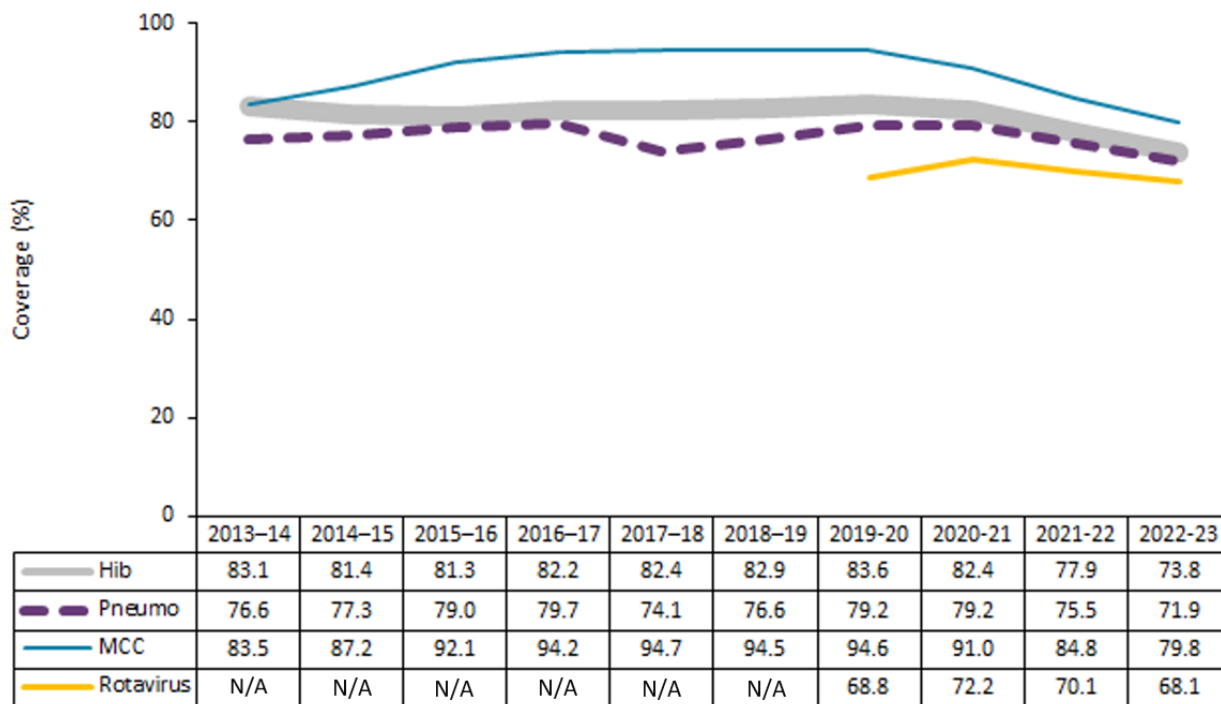
b) 17-year-olds



Notes for Figures 2a-2b:

- UTD immunization coverage estimates reflect immunizations received as of August 31st of the respective school years; estimates for 2013-14 to 2018-19 school years reflect point-in-time estimates from previous annual reports and were not re-calculated, as new estimates were added for 2019-20 to 2022-23.
- Antigens included in a multi-component vaccine may have very similar antigen-specific coverage estimates. However in some cases, the number of doses required to be up-to-date may differ among antigens within a multivalent product, thus resulting in different estimates.

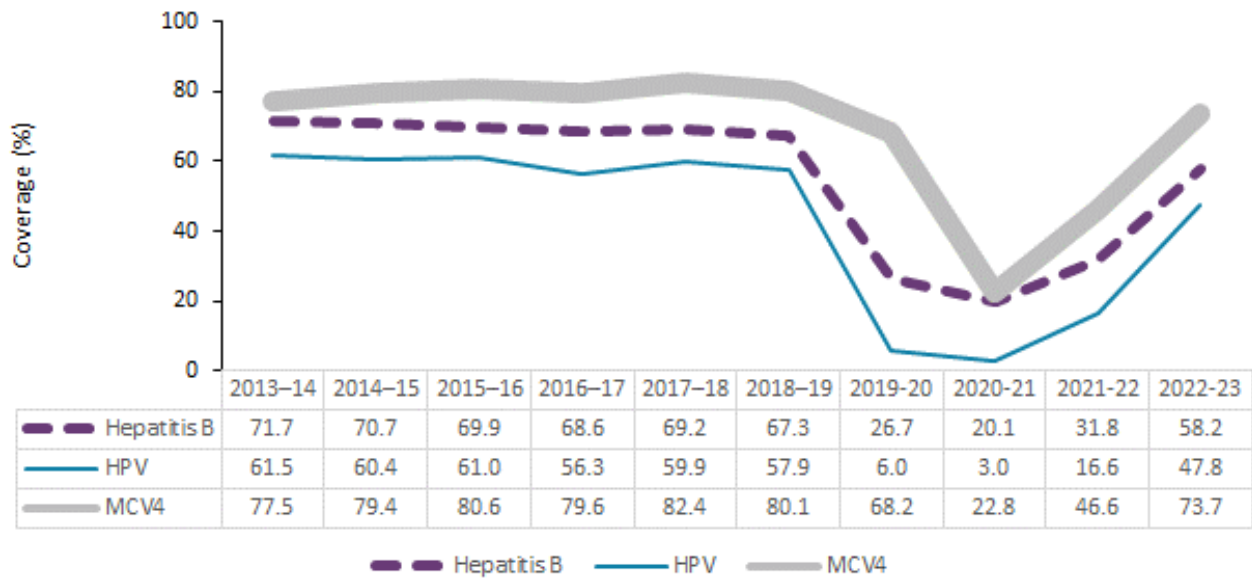
Figure 3. *Haemophilus influenzae* type b (Hib), pneumococcal, meningococcal C conjugate (MCC) and rotavirus immunization coverage among 7-year-olds in Ontario: 2013–14 to 2022–23 school years



Notes:

- UTD immunization coverage estimates reflect immunizations received as of August 31st of the respective school years; estimates for 2013-14 to 2018-19 school years reflect point-in-time estimates from previous annual reports and were not re-calculated, as new estimates were added for 2019-20 to 2022-23.
- Coverage estimates for rotavirus vaccine as of the 2019-20 school year are presented for the first time in this report. Historical estimates from 2013-14 to 2018-19 were not retrospectively calculated. Methodology to assess up-to-date immunization status is described in the Data Notes.
- Antigens included in a multi-component vaccine may have very similar antigen-specific coverage estimates. However in some cases, the number of doses required to be up-to-date may differ among antigens within a multivalent product, thus resulting in different estimates.

Figure 4. Hepatitis B, human papillomavirus and quadrivalent meningococcal conjugate vaccines among 12-year-olds in Ontario: 2013-14 to 2022-23 school years

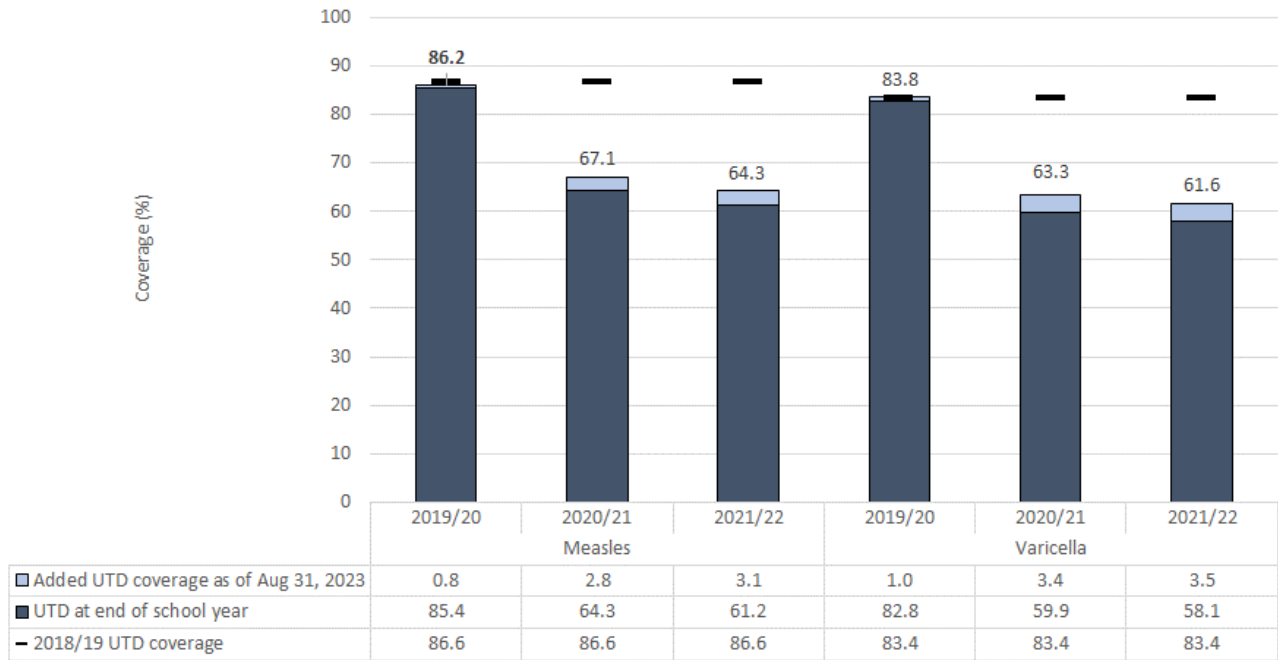


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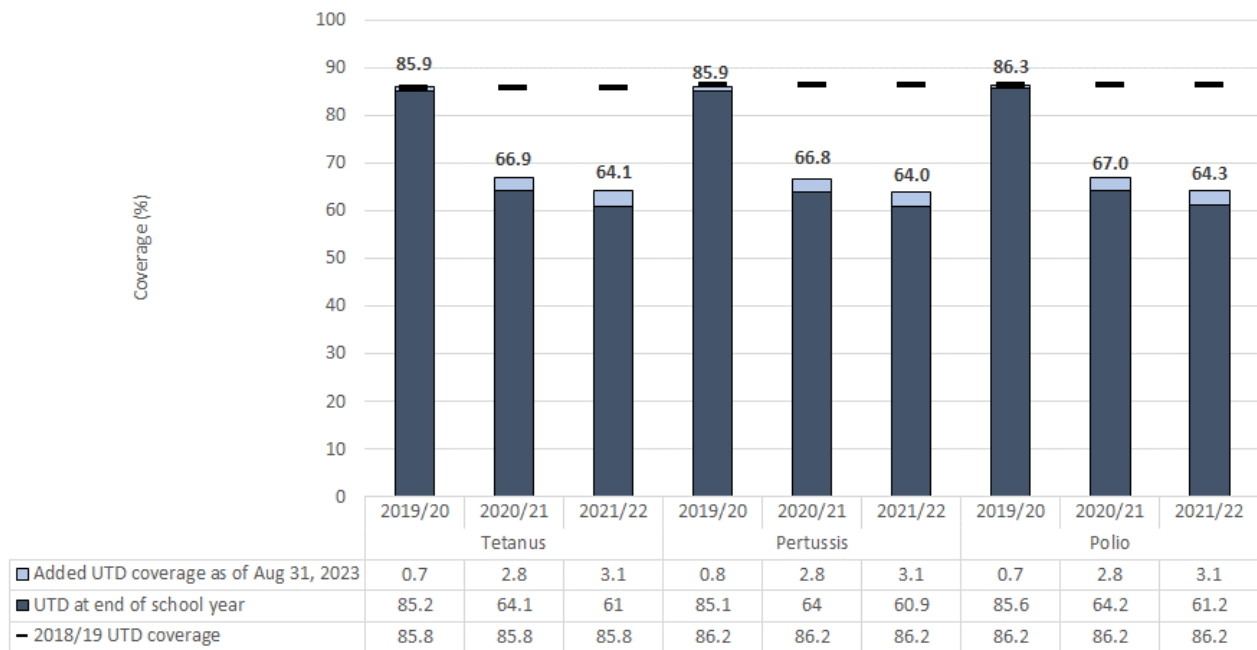
- UTD immunization coverage estimates reflect immunizations received as of August 31st of the respective school years; estimates for 2013-14 to 2018-19 are point-in-time estimates from previous annual reports and were not recalculated.
- UTD immunization coverage estimates reflect immunizations received as of August 31st of the respective school years.
- HPV coverage estimates for 2013-14 to 2015-16 school years represent 13-year-old female cohorts, whereas as of the 2016-17 school year, estimates represent all genders for 12-year-old students. Students who completed either a valid two-dose or three-dose series were considered up-to-date for all assessment years.

Figure 5. Immunization coverage reflecting extended period of assessment for selected routine infant and childhood immunizations among 7-year olds: 2019-20 to 2021-22 school years in Ontario

a) Measles, Varicella



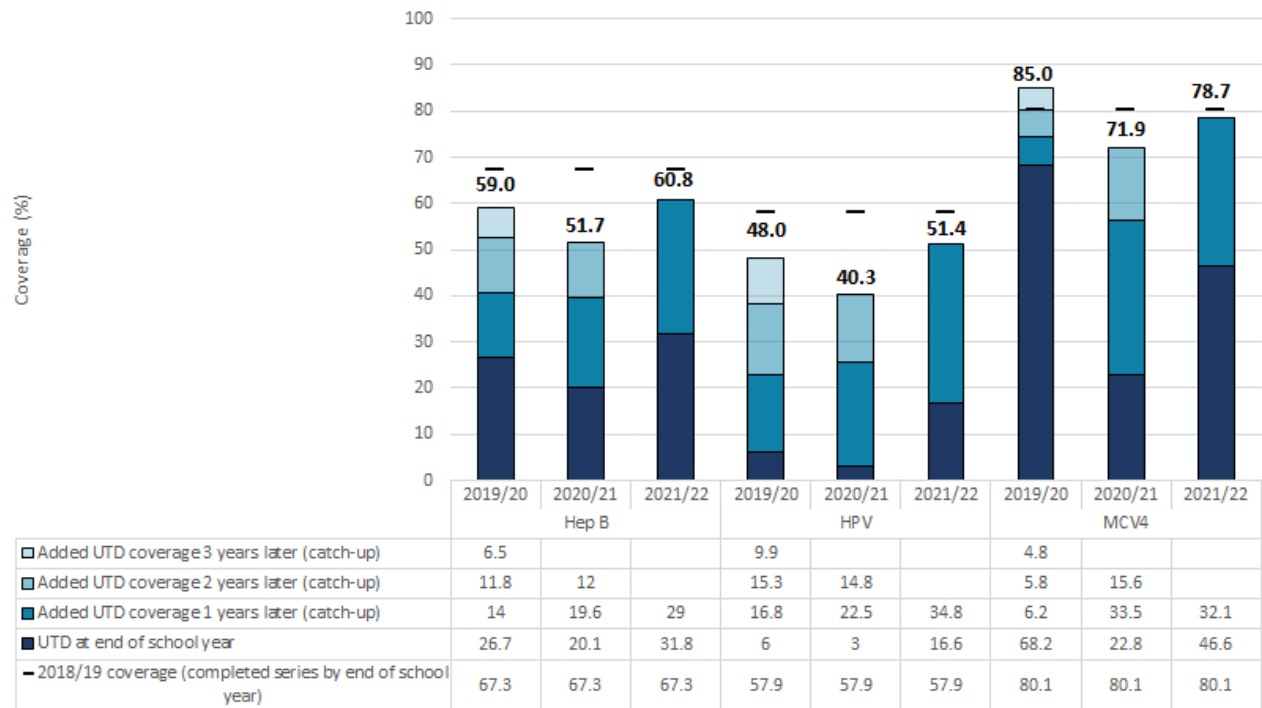
b) Tetanus, Pertussis, Polio



Notes for Figures 5a-5b:

- Coverage estimates reflect the proportion of students who received the recommended number of doses for their age by August 31st of the respective school year, as well as up to three years following the corresponding school year.
- 2018-19 coverage estimates are included for comparison; they are from previous annual reports and have not been re-calculated for this report.

Figure 6. Immunization coverage for school-based programs with catch-up programs among 12-year olds: 2019-20 to 2022-23 school years in Ontario

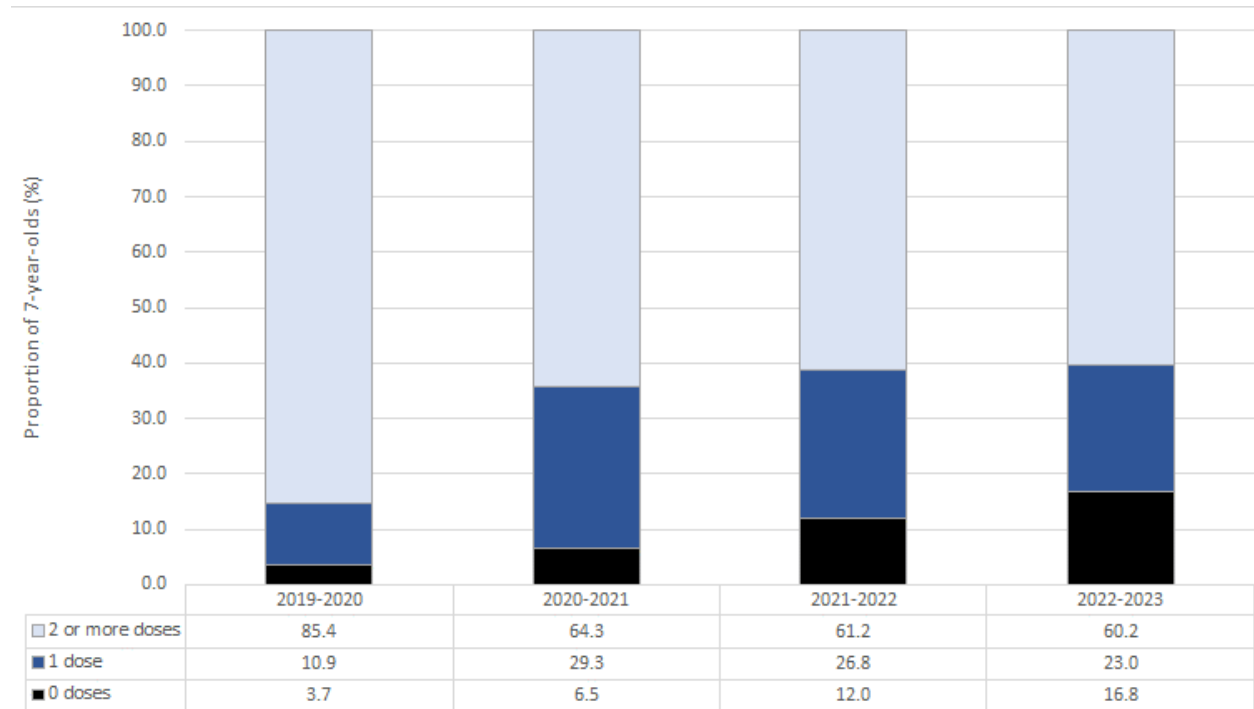


Notes:

- UTD immunization coverage estimates reflect the proportion of students who completed the series and received all recommended doses for their age by August 31st of the respective school year or catch-up period (i.e. 1, 2, or 3 years following corresponding school year).
- 2018-19 coverage estimates are included for comparison; they are from previous annual reports and have not been re-calculated for this report.
- In the 2016-17 school year, the HPV program was expanded to include males. Females have been included in the HPV program since the 2007-08 school year. Coverage is therefore assessed for all genders for 12-year-olds for the 2018-19 to 2022-23 school years.

Coverage by Dose Number

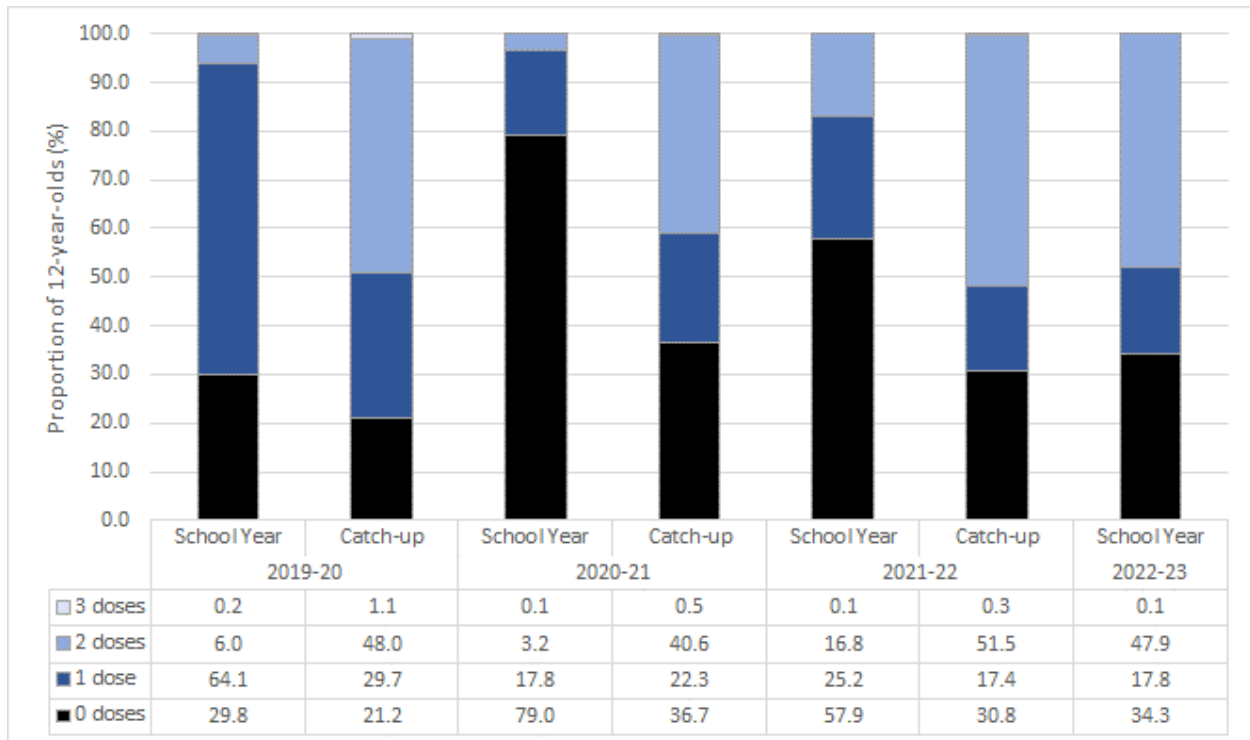
Figure 7. Measles coverage by number of doses among 7-year-olds in Ontario: 2019-20 to 2022-23



Notes:

- Only valid doses where minimum intervals and age requirements have been satisfied are shown. Further detail can be found in the [Technical Notes](#).

Figure 8. HPV coverage by number of doses among 12-year-olds in Ontario: 2019-20 to 2022-23 with catch-up for doses received as of August 31, 2023

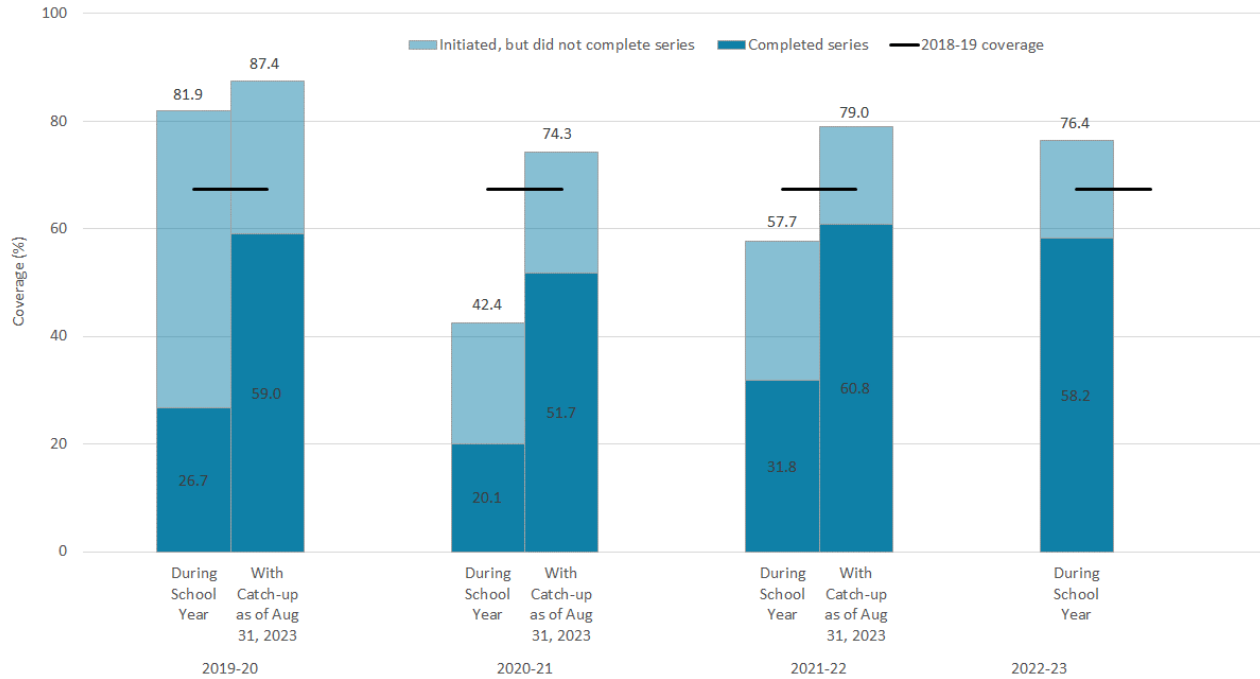


Notes:

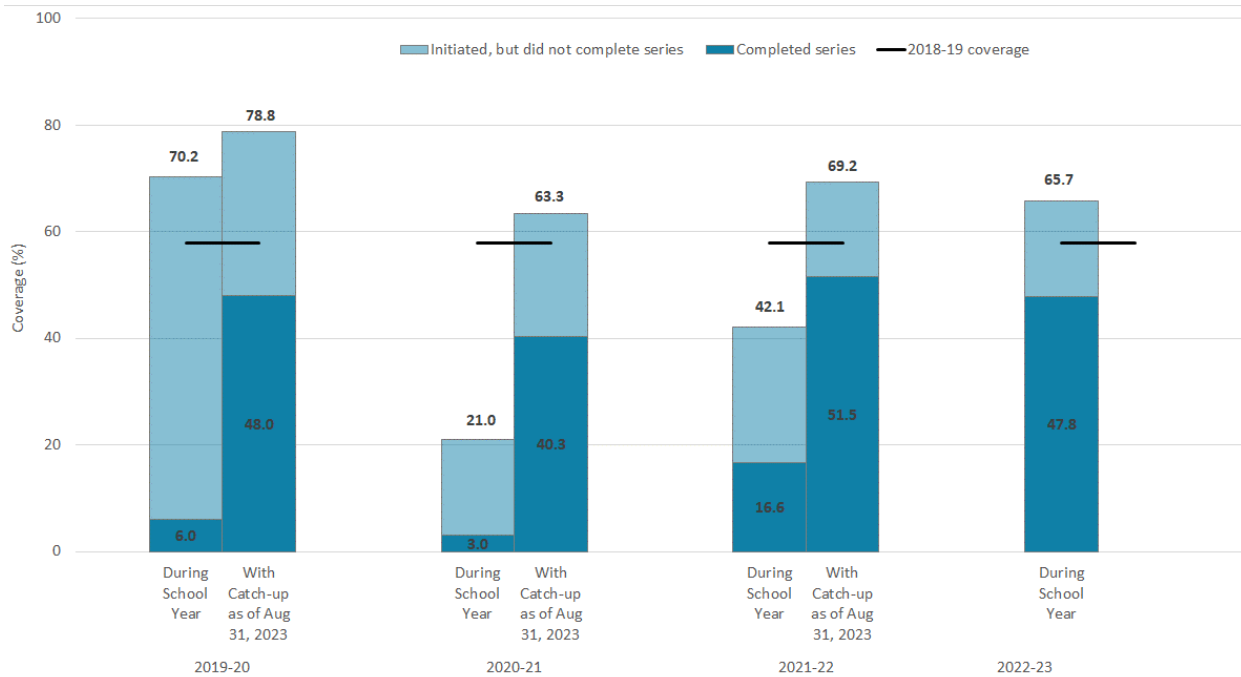
- Only valid doses where minimum intervals and age requirements have been satisfied are shown; a varied number of valid doses are required to be considered UTD for each antigen. Further detail can be found in the [Technical Notes](#).
- The number of doses received as of August 31st of the respective school year are provided, as well as during the catch-up period for doses received as of August 31, 2023.

Figure 9. School-based immunization coverage by series initiation and completion by the end of the school year and during catch-up among 12-year-old students in Ontario: 2019-20 to 2022-23

a) Hepatitis B



b) HPV



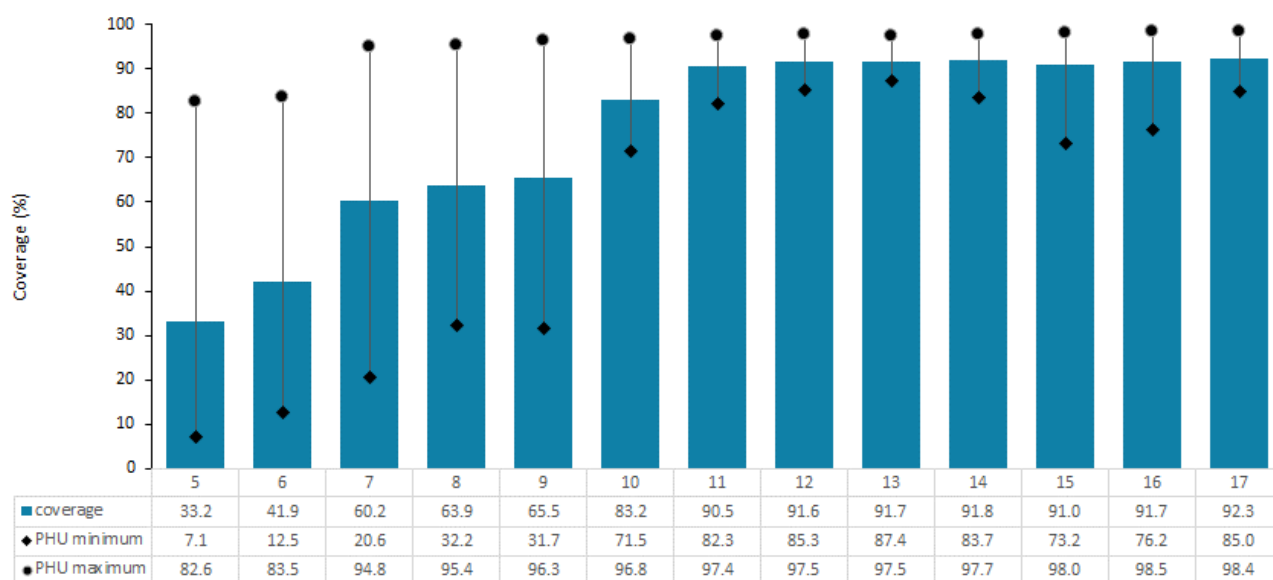
Notes for Figures 9a-9b:

- UTD immunization coverage estimates reflect the proportion of students who initiated their immunization series (i.e. received at least one dose) or completed the series (i.e. received all recommended doses for their age) by August 31st of the corresponding school year or catch-up period (i.e. August 31, 2023).
- 2018-19 coverage estimates reflect series completion during the school year, and are included for comparison; they are from previous annual reports and have not been re-calculated for this report.
- In the 2016-17 school year, the HPV program was expanded to include males. Females have been included in the HPV program since the 2007-08 school year. Coverage is therefore assessed for all genders for 12-year-olds for the 2018-19 to 2021-22 school years. In the 2016–17 school year, the grade 7 HPV program was expanded to include males; males in older grades were not made eligible. Coverage is therefore assessed for females only for 17-year-olds in the 2018-19, 2019-20 and 2020-21 school years, while all genders were included in the 2021-22 school year.

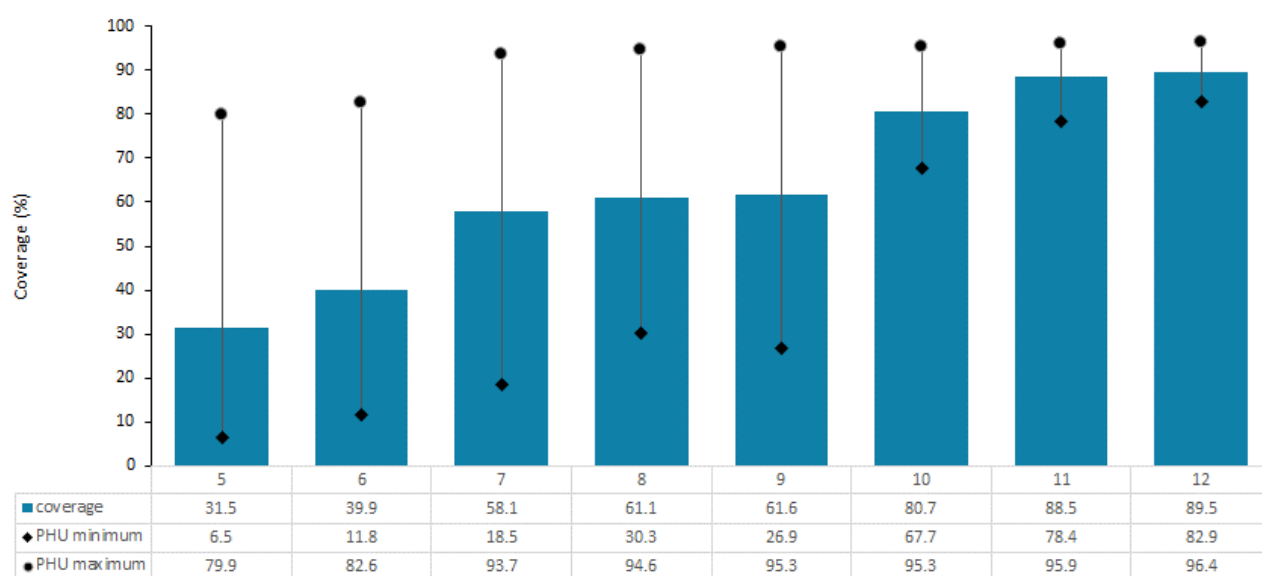
Demographic and Geographic Variability

Figure 10. Routine infant and childhood immunization coverage among 5- to 17-year-olds in Ontario: 2022–23 school year

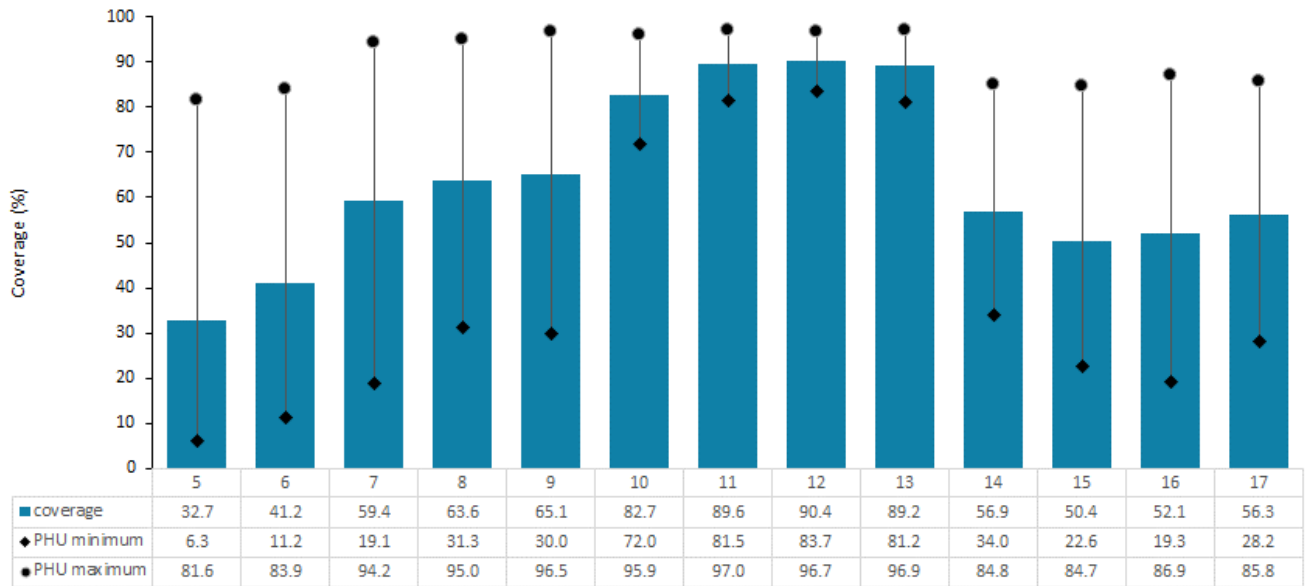
a) Measles



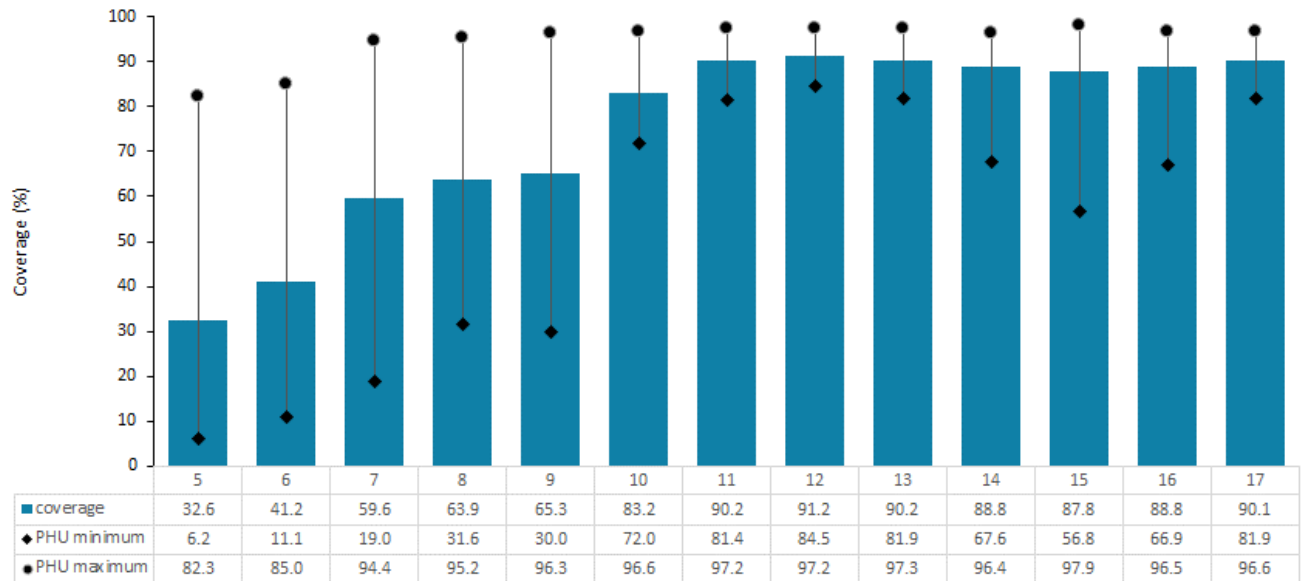
b) Varicella



c) Pertussis



d) Polio

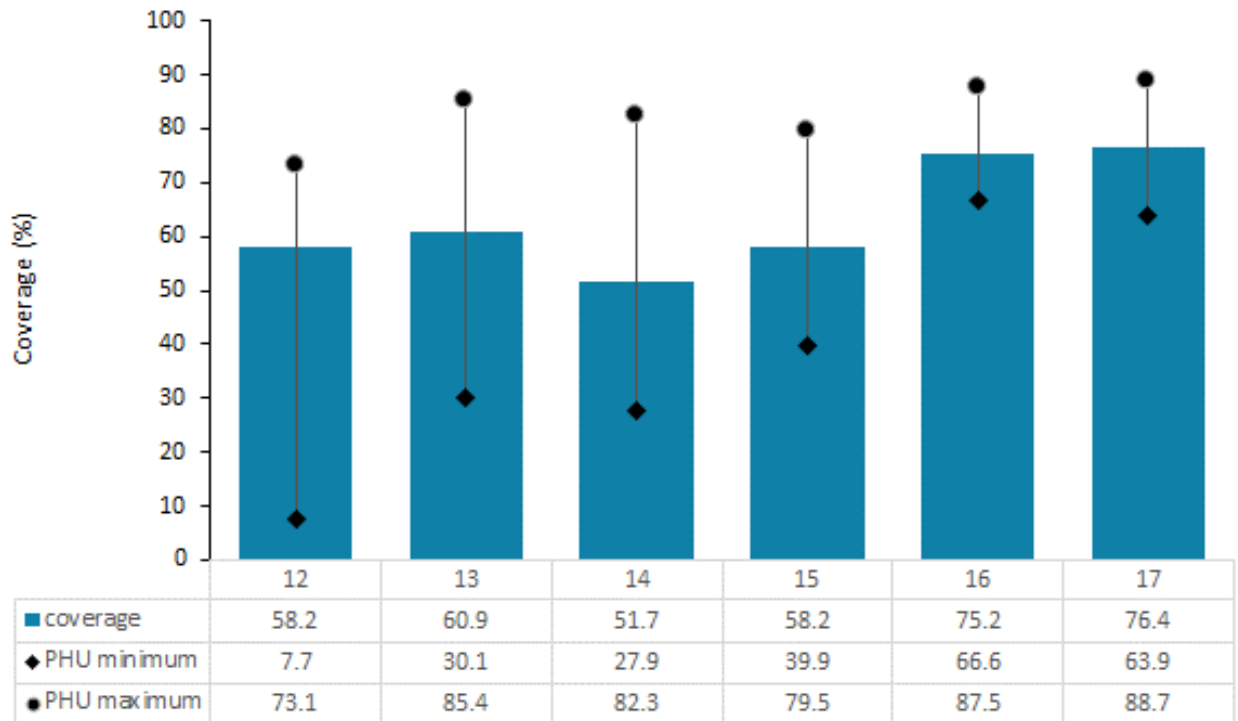


Notes for Figure 10a-10d:

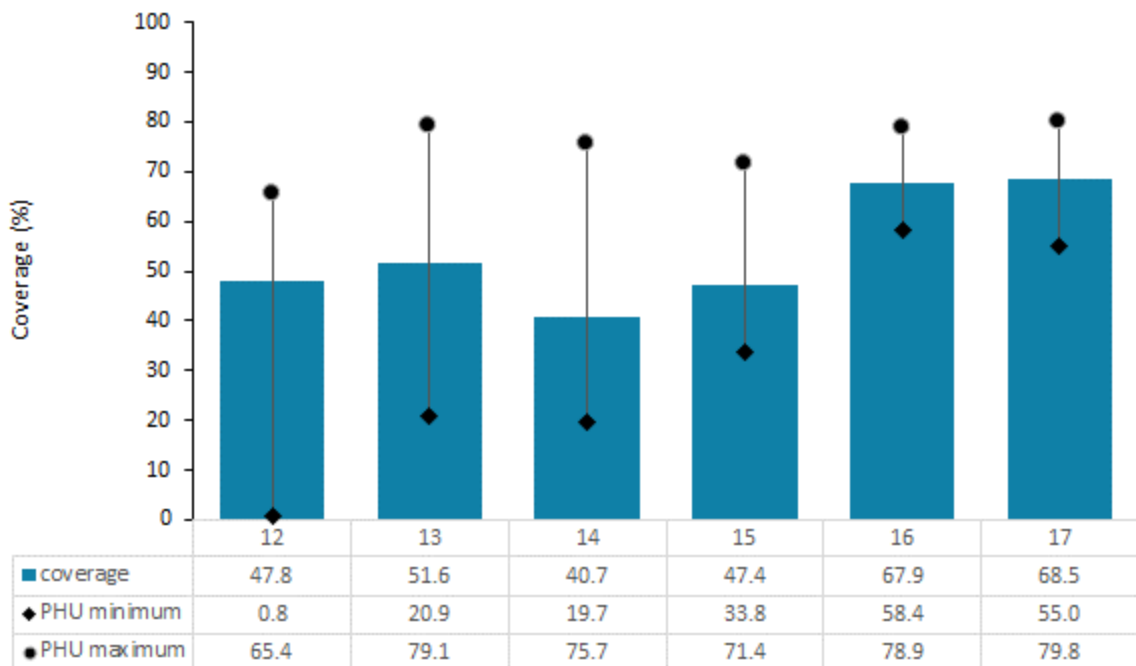
- The diamonds and circles attached to the black bars represent the minimum and maximum PHU-specific estimates, respectively.
- Age shown is as of December 31, 2022, while immunization records in the DHIR-Panorama with an administered date up to the end August 31, 2023 are included in coverage estimates.
- The large drop in pertussis coverage observed among those 14 years of age and older reflects a decline in adolescents receiving an adolescent Tdap booster, which is required to be considered up-to-date.

Figure 11. School-based immunization coverage among 12- to 17-year-olds in Ontario: 2022–23 school year

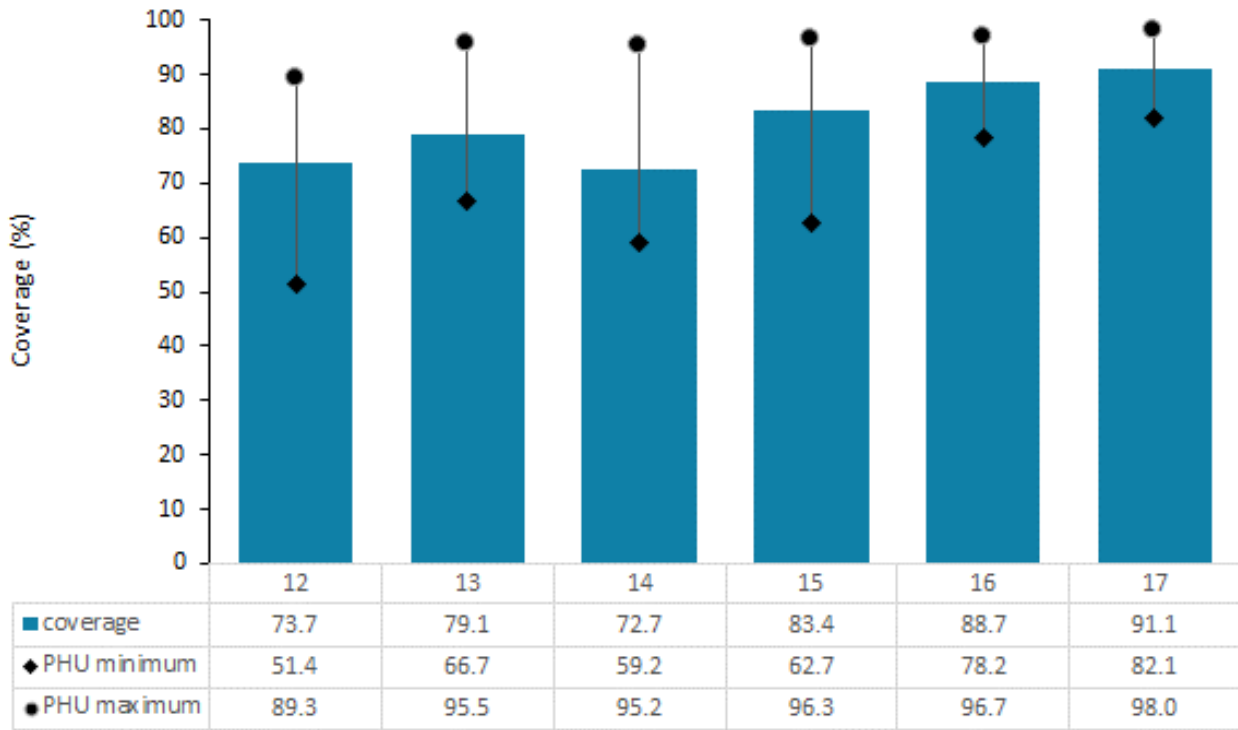
a) Hepatitis B



b) HPV



c) MCV4



Notes for Figures 11a-11c:

- The diamonds and circles attached to the black bars represent the minimum and maximum PHU-specific estimates, respectively.
- Age shown is as of December 31, 2022, while immunization records in the DHIR-Panorama with an administered date up to the end August 31, 2023 are included in coverage estimates.

Technical Notes

Data Sources

Data for this report were obtained using from the Digital Health Immunization Repository (DHIR) – Ontario’s provincial immunization repository. Data were extracted on October 27, 2023.

Methods

- This report describes immunization coverage for Ontario’s [publicly-funded routine infant and childhood immunization programs](#), with the exception of the influenza vaccine.
- Please see the Technical Annex from the 2018-19 school year report for a detailed description of the DHIR and methods used for the assessment of student immunization, including details on cohort creation and up-to-date (UTD) coverage assessment by age and antigen, as well as a description of the limitations. The methodologies have not changed from previous years, with the exception of the updates described below made to assess UTD coverage with an extended period of assessment and with respect to diphtheria, tetanus and pertussis coverage assessment among 17-year-olds.
- Coverage was assessed at 7 and 17 years of age for each respective school year for all antigens. For measles, pertussis and polio, 7-year-olds from the 2019-20 and 2020-21 school years were followed for up to two years to assess the impact of any catch-up activities and delayed reporting of immunizations (please see below for cut-off dates used for immunization administration dates); age-specific estimates for 5- to 17-year olds were also derived for the 2021-22 school year for these antigens.
- For the 2019-20 school year:
 - Students were included in the analysis if they had an education record that met the following criteria:
 - Effective From: On or after September 1, 2019 or missing, AND
 - Effective To: On or before August 31, 2020
 - Immunizations with administration dates on or before August 31, 2020 were included in the UTD coverage estimates.
 - Immunizations with administration dates on or before August 31, 2021 were included in the UTD coverage estimates with one year of extended period of assessment.
 - Immunizations with administration dates on or before August 31, 2022 were included in the UTD coverage estimates with two years of extended period of assessment.
 - Immunizations with administration dates on or before August 31, 2023 were included in the UTD coverage estimates with three years of extended period of assessment.
- For the 2020-21 school year:
 - Students were included in the analysis if they had an education record that met the following criteria:
 - Effective From: On or after September 1, 2020 or missing, AND
 - Effective To: On or before August 31, 2021
 - Immunizations with administration dates on or before August 31, 2021 were included in the UTD coverage estimates.

- Immunizations with administration dates on or before August 31, 2022 were included in the UTD coverage estimates with one year of extended period of assessment.
- Immunizations with administration dates on or before August 31, 2023 were included in the UTD coverage estimates with two years of extended period of assessment.
- For the 2021-22 school year:
 - Students were included in the analysis if they had an education record that met the following criteria:
 - Effective From: On or after September 1, 2021 or missing, AND
 - Effective To: On or before August 31, 2022
 - Immunizations with administration dates on or before August 31, 2022 were included in the UTD coverage estimates.
 - Immunizations with administration dates on or before August 31, 2023 were included in the UTD coverage estimates with one year of extended period of assessment.
- For the 2022-23 school year:
 - Students were included in the analysis if they had an education record that met the following criteria:
 - Effective From: On or after September 1, 2022 or missing, AND
 - Effective To: On or before August 31, 2023
 - Immunizations with administration dates on or before August 31, 2023 were included in the UTD coverage estimates.
- The following update was made to diphtheria, tetanus and pertussis up-to-date coverage assessment among 17-year-olds, which is available in the Technical Annex from the 2018-19 school year report³. The criteria to be considered up-to-date with 5 valid doses was expanded to include a second condition:
 - Five valid doses and only if satisfies one of the following:
 - Received first valid dose at < 7 years old AND received fourth valid dose at ≥ 4 years old.
 - Received first valid dose at < 7 years old AND received fifth valid dose at ≥ 4 years old AND <10 years between fifth valid dose and assessment date [NEW]

Table 1. Rotavirus UTD Logic Assessment for 2019/20 – 2022/23 School Years

Parameter	Definition
Age assessed	7 years old
Up-to-date definition	<p>Must satisfy one of the following criteria:</p> <ul style="list-style-type: none"> • 2 valid doses in accordance with the two-dose schedule • 3 valid doses in accordance with the three-dose schedule
Relevant vaccines	Rota-1, Rota-5, rota-unspecified
Vaccine interactions	Not applicable
Multiple vaccines on the same day	<p>If multiple RV vaccines are recorded as having been received on the same day, use the following hierarchy to keep only one record: Rota-1 > rota-unspecified > Rota-5.</p> <p>The hierarchy is guided by giving preference to the publicly-funded vaccine used in Ontario for infants born between 2012 and 2018 (Rota-1). Similarly, Rota-unspecified was assumed to be Rota-1 given the availability of Rota-1 vaccines between 2012 and 2018. This assumption may need to be revised in future years to accommodate the introduction of RotaTeq (Rota-5) between 2018-2021</p>
Evidence of immunity	Not applicable
Valid dose definitions	<p>Received relevant immunizing agent in accordance with the following criteria:</p> <p><u>2-dose schedule:</u></p> <ul style="list-style-type: none"> • First valid dose — Rota-1, rota-unspecified received at ≥42 days old • Second valid dose — Rota-1, rota-unspecified received ≥28 days after first valid dose <p><u>3-dose schedule (at least one dose must be Rotarix):</u></p> <ul style="list-style-type: none"> • First valid dose — Rota-5, Rota-1, rota-unspecified received at ≥42 days old • Second valid dose — Rota-5, Rota-1, rota-unspecified received ≥28 days after first valid dose • Third valid dose — Rota-5, Rota-1, rota-unspecified received ≥28 days after second valid dose

Parameter	Definition
Additional notes	<ul style="list-style-type: none"> • Beginning August 8, 2011, Ontario introduced a publicly-funded RV vaccine program using Rota-1 vaccine. • Beginning September 1, 2018, Rota-5 replaced the Rota-1 vaccine in Ontario’s RV vaccination program. • Beginning August 1, 2021, Rota-1 replaced Rota-5 vaccine in Ontario’s RV vaccination program. • As per the CIG and Ministry of Health, if any dose in the series was Rota-5, then a total of 3 doses is needed.

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For Further Information

Contact: ivpd@oahpp.ca.

Public Health Ontario

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