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Immunization Data Tool

Technical Notes

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Public Health Ontario

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Routine Immunization Coverage

Introduction

Immunization coverage refers to the proportion of a population that is appropriately immunized against a vaccine preventable disease at a point in time. Achieving and maintaining high immunization coverage is essential for effective prevention and control of vaccine preventable diseases. 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.[1]

In Ontario, publicly-funded routine infant and childhood immunization programs are primarily delivered by community-based primary care providers[2], 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.

The Routine Immunization Coverage section of the Immunization Data Tool allows users to view immunization coverage data for school-based and routine infant and childhood immunization programs by antigen, age, PHU, and school year for school-aged children.

Methods

Data Source

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 and exemption information in the DHIR is largely driven by the *Immunization of School Pupils Act* (ISPA)[3] 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 and exemption documentation, whereas adolescent immunizations administered in school-based immunization programs are entered by the PHUs directly into the DHIR. Immunizations or exemptions not reported to PHUs for entry into the DHIR are not captured in this tool.

Immunization coverage data in the tool reflect immunizations administered as of the end of each school year (August 31). Data for routine coverage assessment are extracted from the DHIR in the fall, following the conclusion of the most recent school year.

Data Processing

Data used to generate all coverage estimates were extracted from the DHIR using the Panorama Enhanced Analytical Reporting (PEAR) tool. Extracted data for students in the 5- to 17-year-old age cohorts for each school year includes:

- demographic information
- immunization records
- immunization exemptions
- education records and school information

Cohorts of students that correspond to coverage assessment milestone ages[1] were identified using the calendar year of birth (i.e., children that reach the milestone age by December 31 of the school year). For example, children who had their seventh birthday between January 1 and December 31, 2024 are represented in the 7-year-old cohort for the 2024–25 school year. This method ensures that all children included in our assessment have at minimum reached the age milestone at the time of assessment.

Students were assigned to PHUs to calculate PHU-specific coverage estimates based on the location of the school each student attended during each school year. The use of school-based PHU assignment, as opposed to assigning students to PHUs based on their residential address, was consistent with the implementation of the ISPA and the delivery of school-based immunization programs. Student assignment to individual schools was accomplished using education records from the DHIR.

As part of assigning students to a PHU, education records with data quality issues or with content indicating that they were used to capture workflow or other business practices were excluded. For example, education records were excluded if:

- there was no school ID,
- the school name included the term ‘holding’,
- the school type was ‘other’,
- the school was not assigned to one of Ontario’s 29 PHUs, or
- the student’s age conflicted with the school record (e.g., school records for a 17-year-old student with a school type field value of ‘elementary school’).

After this data cleaning was applied, a student was included in the assessment if they had evidence of school attendance at any time during each school year, as determined by the education record’s ‘Effective From’ and ‘Effective To’ dates. Next, education records were processed using a set of decision rules to assign each student to one PHU. The decisions were made to try to use the most appropriate school record for PHU assignment when students had multiple education records effective during the school year (and in some cases were effective for the same time period).

Immunization information was extracted to derive coverage estimates for the following antigens:

- ISPA-designated diseases:
    - Diphtheria
    - Measles
    - Meningococcal conjugate C (MCC)
    - Meningococcal conjugate quadrivalent (MCV4)
    - Mumps
    - Pertussis
    - Polio
    - Rubella
    - Tetanus
    - Varicella
- Non-ISPA diseases:
    - *Haemophilus influenzae* type b (Hib)
    - Hepatitis B (Hep B)
    - Human papillomavirus (HPV)
    - Pneumococcal conjugate
    - Rotavirus (added to the immunization coverage assessment in March 2024 and trends were available as of the 2019–20 school year)

An antigen is the active component of a vaccine that produces immunity to a specific disease. Although vaccines contain antigens that confer immunologic protection against one or more diseases, our coverage estimates assess the antigen components of combination vaccines separately to derive antigen-specific coverage. For example, we report on measles coverage rather than coverage for the measles, mumps, rubella (MMR) vaccine. In some instances, when a vaccine contains multiple antigens that confer protection against one disease, we report coverage at the level of the vaccine (e.g., MCV4 and pneumococcal conjugate vaccines).

Data Analysis

COVERAGE ESTIMATION

Definitions of up-to-date (UTD) coverage for each antigen are outlined in the Appendix B. The definitions specify the number of doses, minimum intervals between doses, and other conditions required for students to be assessed as UTD by age. All minimum intervals less than one year in length were calculated using a 28-day month (i.e., one month = 28 days, six months = 168 days). UTD definitions were developed by consulting multiple resources, including vaccine product monographs, the Ontario publicly-funded immunization schedule[2], the *Canadian Immunization Guide*[4], the *Panorama Ontario Immunization Schedules Logic: Reference Document*[5], and immunization subject matter experts from Public Health Ontario (PHO). Immunizations with administration dates before or on August 31 of each school year were included in the calculation of coverage estimates.

UTD coverage was calculated using the following formula:

$$\text{Coverage} = \frac{\text{Numerator}}{\text{Denominator}} \times 100\%$$

Numerator: The number of students from the denominator that have received the age-appropriate number of valid doses of the specified antigen-containing vaccine (i.e., are UTD) or have a recorded exemption based on evidence of immunity, where appropriate.
Denominator: All students in the specified age cohort with an active client record in the DHIR and at least one school record during each school year.

For measles, mumps, rubella, varicella, and hepatitis B, exemption records were examined for documentation of immunity to these diseases, as natural infection confers long-term protection against subsequent infection. Students with an exemption to one of these diseases due to 'Medical - clinical record of disease' or 'Medical - documented immunity' were considered to be UTD, regardless of immunization history, if the exemption had an 'Effective From' date before or on August 31 of each school year.

Immunization information for all live-virus parenteral vaccines, including those not assessed for coverage (e.g., yellow fever and Bacillus Calmette-Guérin (BCG) vaccines), were examined for vaccine interactions with other live-virus vaccines. Doses of parenteral live-virus vaccines administered less than 28 days after the receipt of another live-virus vaccine were considered invalid and not counted towards the dose requirements for UTD coverage. Refer to the antigen-specific sections in the Appendix B for a list of immunizing agents, interactions relevant to vaccines (if applicable), and criteria for valid dose assessment.

In the event that a student had records of multiple doses of a vaccine containing the same antigen administered on the same day, this was assumed to reflect data entry or data migration errors and only one of the doses from that date was used in the analysis. Refer to the antigen-specific sections in the Appendix B for further details on the selection of doses administered on the same day.

Data Caveats

COHORT ASSIGNMENT

To assign each student to a PHU, we developed a series of rules to select one education record extracted from the DHIR per student. Our decision rules were based on knowledge of typical school progression and supported by previous data analysis. However, it is possible that our methods may have excluded current students from the analysis or assigned students to a PHU that was not involved in their immunization delivery or ISPA assessment. We believe that the likelihood that these events have introduced an error into the coverage estimates is small, given that most student assignments were straightforward using our algorithm.

Education records in the DHIR are updated by PHUs using school-/school board-generated student lists at various times throughout the year. Depending on the timing of these updates, new or transferred students may not have been captured in PHU ISPA assessment activities for the school year but may have appeared in our analytic cohort. This could result in underestimating coverage, as students not yet assessed by the ISPA process may have received immunizations, but not reported them to their PHU. Further, students who are not actively attending school may be included in student lists. These students would therefore be captured in our analytic cohort; however, PHUs would not have had the opportunity to deliver immunizations or carry out ISPA assessment activities for them. This scenario would also result in underestimating coverage.

Although eligibility for school-based programs is determined by school grade, age cohorts were used to approximate grades due to data quality issues with the school grade field in the DHIR. For example, the 12-year-old age cohort was used to assess immunization coverage for school-based immunization programs administered in Grade 7, as children in this grade typically turn 12 years old by December 31 of the school year. However, coverage may be underestimated as children who are 12 years old but not yet in Grade 7 will not have had an opportunity to be vaccinated.

DATA QUALITY

As with any information system, some data quality issues are evident in the data extracted from the DHIR. Data quality issues included inaccurate date values, such as school records with an 'Effective To' date prior to the 'Effective From' date or immunization records with an administration date prior to the student's date of birth. We did not exclude students with these data quality issues from the analysis.

There were also system-level issues that posed challenges to our coverage analysis. One issue is the absence of unique vaccine terminology to differentiate Twinrix® and Twinrix® Junior at the agent level (both are hepatitis A and hepatitis B combined vaccines but have different dose schedules). As a result, those two agents can only be differentiated in the presence of a Trade Name, which does not have a high level of completeness and/or accuracy, especially for older migrated data. To address this issue, certain assumptions were made in developing our decision rules for UTD hepatitis B coverage based on schedule received and age (see the Hepatitis B section of the Appendix B for further details). The impact of this limitation on coverage estimates is unclear.

If errors were made by immunization providers, such as by PHUs during data entry or by parents using web-based portals, these may also have impacted coverage estimates. Parents and guardians are asked to provide the date of the immunization event(s), rather than formal documentation from the healthcare provider who administered the vaccine(s). Therefore, incorrect information could be relayed from families to the local PHU. Additional errors could include incorrect vaccines administered or documented, or errors in transcription of administered doses. The impact of these types of errors on coverage estimates is unknown.

DATA COMPLETENESS

It is possible that students may be appropriately immunized or have a valid exemption, but data entry into the DHIR had not yet occurred and is therefore not reflected in the coverage estimates presented in this tool. This could be due to families not submitting the information to their local PHU, or because the PHU had received the information but had not yet entered it into the DHIR. Both scenarios would result in underestimating coverage. The lack of system integration for immunizations and exemptions provided by health care providers, and incorporating that information into the DHIR, poses significant limitations to the timeliness and accuracy of immunization coverage assessments.

Data completeness may also vary by antigen. Data completeness is likely to be higher among ISPA-designated diseases, as documentation of immunization or exemption is actively sought by PHUs for these antigens. Additional PHU practice variations (e.g., frequency of immunization coverage assessment activities, timing of data entry and specific age cohorts assessed) may also impact data completeness.

There are limitations in timely coverage assessment of infants and pre-school children as ISPA applies only to school-age children. Although the *Child Care and Early Years Act, Ontario Regulation 137/15*[6] sets out the requirement for daycare operators to receive proof of immunizations or exemptions for children who are enrolled in their childcare program as defined in the Act, not all young children in Ontario attend childcare facilities. Therefore, children may not be regularly assessed for coverage until they are enrolled in an Ontario school and fall under the authority of the ISPA. Pre-school aged children (including infants and toddlers) are an important group to monitor because most vaccine preventable diseases have a higher risk of complications in younger age groups, especially infants, who are particularly vulnerable. Furthermore, two years of age is a nationally and internationally defined benchmark to monitor progress towards meeting immunization coverage goals.[1]

Evidence of immunity exemptions for non-ISPA diseases are also recorded in the DHIR. For example, students with evidence of immunity for hepatitis B were considered UTD in our coverage calculations. However, because hepatitis B is not an ISPA-designated disease, the number of immunity exemptions for this antigen may be under-reported.

The COVID-19 pandemic caused significant disruptions to routine immunizations across Canada, and data entry into the DHIR during this time likely varied by region. Primary care providers limited in-person visits (shifting to virtual care), public health measures led to deferral of non-essential medical appointments, and concerns about virus transmission reduced healthcare-seeking behavior, including for vaccinations. School closures and the redeployment of public health staff also paused ISPA assessment and catch-up activities. As a result, several regions reported declines in vaccine uptake, prompting guidance from

National Advisory Committee on Immunization (NACI) and the Ontario Ministry of Health (MOH) to prioritize routine immunizations and support continued immunization services during the pandemic. While Ontario schools reopened during the 2021–22 school year, most PHUs did not resume ISPA activities until the 2022–23 school year. Therefore, coverage estimates for the 2019–20 to 2022–23 school years should be interpreted with caution.

Finally, private schools, religious schools, and homeschool settings often do not participate in ISPA, and therefore their immunization data is not captured in the DHIR. As a result, children and adolescents in these educational settings are missing from both the numerator and denominator of coverage estimates. Coverage may therefore be overestimated in PHUs with higher proportions of students in these educational settings.

DATA MIGRATION

As the immunization module of the Panorama system has only been fully implemented in Ontario since 2016, many immunization records stored in the system are historical data migrated to the DHIR from the Immunization Records Information System (IRIS). Panorama data standards and best practices recommendations, including drop-down values and field logic, were not applicable to data originally entered; therefore, several data fields for these migrated data do not adhere to the expected values and data quality standards of Panorama. For example, while the Trade Name field is auto-populated for immunization records entered directly into Panorama upon selection of a Lot Number, Trade Name is free-text and Lot Number is not a required field for historical records.[5] This reduces the completeness and usefulness of the Trade Name field for analytic purposes. The impact of this limitation will diminish over time, as all new data will be entered directly into Panorama in accordance with data standards and best practice recommendations.

Vaccine Safety

Introduction

The Vaccine Safety section of the Immunization Data Tool allows users to explore and download Ontario's vaccine safety surveillance data, which comprised reports of adverse events following immunization (AEFI). Individual case reports of AEFIs represent an important source of vaccine safety data because they have the potential to identify previously unrecognized or rare AEFIs, identify vaccine safety signals, and detect an increase in frequency or severity of known AEFIs, which can then be further evaluated.[7]

An AEFI (adverse event following immunization) is defined as any unwanted or unexpected health event that happens after someone received a vaccine, which may or may not be caused by the vaccine. The adverse event may be any unfavourable or unintended sign, laboratory finding, symptom or disease.[8]

Vaccine Safety System and Public Health Surveillance of AEFIs

In Canada, vaccines are thoroughly reviewed for efficacy and safety prior to being approved for use. Following approval of a new vaccine, vaccines are highly regulated to ensure safety.[9] Post-marketing surveillance is initiated to ensure there is ongoing monitoring of vaccine safety in the population receiving the vaccine.[8] Vaccine manufacturers are also required to adhere to internationally accepted standards of manufacturing to ensure vaccine quality and consistency. In addition, all lots of vaccine are subject to Health Canada's lot release program, which specifies standards for the production of each lot that must be met before sale in Canada.[8] The National Advisory Committee on Immunization (NACI) independently reviews the available evidence on safety and efficacy of vaccines to make recommendations for the use of currently or newly approved vaccines in Canada.[10]

Post-marketing vaccine safety surveillance is a shared responsibility between Health Canada, vaccine manufacturers, the Public Health Agency of Canada (PHAC), provinces and territories, as well as local public health authorities.[11] PHAC and Health Canada coordinate post-marketing surveillance nationally, while provinces and territories coordinate public health surveillance of AEFIs occurring within their jurisdiction in collaboration with local partners. AEFIs received by the provincial and territorial public health authorities are reported to the Canadian Adverse Event Following Immunization Surveillance System (CAEFISS), a national database maintained by PHAC for monitoring vaccine safety across Canada. AEFI reports received by vaccine manufacturers may also be voluntarily reported to CAEFISS. However, any reports of serious adverse reactions received directly by the manufacturers are also required by law to be reported to Health Canada.

In Ontario, provincial vaccine safety surveillance relies on reporting of AEFIs by health care providers, vaccine recipients, or their caregivers to their local public health unit (PHU). The Ministry of Health is responsible for public health legislation and standards, which enable the reporting and collection of information required for provincial surveillance. The Health Protection and Promotion Act (HPPA), s. 38.3 mandates all health care providers who administer immunizations to report AEFIs for all vaccines authorized for use in Canada.[12] PHUs are required to enter AEFI reports into the integrated Public Health Information System (iPHIS), the provincial electronic reporting system for diseases of public health significance and AEFIs, within five business days of receipt of initial notification to a PHU.[13,14] Once PHUs receive initial reports of AEFIs, reports are investigated, assessed, and documented according to provincial surveillance guidelines.[15] The Public Health Case and Contact Management Solution (CCM) was also used as the electronic reporting system for AEFIs between January 2021 and May 2024, and iPHIS returned as the sole reporting system for AEFIs in June 2024.

Public Health Ontario (PHO) conducts provincial surveillance of AEFIs using the AEFI data reported in the provincial electronic reporting system. The provincial AEFI data are routinely transmitted to PHAC for inclusion in CAEFISS. Through routine data extraction and analysis, PHO monitors for potential signals and investigates vaccine safety issues that may warrant further assessment or action. Robust public health surveillance of AEFIs in Ontario will help mitigate any potential impact on the health of individuals, maintain public confidence in vaccine programs, and provide important data to support provincial immunization program planning and evaluation. PHO also provides advice and support for local PHUs in the investigation and management of AEFI reports. For more detailed information on vaccine safety surveillance in Ontario, including previous annual reports (in PDF format), please see PHO's Vaccine Safety web page.

Methods

Data Sources

- **AEFI data:** AEFI data were extracted from iPHIS on June 2, 2025 and from CCM on June 28, 2024.
- **Ontario population data:** Population estimates are sourced from Statistics Canada for years 2015–2024 on February 21, 2025.[16]
- **Doses distributed data (routine publicly-funded vaccines only):** Number of doses distributed are estimated using vaccine distribution data extracted on May 12, 2025 from the Digital Health Immunization Repository, which is the provincial information system for vaccine supply management. The number of net doses distributed are calculated by subtracting the number of wasted and reusable vaccines returned to the Ontario Government Pharmaceutical and Medical Supply Services (OGPMSS) from the gross number of vaccines distributed in a given year.
- **Doses administered data (COVID-19 vaccines only)**: Number of COVID-19 vaccine doses administered up to December 31, 2024 were extracted from the Ontario Ministry of Health's COVaxON application on January 21, 2025. Doses administered from non-Ontario stock (e.g., doses from federal stock for populations such as the Armed Forces) are excluded.

Data Processing

The unit of analysis is an individual AEFI report. An AEFI report refers to a report received by the PHU, which pertains to one individual vaccine recipient who experienced one or more adverse events that occurred after administration of one or more vaccines and cannot be clearly attributed to other causes.

Only AEFI reports that meet the following criteria were included in the analysis:

- AEFI reports with a case classification of "confirmed" (i.e., meets the provincial AEFI surveillance definition).
- AEFI reports with a disposition other than "does not meet definition," "entered in error" or "closed- duplicate – do not use".
- AEFI reports associated with at least one Health Canada-approved active immunizing agent administered between January 1, 2015 and December 31, 2024. AEFI reports that are only associated with diagnostic agents (e.g., tuberculin skin test) and/or passive immunizing agents (e.g., immune globulin) with no active immunizing agents administered at the same time are not within the scope of provincial AEFI surveillance.
- AEFI reports with at least one adverse event.
- AEFI reports in those who were residents of Ontario at the time of adverse event.

This tool describes adverse events that were temporally associated with vaccination. Based on the provincial AEFI surveillance definitions in Appendix 1 of the Ontario Infectious Diseases Protocol, a causal relationship between the administration of the vaccine and the adverse event does not need to be established in order for an AEFI to be reported as a confirmed case for surveillance purposes.[15]

SERIOUS AEFIS

The World Health Organization (WHO) standard definition of a serious AEFI is "an AEFI that results in death, is life-threatening, requires in-patient hospitalization or prolongs an existing hospitalization, results in persistent or significant disability/incapacity, or in a congenital anomaly/birth defect".[17] Due to the surveillance data limitations, serious AEFIs are operationally defined in Ontario as those who have been admitted to a hospital as an in-patient for at least one day or have reported a fatal outcome. Persistent or significant disability/incapacity and congenital anomaly/birth defect are not systematically captured in the provincial data due to the relatively brief investigation period of AEFIs reported in Ontario.

Data Analysis

CALCULATION OF AEFI REPORTING RATES

DOSES ADMINISTERED RATES

For AEFIs associated with COVID-19 vaccines, number of doses administered were used to calculate true reporting rates (i.e., AEFI incidence rates per 100,000 doses administered) for specific demographic groups (e.g., age groups, sex) and geographic regions. Reporting rates are calculated using the number of COVID-19 AEFIs reported within a demographic/geographic group in a given year divided by the number of COVID-19 vaccine doses administered within the same group in the specified year. Reporting rates are expressed as the number of AEFI reports for every 100,000 vaccine doses administered. Reporting rates for AEFIs associated with COVID-19 vaccines using doses administered are presented in the Trends, Age and Sex, Geography and Vaccines section of the tool.

DOSES DISTRIBUTED RATES

For other publicly-funded vaccines, AEFI reporting rates are calculated using doses distributed. This is based on the number of vaccine-specific AEFI reports by year within a geographic region (e.g., all of Ontario or within a PHU) divided by the annual net number of vaccine doses distributed within the specified geographic region. Reporting rates are expressed as the number of AEFI reports for every 100,000 vaccine doses distributed. Doses distributed is used as a proxy for doses administered and enables a more accurate comparison of AEFI reporting rates across geographic areas than population-based rates by taking into account the differences in vaccine distribution. In the tool, dose-based AEFI reporting rates are presented in the Geography section for the influenza vaccine and in the Vaccines section.

POPULATION BASED RATES

Since dose distribution data are not available within specific demographic groups (e.g., age groups, sex) and for vaccines that are not publicly-funded (including high risk publicly-funded vaccines), population-based rates are used for calculating reporting rates within specific demographic/geographic groups overall. Population-based reporting rates are calculated using the number of AEFI reports by year of vaccine administration within a specific demographic group divided by the annual population of the same demographic group. Reporting rates are expressed as the number of AEFI reports for every 100,000 population. In the tool, population-based AEFI reporting rates are presented in the Trends, Age and Sex, and Geography sections.

See the section on Data Caveats for more information on denominators used to calculate reporting rates.

TRENDS

Each AEFI report refers to an individual who received one or more vaccines that are temporally associated with the reported adverse event. AEFIs associated with a COVID-19 vaccine co-administered with a non-COVID-19 vaccine (e.g., influenza vaccine) will be counted under both the ‘Non-COVID-19 vaccine’ and ‘COVID-19 vaccine’ vaccine types. Thus, the sum of ‘COVID-19 vaccine’ and ‘Non-COVID-19 vaccine’ AEFIs will not equal the number of AEFIs reported for ‘All vaccines’.

AGE AND SEX

Age is calculated as age at date of vaccine administration. Those with ages greater than 119 years or missing date of birth were considered to have unknown age. AEFI reports with unknown age are excluded from age-specific analysis but are included in the ‘all ages’ category.

Gender is completed in iPHIS by PHUs based on the reported gender of the client. For analysis purposes, gender is used as a proxy for biological sex for iPHIS data. For CCM data, sex and gender are captured separately; when sex was unknown or missing, gender was used as a proxy if available. AEFI reports with unknown or unspecified/other gender (including gender other than male or female) are excluded from sex-specific analysis but are included in the ‘all sexes’ category.

GEOGRAPHY

In the map, reporting rates are grouped into four categories using quartiles (i.e., 0–24th, 25–49th, 50–74th and 75th and higher percentiles) specific to each year and vaccine category. Reporting rates are calculated per 100,000 population, per 100,000 doses distributed (influenza vaccine only), and per 100,000 doses administered (COVID-19 vaccines only).

- **All vaccines**: includes AEFIs reported following any vaccine administered each year. The population includes people of all ages.
- **COVID-19 vaccine**: includes AEFIs reported following COVID-19 vaccines. The reporting rate is calculated using both population (all ages) and doses administered.
- **Early childhood vaccines**: includes AEFIs reported following routine vaccines that are predominantly administered by primary health care providers to infants and young children. These vaccines include DTaP-IPV-Hib, Pneu-C-13/Pneu-C-15 (Pneu-C-15 replaced Pneu-C-13 in July 2024), MMR, Men-C-C, Var, and Rot-1/Rot-5 (Rot-5 replaced Rot-1 in 2018 and then Rot-1 replaced Rot-5 in mid-2021). The population only includes children under four years of age.
- **Influenza vaccines**: includes AEFIs reported following influenza vaccine. The reporting rate is calculated using both population (all ages) and doses distributed.
- **School-based vaccines**: includes AEFIs reported following vaccines that are routinely administered by PHUs to adolescents in school-based settings. These vaccines include Men-C-ACWY, HB, and HPV4/HPV-9 (HPV9 replaced HPV4 in 2017). The population only includes adolescents between 11 and 17 years of age.

VACCINES

The term “vaccine” refers to a generic active immunizing agent and may include one or more vaccine products (e.g., “influenza vaccine” refers to all influenza vaccine products). Additional information on vaccines presented in this tool can be found on Public Health Agency of Canada’s list of approved vaccines in Canada and the National Vaccine Catalogue. The Canadian Immunization Guide is also a comprehensive resource on immunization and the diseases prevented by vaccines. Since an AEFI report may include one or more vaccines that are temporally associated with the reported adverse event, the total number of vaccine-specific AEFI reports can exceed the number of individual AEFI reports reported in a given year. Vaccines are grouped into categories based on the recommended age to receive the vaccine according to the Publicly Funded Immunization Schedules for Ontario.[2]

- Infant and childhood vaccines: those that are routinely administered to children 10 years of age and younger
- Adolescent vaccines: those that are routinely administered to adolescents between 11 and 17 years of age in all settings
- Adult vaccines: those that are routinely administered to adults 18 years of age and older
- Universal vaccine programs: vaccines that are offered to everybody in the province who are eligible and typically include most age groups.

Vaccine-specific reporting rates are calculated using doses distributed for publicly-funded vaccines and using doses administered for COVID-19 vaccines. For high-risk publicly funded, travel, and non-publicly funded vaccines, reporting rates are not calculated due to unknown vaccine distribution within the private market. Reporting rates are also not presented where the net doses distributed is zero or smaller (i.e., wastage is greater than doses distributed).

ADVERSE EVENTS

Adverse events are presented both individually and within event categories, based on the provincial surveillance definitions and categories.[15] As an AEFI report may contain multiple adverse events, the total number of adverse events can exceed the number of individual AEFI reports reported in a given year. In addition, if an AEFI report contains more than one adverse event within the same event category, they are counted only once in the category total. Therefore, the total number of adverse events within a category may not equal to the category total. Percent of all AEFI reports is calculated by dividing the number of event or category- specific AEFI reports by the total number of individual AEFI reports reported in a given year.

Several adverse events of special interest (AESIs) have been identified by international health authorities based on a theoretical rationale for possible association with COVID-19 vaccines during the pandemic. During the COVID-19 pandemic, a number of the identified AESIs were integrated into the provincial vaccine surveillance system, which are represented as 'COVID-19 adverse events of special interest' in the tool.

Data Caveats

Changes to AEFI surveillance in the province (e.g., revised case definitions, updates to the iPHIS application) may impact comparability of AEFI surveillance data over time. Trends in reported AEFIs can be influenced by changes to the publicly-funded program such as changes in vaccine products or the introduction of a new vaccine program. The COVID-19 pandemic significantly reduced the number of AEFI reports that are associated with non-COVID-19 vaccines during 2020–2022 due to the impacts on public health surveillance arising from deferred routine immunization services, diminished health care seeking behaviours as a result of COVID-19 public health measures, decreased reporting from HCPs, as well as diversion of public health resources to the pandemic response. All these factors had an impact on reporting, investigation, and data entry for AEFIs. Therefore, the number of non-COVID-19 AEFI reports reported during 2020–2022 should be interpreted with caution.

It is also important to note the changes in the provincial reporting system for AEFIs that occurred during the surveillance period with the temporary use of CCM between then years 2021 and 2024. Changes in reporting system may impact comparability of AEFI surveillance data and analyses of trends over time.

AEFI surveillance data presented in the tool have general data limitations that are similar to other passive AEFI surveillance systems. These include inconsistent data quality, inconsistent completeness of AEFI reports, and reporting bias. Reporting bias includes under-reporting, particularly for mild or common reportable events, and stimulated (elevated) reporting, which can occur in response to media coverage and subsequently increased public awareness. Additionally, the provincial AEFI surveillance system does not include an unimmunized group for comparison. Therefore determining whether immunization is associated with an increased risk of a specific adverse event at a population level is not possible based on data presented in the tool.

A further limitation of the analysis of AEFI surveillance data in Ontario is the lack of a population-based provincial immunization registry for non-COVID-19 vaccines to estimate the number of individuals who were immunized or doses administered to individuals. This would enable estimation of AEFI incidence rates, including specific events, by vaccine type. In lieu of this, AEFI reporting rates are estimated using either the entire population irrespective of immunization status or vaccine doses distributed as the denominator. In this analysis, population-based denominators are used for overall system reporting rates (all vaccines combined) and for overall demographic analysis. This approach enables comparison of overall AEFI reporting trends over time and across geographic areas; however, population-based reporting rates have limitations as a proxy for true AEFI incidence where there are variations in vaccine uptake (i.e., coverage) over time or between geographic areas. Doses distributed are widely used in analyses of passive AEFI surveillance systems and can be a reasonable proxy for doses administered for established programs with known vaccine wastage.[18,19] When the amount of wastage is unknown and underestimated, this can result in underestimates of reporting rates. Additionally, in the context of new or discontinued vaccines/programs, the AEFI reporting rate using doses distributed as the denominator can be temporarily rendered invalid due to fluctuations in vaccine distribution caused by stockpiling, delayed vaccine use or large returns of unused/expired doses. For COVID-19 vaccines, having the true number of doses administered provided an accurate denominator for estimating rates of AEFIs. These data were essential for population-based assessments of vaccine safety, especially during the initial roll-out of a new COVID-19 vaccination program during the pandemic, and allowed for timely detection of rare vaccine safety signals.

COVID-19 Immunization

Introduction

Ontario's COVID-19 immunization program began on December 14, 2020. Currently, all individuals in the province aged 6 months and older are eligible to receive a Health Canada (HC)-authorized COVID-19 vaccine.[20] All vaccine providers (e.g., nurses, pharmacists) are required to record each administered dose in the Ontario Ministry of Health's (MOH) COVaxON application.

Each fall, the MOH typically recommends that individuals receive one or two doses of updated formulation for the respiratory season, depending on prior immunization history. In spring, specific high-risk populations are typically also eligible to receive an additional dose of updated formulation. For the 2024–25 immunization program, the updated formulation available in Ontario was KP.2 and high-risk populations eligible for an additional spring dose included:

- Adults aged 64 years and older
- Adult residents of long-term care homes and other congregate living settings for seniors
- Individuals aged 6 months and older who are moderately to severely immunocompromised
- Individuals aged 55 years and older who identify as First Nations, Inuit or Metis, as well as their non-Indigenous household members aged 55 years and older

The COVID-19 Immunization section of the Immunization Data Tool allows users to view COVID-19 immunization coverage by age, sex, PHU, and last dose status. Users can also view doses administered by vaccine product, PHU, and week administered.

Methods

Data Sources

- **COVID-19 immunization data:** COVID-19 immunizations were assessed using data extracted from the MOH's COVaxON application. The tool reflects data extracted from COVaxON as of July 2, 2025 and describes vaccinations reported up to June 30, 2025.
- **Ontario population data:** Population projections for 2025 were sourced from Ontario Ministry of Finance on June 10, 2024.[21]

Data Processing

INCLUSION AND EXCLUSION CRITERIA

Data includes all Ontario clients with dose administration records in COVaxON, and also captures a small number of client records with a residential postal code outside of Ontario who may be eligible for vaccination on the basis of working in a high-risk setting (e.g., long-term care home) in the province.

Non-valid dose records were excluded. Non-valid records include doses where the status was reported as 'entered in error', 'invalid', or other similar variations, as well as doses where the status was valid (e.g., 'administered') but were identified as non-valid client records (e.g., client first and last name were reported as 'test', 'do not use', 'error', 'ignore', or other similar variations).

Duplicate dose administration records (i.e., clients with multiple dose administration records with the same date) were identified and excluded using personal identifiers such as health card number, name, date of birth, and postal code, where available, as well as dose administration date.

DATES

For missing dose administration dates and dose administration dates prior to December 14, 2020, the date the administration record was created was used as a proxy.

DOSE ASSIGNMENT AND INTERVALS

Dose number was assigned based on the dose administration date reported. Dose administration date was also used to determine the dose interval.

- For clients with multiple doses reported with different administration dates, the first chronological dose was considered the first dose.
- To determine a date for the second dose, the first subsequent dose administered on or after the product-specific recommended minimum interval of the first dose product, with a 4-day grace period, was used. Doses administered prior to the product-specific recommended minimum interval, with a 4-day grace period, were not considered valid. For example, if there were two subsequent doses that were 7 days and 21 days from a Moderna Spikevax COVID-19 vaccine first dose, respectively, then the dose that was 21 days from the first dose was used as the second dose. Similarly, if there were two subsequent doses that were 10 days and 12 days from the first dose, respectively, then neither dose was used and the individual was not assigned a second dose. The recommended product-specific minimum intervals, with a 4-day grace period, as outlined by the National Advisory Committee on Immunization (NACI) were as follows:
    - Pfizer-BioNTech Comirnaty and Pfizer-BioNTech Comirnaty Bivalent BA.4/5: 15 days (19 days with a 4-day grace period).
    - Pfizer-BioNTech Comirnaty XBB.1.5, Moderna Spikevax, Moderna Spikevax Bivalent BA.4/5, Moderna Spikevax Bivalent BA.1, Novavax Nuvaxovid, Janssen Jcovden, and unspecified/missing/other products: 17 days (21 days with a 4-day grace period).
    - Pfizer-BioNTech Comirnaty KP.2, Moderna Spikevax XBB.1.5, Moderna Spikevax KP.2, Novavax Nuvaxovid JN.1, and AstraZeneca Vaxzevria/COVISHIELD: 24 days (28 days with a 4-day grace period).
- To determine a date for the third dose, the first subsequent dose administered 21 days or more after the second dose was used, regardless of the HC-authorized vaccine product administered for the second dose (i.e., the dose interval was not product-specific). If multiple valid doses after the second dose were reported, then the first chronological dose after the second dose was used.
- To determine dates for the fourth to eleventh doses, the first subsequent dose administered 56 days or more after the previous dose was used, regardless of the HC-authorized vaccine product administered for the previous dose (i.e., the dose interval is not product-specific). If multiple valid doses after the previous dose were reported, then the first chronological dose after the previous dose was used. A maximum of eleven doses was assigned per individual.

DEMOGRAPHICS

Clients reporting a gender of 'Non-binary/third gender' or 'Other' were combined into an 'Other' category. 'Unknown' gender includes clients where gender was reported as 'Prefer not to say', 'Unknown', or where gender was missing. For analysis purposes, gender was used as a proxy for biological sex.

Age at the time of data extraction was calculated using the client date of birth and the date of data extraction. Individuals whose age was reported as below the minimum authorized age for their COVID-19 vaccine product, greater than 119 years, or missing date of birth were considered to have unknown age.

Data Analysis

COVERAGE (LAST DOSE STATUS)

Last dose status for the 2024–25 respiratory season was categorized according to the following mutually exclusive groups:

- Last COVID-19 vaccine was received prior to the 2024–25 immunization program
- Last COVID-19 vaccine was a KP.2 dose during the 2024-25 Fall/Winter program
- Last COVID-19 vaccine was a KP.2 dose during the 2025 Spring program

Coverage was calculated using the following formula:

$$\text{Coverage} = \frac{\text{Numerator}}{\text{Denominator}} \times 100\%$$

Numerator: Number of clients from the specified age group with dose administration records in COVaxON, categorized by last dose status.
Denominator: Ontario population count for the specified age group.

Age at the time of data extraction was used when describing coverage estimates by age group.

Coverage inclusion and exclusion criteria:

- Clients with 'Unknown'/'Other' age or sex were excluded from age-/sex-specific analyses, but were included in overall coverage estimates.
- Clients who received doses out of province or from non-Ontario stock (e.g., doses from federal stock for populations such as the Armed Forces) were included in coverage estimates.
- Clients reported as deceased or moved out of province were excluded from coverage estimates.

Coverage estimates have been suppressed in certain stratified groups (e.g., PHU-specific younger age groups) where the numerator was five or fewer.

DOSES ADMINISTERED

Doses administration counts were calculated by summing the total number of doses in the data by administration date and vaccine product.

Doses administered inclusion and exclusion criteria:

- Dose records where the product was reported as 'Other'/'Unknown'/'Missing' were excluded from product-specific analyses.
- Doses received by clients later reported as deceased or moved out of province were included in dose administration counts.
- Doses administered out of province or from non-Ontario stock were excluded from dose administration counts.

Data Caveats

Data presented may differ from other sources for various reasons, including differing extract times and methodologies for processing COVaxON data. COVaxON is a dynamic reporting system, which allows ongoing updates to data previously entered. As a result, data extracted from COVaxON represents a snapshot at the time of extraction and may differ from previous or subsequent extractions. All counts may be subject to varying degrees of underreporting due to a variety of factors.

Children 0–6 months of age are included in the population denominator used to calculate coverage estimates for the under 5 years of age group. However, children 0–6 months of age are not eligible for COVID-19 immunizations, and therefore are not included in the numerator.

Counts reported for coverage will not align with counts reported for doses administered for the following reasons:

- Each client in the dataset may have received up to eleven doses.
- Dose administration counts exclude doses given out of province or from non-Ontario stock. However, clients who received such doses are still included in coverage estimates.
- Coverage estimates (based on the number of immunized clients) exclude clients reported as deceased or moved out of province. However, dose administration counts include doses given to these clients prior to their status change.

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Appendix A: Immunizing Agent Abbreviations and Descriptions

aP: Acellular pertussis

ap: Acellula pertussis (reduced)

ap-unspecified: Reduced acellular pertussis-containing agent (agent formulation unknown)

BCG vaccine: Bacillus Calmette-Guérin

D: Diphtheria toxoid

d: Diphtheria toxoid (reduced)

D-Hib: Diphtheria toxoid, *Haemophilus influenzae* type b

DPT: Diphtheria toxoid, tetanus toxoids, whole-cell pertussis

DPT-HB: Diphtheria toxoid, tetanus toxoid, whole-cell pertussis, hepatitis B

DPT-HB-Hib: Diphtheria toxoid, tetanus toxoid, whole-cell pertussis, hepatitis B, *Haemophilus influenzae* type b

DPT-Hib

DPT-IPV: Diphtheria toxoid, tetanus toxoid, whole-cell pertussis, inactivated poliomyelitis

DPTP: Diphtheria toxoid, tetanus toxoid, whole-cell pertussis, poliomyelitis

DPTP-Hib: Diphtheria toxoid, tetanus toxoid, whole-cell pertussis, poliomyelitis, Haemophilus influenzae type b

DT: Diphtheria, tetanus

DTaP: Diphtheria, tetanus, acellular pertussis

DTaP-HB-IPV: Diphtheria toxoid, tetanus toxoid, acellular pertussis, hepatitis B, inactivated poliomyelitis

DTaP-HB-IPV-Hib: Diphtheria toxoid, tetanus toxoid, acellular pertussis, hepatitis B, inactivated poliomyelitis, *Haemophilus influenzae* type b

DTaP-Hib: Diphtheria toxoid, tetanus toxoid, acellular pertussis, *Haemophilus influenzae* type b

DTaP-IPV: Diphtheria toxoid, tetanus toxoid, acellular pertussis, inactivated poliomyelitis

DTaP-IPV-Hib: Diphtheria toxoid, tetanus toxoid, acellular pertussis, inactivated poliomyelitis, *Haemophilus influenzae* type b

DT-IPV: Diphtheria toxoid, tetanus toxoid, inactivated poliomyelitis

DTwP-HB: Diphtheria toxoid, tetanus toxoid, whole-cell pertussis, hepatitis B

d-unspecified: Diphtheria toxoid-containing agent (agent formulation unknown)

HAHB: Hepatitis A, hepatitis B

HAHB-pediatric: Hepatitis A, hepatitis B (pediatric formation)

HAHB-unspecified: Hepatitis A, hepatitis B (agent formulation unknown)

HB: Hepatitis B

HB-dialysis: Hepatitis B (dialysis formulation)

HB-pediatric: Hepatitis B (pediatric formulation)

HB-unspecified: Hepatitis B-containing agent (agent formulation unknown)

Hib: *Haemophilus influenzae* type b

Hib-HB: *Haemophilus influenzae* type b, hepatitis B

HPV: Human papillomavirus

HPV-2: Bivalent human papillomavirus [types 16, 18]

HPV-4: Quadrivalent human papillomavirus [types 6, 11, 16, 18]

HPV-9: Nonavalent human papillomavirus [types 6, 11, 16, 18, 31, 33, 45, 52, 58]

hpv-unspecified: Human papillomavirus-containing agent (agent formulation unknown)

IPV: Inactivated poliomyelitis

M: Measles

MCC: Meningococcal-C-conjugate

MCV4: Quadrivalent meningococcal conjugate

men-AC-unspecified: Meningococcal groups A, C-containing agent (agent formulation unknown)

Men-ACYW-135 unspecified: Quadrivalent meningococcal-agent (agent formulation unknown)

Men-C-AC: Meningococcal conjugate bivalent (groups A, C)

Men-C-ACYW-135: Meningococcal conjugate, quadrivalent (groups A, C, Y, W-135)

Men-C-C: Meningococcal conjugate, monovalent (group C)

Men-C-CY: Meningococcal conjugate (groups C, Y)

Men-C-CY-Hib: Meningococcal conjugate (groups C, Y), *Haemophilus influenzae* type b

men-c-unspecified: Meningococcal conjugate agent (agent formulation unknown)

men-p-AC unspecified: Meningococcal polysaccharide, bivalent (groups A, C)

men-p-unspecified: Meningococcal polysaccharide agent (agent formulation unknown)

Men-P-ACYW-135: Meningococcal polysaccharide, quadrivalent (groups A, C, Y, W-135)

men-p-A unspecified: Meningococcal polysaccharide group A-containing agent (agent formulation unknown)

men-unspecified: Meningococcal agent (agent formulation unknown)

MMR: Measles, mumps, rubella

MMR-Var: Measles, mumps, rubella, varicella

MR: Measles, rubella

Mu: Mumps

OPV: Live attenuated oral poliomyelitis

p: Polio

pertussis-unspecified: Pertussis-containing agent (agent formulation unknown)

Pneu-C-10: Pneumococcal conjugate, 10-valent

Pneu-C-13: Pneumococcal conjugate, 13-valent

Pneu-C-15: Pneumococcal conjugate, 15-valent

Pneu-C-20: Pneumococcal conjugate, 20-valent**Pneu-C-7:** Pneumococcal conjugate, 7-valent

pneu-c-unspecified: Pneumococcal conjugate agent (agent formulation unknown)

Pneu-P-23: Pneumococcal polysaccharide, 23-valent

pneu-p-unspecified: Pneumococcal polysaccharide agent (agent formulation unknown)

pneu-unspecified: Pneumococcal agent (agent formulation unknown)

p-unspecified: Poliomyelitis-containing agent (agent formulation unknown)

R: Rubella

Rota-1: Rotavirus monovalent

Rota-5: Rotavirus pentavalent

rota-unspecified: Rotavirus-containing agent (agent formulation unknown)

Sma: Smallpox

T: Tetanus

Td: Tetanus toxoid, reduced diphtheria toxoid

Tdap: Tetanus toxoid, reduced diphtheria toxoid, reduced acellular pertussis

Tdap-IPV: Tetanus toxoid, reduced diphtheria toxoid, reduced acellular pertussis, inactivated poliomyelitis

Td-IPV: Tetanus toxoid, reduced diphtheria toxoid, inactivated poliomyelitis

T-IPV: Tetanus toxoid, inactivated poliomyelitis

Var: Varicella

wP: Whole-cell pertussis

YF: Yellow Fever

Zos: Herpes zoster

Zos-Live: Live attenuated herpes zoster

Zos-unspecified: Herpes zoster (agent formulation unknown)

Appendix B: Definitions of Up-to-Date Coverage by Disease Antigen

Diphtheria

Age assessed: 7 and 17 years old

Up-to-date definition:

7-year-olds must satisfy one of the following criteria:

- ≥5 valid doses
- Four valid doses (only if received first valid dose at <7 years old AND received fourth valid dose at ≥4 years old)

17-year-olds must satisfy one of the following criteria:

- ≥6 valid doses
- 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
- Four valid doses and only if satisfies one of the following:
    - Received first valid dose at <7 years old AND <10 years between fourth valid dose and assessment date
    - Received first valid dose at ≥7 years old (i.e., two primary and two booster doses)
- Three valid doses (only if received first valid dose ≥7 years old AND <10 years between third valid dose and assessment date)
    - Note: PHO considers receipt of two primary doses and one booster dose for individuals who start their series late (i.e., ≥7 years old) as the minimum requirement to be considered up-to-date, as long as less than 10 years have elapsed between the last (booster) dose and the date of assessment

Relevant immunizing agents:

- D
- d
- D-Hib
- DPT
- DPT-HB
- DPT-HB-Hib
- DPT-Hib
- DPT-IPV
- DPTP
- DPTP-Hib
- DT
- DTaP
- DTaP-HB-IPV
- DTaP-HB-IPV-Hib
- DTaP-Hib
- DTaP-IPV
- DTaP-IPV-Hib
- DT-IPV
- DTwP-HB
- d-unspecified
- Td
- Tdap
- Tdap-IPV
- Td-IPV

See the Appendix A for immunizing agent abbreviations and descriptions.

Vaccine interactions: None

Multiple vaccines on the same day: Keep any one

Evidence of immunity: Not applicable

Valid dose definitions: Relevant immunizing agents must be received in accordance with the following criteria to be considered a valid dose:

- First valid dose — Received at ≥42 days old
- Second valid dose — Received ≥28 days after first valid dose
- Third valid dose — One of the following:
    - Received first valid dose at <7 years old AND received ≥28 days after second valid dose
    - Received first valid dose at ≥7 years old AND received ≥168 days after second valid dose
- Fourth valid dose — One of the following:
    - Received first valid dose at <7 years old AND received ≥168 days after third valid dose AND ≥1 year old
    - Received first valid dose at ≥7 years old AND one of the following:
        - Received ≥10 years after third valid dose
        - Received ≥28 days after third valid dose AND ≥14 years old

- Fifth valid dose — One of the following:
    - Received first valid dose at <7 years old AND one of the following:
        - Received fourth valid dose at 1 to <4 years old AND received ≥28 days after fourth valid dose AND ≥4 years old
        - Received fourth valid dose at ≥4 years old AND received ≥10 years after fourth valid dose
        - Received fourth valid dose at ≥4 years old AND received ≥28 days after fourth valid dose AND ≥14 years old
    - Received first valid dose at ≥7 years old AND received ≥10 years after fourth valid dose
- Sixth valid dose — One of the following:
    - Received first valid dose at <7 years old AND received fourth valid dose at 1 to <4 years old AND one of the following:
        - Received ≥10 years after fifth valid dose
        - Received ≥28 days after fifth valid dose AND ≥14 years old
    - Received first valid dose at <7 years old AND received fourth valid dose at ≥4 years old AND received ≥10 years after fifth valid dose
    - Received first valid dose at ≥7 years old AND received ≥10 years after fifth valid dose

Additional notes:

- All immunizing agents containing the respective antigens were considered valid (i.e., D or d) as long as they met the minimum age and minimum interval requirements
- Although an accelerated schedule is not specified in the *Canadian Immunization Guide* chapter on diphtheria for children who initiate the series when ≥7 years old[4], the minimum intervals outlined between doses of the primary series for infants were also applied to older children
- For the last (booster) dose, we used a 10-year interval instead of a five-year interval (as is used in the Panorama forecaster logic), in accordance with the *Canadian Immunization Guide*[4]
- See the Appendix C for changes to the publicly-funded diphtheria immunization program over time

Haemophilus influenza Type B (Hib)

Age assessed: 7 years old

Up-to-date definition: Must satisfy one of the following criteria:

- ≥4 valid doses
- Three valid doses (only if received first valid dose at 7 to <12 months old)
- Two valid doses (only if received first valid dose at 12 to <15 months old)
- One valid dose (only if received first valid dose at ≥15 months old)

Relevant immunizing agents:

- D-Hib
- DPT-HB-Hib
- DPT-Hib
- DPTP-Hib
- DTaP-HB-IPV-Hib
- DTaP-Hib
- DTaP-IPV-Hib
- Hib
- Hib-HB
- Men-C-CY-Hib

See the Appendix A for immunizing agent abbreviations and descriptions.

Vaccine interactions: None

Multiple vaccines on the same day: Keep any one

Evidence of immunity: Not applicable

Valid dose definitions: Relevant immunizing agents must be received in accordance with the following criteria to be considered a valid dose:

- First valid dose — Received at ≥42 days old
- Second valid dose — One of the following:
  - Received first valid dose at <12 months old AND received ≥28 days after first valid dose
  - Received first valid dose at 12 to <15 months old AND received ≥56 days after first valid dose
- Third valid dose — One of the following:
  - Received first valid dose at <7 months old AND received ≥28 days after second valid dose
  - Received first valid dose at 7 to <12 months old AND received ≥56 days after second valid dose AND ≥1 year old
- Fourth valid dose — Received first valid dose at <7 months old AND received ≥56 days after third valid dose AND ≥1 year old

Additional notes:

- Doses administered after the fifth birthday, but before the assessment date are considered valid for 7-year-olds if they satisfy the criteria for valid dose assessment
- An accelerated schedule (a 28-day interval between the first three doses) for those initiating a series at 2 to <7 months was accepted. This differs from the recommended schedule in the *Canadian Immunization Guide* for those initiating a series at 7 to <12 months, where a two-month interval is recommended.[4]
- Specific to Hib, a two-month interval between completion of the primary series and booster dose was applied

Hepatitis B

Age assessed: 12 and 17 years old

Up-to-date definition: Must satisfy one of the following criteria:

- Three valid doses in accordance with the three-dose schedule
- Two valid doses in accordance with the two-dose schedule
- Have a documented exemption for evidence of immunity

Relevant immunizing agents:

- DPT-HB
- DPT-HB-Hib
- DTaP-HB-IPV
- DTaP-HB-IPV-Hib
- DTwP-HB
- HAHB
- HAHB-pediatric
- HAHB-unspecified
- HB
- HB-dialysis
- HB-pediatric
- HB-unspecified
- Hib-HB

See the Appendix A for immunizing agent abbreviations and descriptions.

Vaccine interactions: None

Multiple vaccines on the same day: Use the following hierarchies to keep only one record:

- DTaP-HB-IPV-Hib > DPT-HB-Hib
- DTaP-HB-IPV > DPT-HB
- DTwP-HB > Hib-HB > HAHB-pediatric > HAHB > HAHB-unspecified > HB-dialysis > HB-pediatric > HB > HB-unspecified

These hierarchies is guided by the inclusiveness of the agent (i.e., keep the agent that includes the largest number of antigens).

Evidence of immunity: Include evidence of immunity records for the following:

- Hepatitis B (HB)
- Hepatitis B (HB-dialysis)
- Hepatitis B (HB-pediatric)
- Hepatitis B (HB-unspecified)
- Hepatitis B (HB-regular)
- Hep B antibody
- Hepatitis B immunoglobulin

Valid dose definitions: Relevant immunizing agents must be received in accordance with the following criteria to be considered a valid dose:

A student is assessed using both the two- and three-dose schedules and is considered up-to-date if at least one schedule is satisfied.

Two-dose schedule for Engerix®-B series (applied only if all doses received by the student are HB or HB-unspecified with an Engerix®-B trade name):

- First valid dose — HB, HB-unspecified or HB-pediatric received at 11 to <16 years old
- Second valid dose — HB, HB-unspecified or HB-pediatric received ≥168 days after first valid dose AND received at 11 to <16 years old

Two-dose schedule for non-Engerix®-B series (applied to those not assessed based on the two-dose schedule for Engerix®-B):

- First valid dose — HB, HB-unspecified, HB-pediatric, HAHB, HAHB-pediatric or HAHB-unspecified received at 11 to <16 years old
- Second valid dose — Received at 11 to <16 years old AND one of the following:
    - First valid dose was HB, HB-unspecified or HB-pediatric AND one of the following:
        - HB, HB-unspecified or HB-pediatric received ≥112 days after first valid dose
        - HAHB, HAHB-pediatric or HAHB-unspecified received ≥168 days after first valid dose
    - First valid dose was HAHB, HAHB-pediatric or HAHB-unspecified AND current dose is HB, HB-unspecified, HB-pediatric, HAHB, HAHB-pediatric or HAHB-unspecified received ≥168 days after first valid dose

Three-dose schedule (all students):

- First valid dose — One of the following:
    - HB, HB-dialysis, HB-unspecified or HB-pediatric received on or after birth
    - HAHB received at ≥1 years old
    - DTaP-HB-IPV-Hib, DPT-HB, DPT-HB-Hib, DTaP-HB-IPV, DTwP-HB or Hib-HB received at ≥42 days old
- Second valid dose — One of the following:
    - HB, HB-dialysis, HB-unspecified or HB-pediatric received ≥28 days after first valid dose
    - HAHB, HAHB-pediatric or HAHB-unspecified received ≥28 days after first valid dose AND ≥1 year old
    - DTaP-HB-IPV-Hib, DPT-HB, DPT-HB-Hib, DTaP-HB-IPV, DTwP-HB or Hib-HB received ≥28 days after first valid dose AND ≥42 days old

- Third valid dose — One of the following:
    - First valid dose was HB, HB-dialysis HB-unspecified, HB-pediatric, DTaP-HB-IPV-Hib, DPT-HB, DPT-HB-Hib, DTaP-HB-IPV, DTwP-HB or Hib-HB AND one of the following:
        - HB, HB-dialysis, HB-unspecified, HB-pediatric, DTaP-HB-IPV-Hib, DPT-HB, DPT-HB-Hib, DTaP-HB-IPV, DTwP-HB or Hib-HB received ≥112 days after first valid dose AND received ≥28 days after second valid dose
        - HAHB, HAHB-pediatric or HAHB-unspecified received ≥168 days after first valid dose AND received ≥28 days after second valid dose AND ≥1 year old
    - First valid dose was HAHB, HAHB-pediatric or HAHB-unspecified AND current dose is HB, HB-dialysis, HB-unspecified, HB-pediatric, HAHB, HAHB-pediatric, HAHB-unspecified, DTaP-HB-IPV-Hib, DPT-HB, DPT-HB-Hib, DTaP-HB-IPV, DTwP-HB or Hib-HB received ≥168 days after first valid dose AND received ≥28 days after 2nd valid dose

Additional notes:

- If a series involves at least two different immunizing agents, the validity of the current dose is assessed based on the logic corresponding to the first valid dose. An exception is for HAHB, HAHB-pediatric and HAHB-unspecified, where a 168-day interval is required between the first and last doses in the series whenever HAHB, HAHB-pediatric or HAHB-unspecified is administered as either the first valid dose or the last dose in the series.
- For the Engerix®-B two-dose schedule, all variations of 'Engerix-B' are considered since Trade Name is a free-text field for historical immunizations
- Trade name is not considered for validation of the three-dose schedule
- Since Twinrix® and Twinrix® Junior are not differentiated at the agent level, all HAHB doses are assumed to be Twinrix® for the two-dose schedule and assumed to be Twinrix® Junior for the three-dose schedule. A more conservative age requirement (11–16 years) is imposed for the two-dose schedule.
- For the two-dose schedules, doses given before 11 years of age do not affect the validity of doses given ≥11 years of age (e.g., doses administered before 11 years of age are not reviewed as part of valid dose assessment for HB two-dose coverage)
- The HB component of DTaP-HB-IPV-Hib is validated even if administered on or after the age of 7 years
- HB-dialysis is validated using the HB logic, but only under the three-dose schedule
- DPT-HB, DPT-HB-Hib, DTaP-HB-IPV, DTwP-HB and Hib-HB are validated using the logic for DTaP-HB-IPV-Hib

Human Papillomavirus (HPV)

Age assessed:

- 12 years old (all students)
- 17 years old (females only)

Up-to-date definition: Must satisfy one of the following criteria:

- Three valid doses in accordance with the three-dose schedule
- Two valid doses in accordance with the two-dose schedule

Relevant immunizing agents:

- HPV-2
- HPV-9
- hpv-unspecified
- HPV-4

See the Appendix A for immunizing agent abbreviations and descriptions.

Vaccine interactions: None

Multiple vaccines on the same day: Use the following hierarchy to keep only one record: HPV-4 > hpv-unspecified > HPV-9 > HPV-2

The hierarchy is guided by giving preference to the publicly-funded vaccine used in Ontario in the 2018–19 school year (HPV-9) and then considering the vaccine offering protection against the greatest number of HPV genotypes. Unspecified HPV vaccines were assumed to be capturing the use of HPV-9 given the high prevalence of HPV-9 vaccines administered during this school year.

Evidence of immunity: Not applicable

Valid dose definitions: Relevant immunizing agents must be received in accordance with the following criteria to be considered a valid dose:

A student is assessed using both the two- and three-dose schedules and is considered up-to-date if at least one schedule is satisfied.

If gender is female:

- Two-dose schedule
    - First valid dose — HPV-2, HPV-4, HPV-9 or hpv-unspecified received at 9 to <15 years old
    - Second valid dose — HPV-2, HPV-4, HPV-9 or hpv-unspecified received ≥168 days after first valid dose

- Three-dose schedule
    - First valid dose — HPV-2, HPV-4, HPV-9 or hpv-unspecified received at ≥9 years old
    - Second valid dose — HPV-2, HPV-4, HPV-9 or hpv-unspecified received ≥28 days after first valid dose
    - Third valid dose — HPV-2, HPV-4, HPV-9 or hpv-unspecified AND received ≥84 days after second valid dose AND ≥168 days after first valid dose

If gender is male:

- Two-dose schedule
    - First valid dose — HPV-4, HPV-9 or hpv-unspecified received at 9 to <15 years old
    - Second valid dose — HPV-4, HPV-9 or hpv-unspecified received ≥168 days after first valid dose
- Three-dose schedule
    - First valid dose — HPV-4, HPV-9 or hpv-unspecified received at ≥9 years old
    - Second valid dose — HPV-4, HPV-9 or hpv-unspecified received ≥28 days after first valid dose
    - Third valid dose — HPV-4, HPV-9 or hpv-unspecified AND received ≥84 days after second valid dose AND ≥168 days after first valid dose

Additional notes:

- If a series involves more than two different immunizing agents, the current dose is validated based on the logic corresponding to the first valid dose
- HPV-2 is not incorporated into the valid dose parameters for coverage in males, as it is not authorized for use in males
- See the Appendix C for changes to the publicly-funded HPV immunization program over time

Measles

Age assessed: 7 to 17 years old

Up-to-date definition: Must satisfy one of the following criteria:

- ≥2 valid doses
- Have a documented exemption for evidence of immunity

Relevant immunizing agents:

- M
- MMR-Var
- MR
- MMR

See the Appendix A for immunizing agent abbreviations and descriptions.

Vaccine interactions: A minimum interval of 28 days between all live-virus vaccine combinations is required, unless they are administered on the same day. Additional immunizing agents used to assess for vaccine interactions:

- Mu
- YF
- Zos-Live
- R
- Sma
- Zos-unspecified
- Var
- Zos
- BCG vaccine

Multiple vaccines on the same day:

- If multiple measles-containing agents are received on the same day, keep any one
- If multiple non-measles containing live-virus vaccines are received on the same day, keep any one
- If a mix of measles and non-measles containing live-virus vaccines is received on the same day, keep one of each

Evidence of immunity: Include evidence of immunity records for: Measles (M)

Valid dose definitions: Relevant immunizing agents must be received in accordance with the following criteria to be considered a valid dose:

- First valid dose — Received at ≥1 year old AND both of the following:
  - Received ≥28 days after any preceding measles-containing vaccine
  - Received on the same day or ≥28 days after any preceding non-measles containing live-virus vaccine
- Second valid dose — Received ≥28 days after any preceding measles-containing vaccine AND received on the same day or ≥28 days after any preceding non-measles containing live-virus vaccine

Additional notes: None

Meningococcal C Conjugate (MCC)

Age assessed: 7 years old

Up-to-date definition: ≥1 valid dose

Relevant immunizing agents:

- men-AC unspecified
- Men-ACYW-135-unspecified
- Men-C-AC
- Men-C-ACYW-135
- Men-C-C
- Men-C-CY
- Men-C-CY-Hib
- men-c-unspecified
- men-unspecified

See the Appendix A for immunizing agent abbreviations and descriptions.

Vaccine interactions: A minimum interval of 168 days (or received on the same day) is required between a meningococcal polysaccharide vaccine followed by a meningococcal conjugate vaccine. Meningococcal polysaccharide C-containing agents:

- men-p-AC unspecified
- men-p-unspecified
- Men-P-ACYW-135

Doses of meningococcal polysaccharide agents administered <2 years of age are ignored as potential vaccine interactions due to the poor immune response generated by infants and toddlers to polysaccharide vaccines.

Multiple vaccines on the same day:

- If multiple MCC-containing vaccines (i.e., relevant immunizing agents) are received on the same day, keep any one
- If multiple meningococcal polysaccharide C-containing vaccines are received on the same day, keep any one
- If a mix of meningococcal conjugate and polysaccharide C-containing vaccines is received on the same day, keep one of each

Evidence of immunity: Not applicable

Valid dose definitions: Relevant immunizing agents must be received in accordance with the following criteria to be considered a valid dose:

- Received at ≥1 year old AND received on the same day or ≥168 days after any previous meningococcal polysaccharide C-containing dose

Additional notes:

- Only doses administered ≥1 year of age are assessed as being valid. No minimum interval is imposed between dose(s) administered prior to the first birthday for valid dose assessment of the dose administered on/after 1 year of age (i.e., doses administered prior to the first birthday are not reviewed as part of valid dose assessment for MCC coverage).
- Due to the low completeness of the Trade Name field in Panorama, product-specific logic could not be developed for quadrivalent meningococcal conjugate (MCV4) records (as different MCV4 products have different dose recommendations and minimum interval requirements). Thus, one valid dose of MCV4 vaccine administered ≥1 year of age is assessed as being sufficient for being up-to-date for MCC at 7 years.
- See the Appendix C for changes to the publicly-funded meningococcal immunization program over time

Meningococcal Conjugate Quadrivalent (MCV4)

Age assessed: 12 and 17 years old

Up-to-date definition: ≥1 valid dose

Relevant immunizing agents:

- Men-C-ACYW-135
- Men-ACYW-135-unspecified

See the Appendix A for immunizing agent abbreviations and descriptions.

Vaccine interactions: A minimum interval of 168 days (or received on the same day) is required between a meningococcal polysaccharide vaccine followed by a meningococcal conjugate vaccine. Meningococcal polysaccharide agents:

- Men-P-ACYW-135
- men-p-unspecified
- men-p-A unspecified
- men-p-AC unspecified

Doses of meningococcal polysaccharide agents administered <2 years of age are ignored as potential vaccine interactions due to the poor immune response generated by infants and toddlers to polysaccharide vaccines.

Multiple vaccines on the same day:

- If multiple MCV4 vaccines (i.e., relevant immunizing agents) are received on the same day, keep any one
- If multiple meningococcal polysaccharide vaccines are received on the same day, keep any one
- If a mix of MCV4 and polysaccharide vaccines is received on the same day, keep one of each

Evidence of immunity: Not applicable

Valid dose definitions: Relevant immunizing agents must be received in accordance with the following criteria to be considered a valid dose:

- Received as early as September 1, five years prior to the end of the Grade 7 school year, based on the assumption that the student is 12 years old in Grade 7 (i.e., received on or after September 1, 2014 for the 2018–19 school year for a 12-year-old) AND received on the same day or ≥168 days after any previous meningococcal polysaccharide dose

Additional notes:

- Extrapolating from the booster dose intervals recommended for children with high risk medical conditions (*Canadian Immunization Guide* recommends a booster dose every five years for those vaccinated at 7 years of age and older[4]), PHO considers MCV4 doses administered in the five-year interval preceding eligibility at the end of Grade 7 as meeting the up-to-date criteria for adolescent MCV4 coverage

- See the Appendix C for changes to the publicly-funded meningococcal immunization program over time

Mumps

Age assessed: 7 and 17 years old

Up-to-date definition: Must satisfy one of the following criteria:

- ≥2 valid doses
- Have a documented exemption for evidence of immunity

Relevant immunizing agents:

- MMR
- MMR-Var
- Mu

See the Appendix A for immunizing agent abbreviations and descriptions.

Vaccine interactions: A minimum interval of 28 days between all live virus vaccine combinations is required, unless they are administered on the same day. Additional immunizing agents used to assess for vaccine interactions:

- M
- MR
- R
- Var
- YF
- Sma
- Zos
- Zos-Live
- Zos-unspecified
- BCG vaccine

Multiple vaccines on the same day:

- If multiple mumps-containing agents are received on the same day, keep any one
- If multiple non-mumps containing live virus vaccines are received on the same day, keep any one
- If a mix of mumps- and non-mumps containing live virus vaccines is received on the same day, keep one of each

Evidence of immunity: Include evidence of immunity records for: Mumps (Mu)

Valid dose definitions: Relevant immunizing agents must be received in accordance with the following criteria to be considered a valid dose:

- First valid dose — Received at ≥1 year old AND both of the following:
  - Received ≥28 days after any preceding mumps-containing vaccine
  - Received on the same day or ≥28 days after any preceding non-mumps containing live virus vaccine
- Second valid dose — Received ≥28 days after any preceding mumps-containing vaccine AND received on the same day or ≥28 days after any preceding non-mumps containing live virus vaccine

Additional notes: None

Pertussis

Age assessed: 7 and 17 years old

Up-to-date definition:

7-year-olds must satisfy one of the following criteria:

- ≥5 valid doses
- Four valid doses (only if received first valid dose at <7 years old AND received fourth valid dose at ≥4 years old)

17-year-olds must satisfy one of the following criteria:

- ≥6 valid doses
- 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
- Four valid doses and only if satisfies one of the following:
    - Received first valid dose at <7 years old AND <10 years between fourth valid dose and assessment date
    - Received first valid dose at ≥7 years old (i.e., two primary and two booster doses)
- Three valid doses (only if received first valid dose ≥7 years old AND <10 years between third valid dose and assessment date)
    - Note: PHO considers receipt of two primary doses and one 'booster' dose for individuals who start their series late (i.e., ≥7 years old) as the minimum requirement to be considered up-to-date, as long as less than 10 years have elapsed between the last (booster) dose and the date of assessment

Relevant immunizing agents:

- aP
- ap
- ap-unspecified
- DPT
- DPT-HB
- DPT-HB-Hib
- DPT-Hib
- DPT-IPV
- DPTP
- DPTP-Hib
- DTaP
- DTaP-HB-IPV
- DTaP-HB-IPV-Hib
- DTaP-Hib
- DTaP-IPV
- DTaP-IPV-Hib
- DTwP-HB
- pertussis-unspecified
- Tdap
- Tdap-IPV
- wP

See the Appendix A for immunizing agent abbreviations and descriptions.

Vaccine interactions: None

Multiple vaccines on the same day: Keep any one

Evidence of immunity: Not applicable

Valid dose definitions: Relevant immunizing agents must be received in accordance with the following criteria to be considered a valid dose:

- First valid dose — Received at ≥42 days old
- Second valid dose — Received ≥28 days after first valid dose
- Third valid dose — One of the following:
    - Received first valid dose at <7 years old AND received ≥28 days after second valid dose
    - Received first valid dose at ≥7 years old AND received ≥168 days after second valid dose
- Fourth valid dose — One of the following:
    - Received first valid dose at <7 years old AND received ≥168 days after third valid dose AND ≥1 year old
    - Received first valid dose at ≥7 years old AND one of the following:
        - Received ≥10 years after third valid dose
        - Received ≥28 days after third valid dose AND ≥14 years old
- Fifth valid dose — One of the following:
    - Received first valid dose at <7 years old AND one of the following:
        - Received fourth valid dose at 1 to <4 years old AND received ≥28 days after fourth valid dose AND ≥4 years old
        - Received fourth valid dose at ≥4 years old AND received ≥10 years after fourth valid dose
        - Received fourth valid dose at ≥4 years old AND received ≥28 days after fourth valid dose AND ≥14 years old
    - Received first valid dose at ≥7 years old AND received ≥10 years after fourth valid dose
- Sixth valid dose — One of the following:
    - Received first valid dose at <7 years old AND received fourth valid dose at 1 to <4 years old AND one of the following:
        - Received ≥10 years after fifth valid dose
        - Received ≥28 days after fifth valid dose AND ≥14 years old
    - Received first valid dose at <7 years old AND received fourth valid dose at ≥4 years old AND received ≥10 years after fifth valid dose
    - Received first valid dose at ≥7 years old AND received ≥10 years after fifth valid dose

Additional notes:

- All immunizing agents containing the respective antigens were considered valid (i.e., P or p) as long as they met the minimum age and minimum interval requirements
- Although an accelerated schedule is not specified in the *Canadian Immunization Guide* chapter on pertussis for children who initiate the series when ≥7 years old[4], the minimum intervals outlined between doses of the primary series for infants were also applied to older children
- For the last (booster) dose, we used a 10-year interval instead of a five-year interval (as is used in the Panorama forecaster logic), in accordance with the *Canadian Immunization Guide*[4]
- See the Appendix C for changes to the publicly-funded pertussis immunization program over time

Pneumococcal Conjugate

Age assessed: 7 years old

Up-to-date definition: Must satisfy one of the following criteria:

- Four valid doses in accordance with the 3+1 schedule
- Three valid doses in accordance with the 2+1 schedule
- Two valid doses in accordance with the two-dose schedule
- One valid dose in accordance with the one-dose schedule

Relevant immunizing agents:

- Pneu-C-7
- Pneu-C-10
- Pneu-C-13
- Pneu-C-15
- Pneu-C-20
- pneu-unspecified
- pneu-c-unspecified

See the Appendix A for immunizing agent abbreviations and descriptions.

Vaccine interactions: A minimum interval of one year (or received on the same day) is required between a pneumococcal polysaccharide vaccine followed by a pneumococcal conjugate vaccine. Pneumococcal polysaccharide agents:

- Pneu-P-23
- pneu-p-unspecified

Doses of pneumococcal polysaccharide agents administered <2 years of age are ignored as potential vaccine interactions due to the poor immune response generated by infants and toddlers to polysaccharide vaccines.

Multiple vaccines on the same day:

- If multiple conjugate pneumococcal vaccines are received on the same day, keep any one
- If multiple polysaccharide pneumococcal vaccines are received on the same day, keep any one
- If a mix of conjugate and polysaccharide pneumococcal vaccines is received on the same day, keep one of each

Evidence of immunity: Not applicable

Valid dose definitions: Relevant immunizing agents must be received in accordance with the following criteria to be considered a valid dose:

A child is assessed according to multiple schedules and is considered up-to-date if at least one schedule is satisfied.

3+1 schedule:

- First valid dose — Received at ≥42 days to <7 months old AND received on the same day or ≥1 year after any preceding polysaccharide dose
- Second valid dose — Received ≥28 days after first valid dose AND received on the same day or ≥1 year after any preceding polysaccharide dose
- Third valid dose — Received ≥28 days after second valid dose AND received on the same day or ≥1 year after any preceding polysaccharide dose
- Fourth valid dose — Received ≥56 days after third valid dose AND ≥1 year old AND received on the same day or ≥1 year after any preceding polysaccharide dose

2+1 schedule:

- First valid dose — Received at ≥42 days to <1 year old AND received on the same day or ≥1 year after any preceding polysaccharide dose
- Second valid dose — Received ≥28 days after first valid dose AND received on the same day or ≥1 year after any preceding polysaccharide dose
- Third valid dose — Received ≥56 days after second valid dose AND ≥1 year old AND received on the same day or ≥1 year after any preceding polysaccharide dose

Two-dose schedule:

- First valid dose — Received at ≥1 year to <2 years old AND received on the same day or ≥1 year after any preceding polysaccharide dose
- Second valid dose — Received ≥56 days after first valid dose AND received on the same day or ≥1 year after any preceding polysaccharide dose

One-dose schedule:

- First valid dose — Received at ≥2 years old AND received on the same day or ≥1 year after any preceding polysaccharide dose

Additional notes:

- No distinction is made between serotype components of conjugate pneumococcal vaccine; any conjugate pneumococcal vaccine will be considered
- Several discrepancies were noted with respect to minimum ages and minimum intervals between the *Canadian Immunization Guide* chapter on pneumococcal vaccines and vaccine-specific product monographs.[4] In general, the interval that would allow for the greatest number of valid doses was selected when discrepancies were noted.
- See the Appendix C for changes to the publicly-funded pneumococcal immunization program over time

Polio

Age assessed: 7 and 17 years old

Up-to-date definition: Must satisfy one of the following criteria:

- Four valid doses
- Three valid doses (only if received third valid dose at ≥4 years old)

Relevant immunizing agents:

- DPT-IPV
- DPTP
- DPTP-Hib
- DTaP-HB-IPV
- DTaP-HB-IPV-Hib
- DTaP-IPV
- DTaP-IPV-Hib
- DT-IPV
- IPV
- OPV before April 1, 2016
- p-unspecified
- Tdap-IPV
- Td-IPV
- T-IPV

See the Appendix A for immunizing agent abbreviations and descriptions.

Vaccine interactions: None

Multiple vaccines on the same day: Keep any one

Evidence of immunity: Not applicable

Valid dose definitions: Relevant immunizing agents must be received in accordance with the following criteria to be considered a valid dose:

- First valid dose — Received at ≥42 days old
- Second valid dose — Received ≥28 days after first valid dose
- Third valid dose — Received ≥168 days after second valid dose AND ≥1 year old
- Fourth valid dose — Received third valid dose at <4 years old AND received ≥28 days after third valid dose AND ≥4 years old

Additional notes:

- IPV and OPV containing immunizing agents were considered interchangeable (while OPV is not used in Canada, it is still used elsewhere in the world)
- In contrast to *Canadian Immunization Guide*[4], the dose administered at ≥4 years old does not need to be IPV (i.e., can be either IPV or OPV)
- See the Appendix C for changes to the publicly-funded polio immunization program over time

Rotavirus

Age assessed: 7 years old

Up-to-date definition: Must satisfy one of the following criteria:

- Three valid doses in accordance with the three-dose schedule
- Two valid doses in accordance with the two-dose schedule

Relevant immunizing agents:

- Rota-1
- Rota-5
- rota-unspecified

See the Appendix A for immunizing agent abbreviations and descriptions.

Vaccine interactions: None

Multiple vaccines on the same day: Use the following hierarchy to keep only one record: Rota-1 > rota-unspecified > Rota-5

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 and 2021.

Evidence of immunity: Not applicable

Valid dose definitions: Relevant immunizing agents must be received in accordance with the following criteria to be considered a valid dose:

A child is assessed using both the two- and three-dose schedules and is considered up-to-date if at least one schedule is satisfied.

Three-dose schedule:

- 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

Two-dose schedule:

- 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

Additional notes:

- As per the *Canadian Immunization Guide*[4] and Ministry of Health, if any dose in the series was Rota-5, then a total of 3 doses is needed
- See the Appendix C for changes to the publicly-funded rotavirus immunization program over time

Rubella

Age assessed: 7 and 17 years old

Up-to-date definition: Must satisfy one of the following criteria:

- ≥1 valid dose
- Have a documented exemption for evidence of immunity

Relevant immunizing agents:

- MMR
- MR
- R
- MMR-Var

See the Appendix A for immunizing agent abbreviations and descriptions.

Vaccine interactions: A minimum interval of 28 days between all live virus vaccine combinations is required, unless they are administered on the same day. Additional immunizing agents used to assess for vaccine interactions:

- M
- Mu
- Var
- YF
- Sma
- Zos
- Zos-Live
- Zos-unspecified
- BCG vaccine

Multiple vaccines on the same day:

- If multiple rubella-containing agents are received on the same day, keep any one
- If multiple non-rubella containing live virus vaccines are received on the same day, keep any one
- If a mix of rubella- and non-rubella containing live virus vaccines is received on the same day, keep one of each

Evidence of immunity: Include evidence of immunity records for: Rubella (R)

Valid dose definitions: Relevant immunizing agents must be received in accordance with the following criteria to be considered a valid dose:

- First valid dose — Received at ≥1 year old AND both of the following:
  - Received ≥28 days after any preceding rubella-containing vaccine
  - Received on the same day or ≥28 days after any preceding non-rubella containing live virus vaccine

Additional notes: None

Tetanus

Age assessed: 7 and 17 years old

Up-to-date definition:

7-year-olds must satisfy one of the following criteria:

- ≥5 valid doses
- Four valid doses (only if received first valid dose at <7 years old AND received fourth valid dose at ≥4 years old)

17-year-olds must satisfy one of the following criteria:

- ≥6 valid doses
- 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
- Four valid doses and only if satisfies one of the following:
    - Received first valid dose at <7 years old AND <10 years between fourth valid dose and assessment date
    - Received first valid dose at ≥7 years old (i.e., two primary and two booster doses)
- Three valid doses (only if received first valid dose ≥7 years old AND <10 years between third valid dose and assessment date)
    - Note: PHO considers receipt of two primary doses and one 'booster' dose for individuals who start their series late (i.e., ≥7 years old) as the minimum requirement to be considered up-to-date, as long as less than 10 years have elapsed between the last (booster) dose and the date of assessment

Relevant immunizing agents:

- DPT
- DPT-HB
- DPT-HB-Hib
- DPT-Hib
- DPT-IPV
- DPTP
- DPTP-Hib
- DT
- DTaP
- DTaP-HB-IPV
- DTaP-HB-IPV-Hib
- DTaP-Hib
- DTaP-IPV
- DTaP-IPV-Hib
- DT-IPV
- DTwP-HB
- T
- Td
- Tdap
- Tdap-IPV
- Td-IPV
- T-IPV

See the Appendix A for immunizing agent abbreviations and descriptions.

Vaccine interactions: None

Multiple vaccines on the same day: Keep any one

Evidence of immunity: Not applicable

Valid dose definitions: Relevant immunizing agents must be received in accordance with the following criteria to be considered a valid dose:

- First valid dose — Received at ≥42 days old
- Second valid dose — Received ≥28 days after first valid dose
- Third valid dose — One of the following:
    - Received first valid dose at <7 years old AND received ≥28 days after second valid dose
    - Received first valid dose at ≥7 years old AND received ≥168 days after second valid dose
- Fourth valid dose — One of the following:
    - Received first valid dose at <7 years old AND received ≥168 days after third valid dose AND ≥1 year old
    - Received first valid dose at ≥7 years old AND one of the following:
        - Received ≥10 years after third valid dose
        - Received ≥28 days after third valid dose AND ≥14 years old
- Fifth valid dose — One of the following:
    - Received first valid dose at <7 years old AND one of the following:
        - Received fourth valid dose at 1 to <4 years old AND received ≥28 days after fourth valid dose AND ≥4 years old
        - Received fourth valid dose at ≥4 years old AND received ≥10 years after fourth valid dose
        - Received fourth valid dose at ≥4 years old AND received ≥28 days after fourth valid dose AND ≥14 years old
    - Received first valid dose at ≥7 years old AND received ≥10 years after fourth valid dose
- Sixth valid dose — One of the following:
    - Received first valid dose at <7 years old AND received fourth valid dose at 1 to <4 years old AND one of the following:
        - Received ≥10 years after fifth valid dose
        - Received ≥28 days after fifth valid dose AND ≥14 years old
    - Received first valid dose at <7 years old AND received fourth valid dose at ≥4 years old AND received ≥10 years after fifth valid dose
    - Received first valid dose at ≥7 years old AND received ≥10 years after fifth valid dose

Additional notes:

- Although an accelerated schedule is not specified in the *Canadian Immunization Guide* chapter for tetanus for children who initiate the series when ≥7 years old[4], the minimum intervals outlined between doses of the primary series for infants were also applied to older children
- For the last (booster) dose, we used a 10-year interval instead of a five-year interval (as is used in the Panorama forecaster logic), in accordance with the *Canadian Immunization Guide*[4]
- See the Appendix C for changes to the publicly-funded tetanus immunization program over time

Varicella

Age assessed: 7 years old

Up-to-date definition: Must satisfy one of the following criteria:

- ≥2 valid doses
- Have a documented exemption for evidence of immunity

Relevant immunizing agents:

- MMR-Var
- Var

See the Appendix A for immunizing agent abbreviations and descriptions.

Vaccine interactions: A minimum interval of 28 days between all live-virus vaccine combinations is required, unless they are administered on the same day. Additional immunizing agents used to assess for vaccine interactions:

- M
- MMR
- MR
- Mu
- R
- YF
- Sma
- Zos
- Zos-Live
- Zos-unspecified
- BCG vaccine

Multiple vaccines on the same day:

- If multiple varicella-containing agents are received on the same day, keep any one
- If multiple non-varicella containing live-virus vaccines are received on the same day, keep any one
- If a mix of varicella- and non-varicella containing live-virus vaccines is received on the same day, keep one of each

Evidence of immunity: Include evidence of immunity records for the following:

- Varicella (Var)
- Varicella-zoster antibody
- Zoster (Zos)

Valid dose definitions: Relevant immunizing agents must be received in accordance with the following criteria to be considered a valid dose:

- First valid dose — Received at ≥1 year old AND both of the following:
    - Received ≥28 days after any preceding varicella-containing vaccine
    - Received on the same day or ≥28 days after any preceding non-varicella containing live virus vaccine
- Second valid dose — Received ≥28 days after any preceding varicella-containing vaccine AND received on the same day or ≥28 days after any preceding non-varicella containing live virus vaccine

Additional notes: None

Appendix C: Changes to the Publicly-Funded Immunization Programs in Ontario

2024:

- Expansion of the RSV program to include the Abrysvo vaccine for pregnant individuals between 32-36 weeks gestation who will deliver during the RSV season.
- Updates to the pneumococcal program including:
    - Replacement of Pneu-C-13 with Pneu-C-15 in the routine childhood program.
    - Replacement of Pneu-P-23 with Pneu-C-20 in the routine adult program and the high-risk program.
- Oral Polio Vaccine (OPV) doses administered on or after April 1, 2016 no longer accepted as valid polio doses.
- Replacement of Pfizer-BioNTech Comirnaty XBB.1.5, Moderna Spikevax XBB.1.5, and Novavax Nuvaxovid XBB.1.5 with Pfizer-BioNTech Comirnaty KP.2 and Moderna Spikevax KP.2 COVID-19 vaccine products.

2023:

- Introduction of a high-risk publicly-funded RSV vaccine program using the AREXVY vaccine, mostly targeting adults aged 60 years and older living in residential care facilities and some retirement homes.
- Updates to the COVID-19 program including:
    - Replacement of Moderna Spikevax Bivalent BA.1 with Moderna Spikevax Bivalent BA.4/5.
    - Discontinuation of original Pfizer-BioNTech Comirnaty, Moderna Spikevax, and Janssen Jcovden.
    - Replacement of Pfizer-BioNTech Comirnaty Bivalent BA.4/5, Moderna Spikevax Bivalent BA.4/5, and Novavax Nuvaxovid with Pfizer-BioNTech Comirnaty XBB.1.5, Moderna Spikevax XBB.1.5, and Novavax Nuvaxovid XBB.1.5.

2022:

- Implementation of the smallpox/mpox vaccine (Imvamune) program for individuals at high risk of mpox exposure (pre-exposure prophylaxis) and post-exposure prophylaxis for those who have been assessed by their local PHU to be a high-risk contact to mpox.

- Updates to the COVID-19 program including:
    - Introduction of Novavax Nuvaxovid, Moderna Spikevax Bivalent BA.1, and Pfizer-BioNTech Comirnaty Bivalent BA.4/5.
    - Discontinuation of Astrazeneca Vaxzevria/COVISHIELD.

2021:

- Replacement of Rot-5 with Rot-1 in the rotavirus program, which resulted in the decrease from three to two doses of vaccine.
- Introduction of Astrazeneca Vaxzevria/COVISHIELD and Janssen Jcovden COVID-19 vaccine products.

2020:

- Introduction of a publicly-funded COVID-19 vaccine program in December using Pfizer-BioNTech Comirnaty and Moderna Spikevax.

2018:

- High-dose trivalent influenza vaccine (High-dose TIV) introduced for persons 65 years of age and older. Trivalent influenza vaccines (TIV) no longer publicly funded. Quadrivalent influenza vaccines (QIV) for all those aged six months and older (previously QIV was only for those 6 months to 17 years of age).
- Replacement of Rot-1 with Rot-5 in the rotavirus program, which resulted in the increase from two to three doses of vaccine.

2017:

- Updates to the HPV program including:
    - Replacement of HPV-4 with HPV-9 for the school-based immunization program: two-dose HPV-9 school-based program offered to Grade 7 students. HPV-9 vaccine eligibility until the end of Grade 12 for Grade 7 students who did not receive or complete the HPV-9 immunization series in Grade 7.
    - Replacement of HPV-4 with HPV-9 for high-risk males 9 to 26 years of age who have not initiated their HPV-4 immunization series.
- DTaP-IPV discontinued and DTaP-IPV-Hib eligibility is expanded to all children five to six years of age who have not completed their primary immunization vaccine series with diphtheria, tetanus, pertussis, and polio. As a result of DTaP-IPV discontinuation, Hib routine eligibility is expanded to children five to six years of age.
- Trivalent influenza vaccine adjuvanted no longer publicly funded.

2016:

- Two-dose HPV-4 school-based program moved to Grade 7 (from Grade 8) for 2016–17 school year and expanded to males, as well as females (previously only girls in Grade 8 were eligible); program also offered to Grade 8 females during same school year. Vaccine series publicly funded for high-risk males nine to 26 years old.
- Zoster vaccine for individuals 65 to 70 years of age and one time catch-up in 2016 for individuals born in 1945.

2015:

- Addition of quadrivalent influenza vaccine (inactivated and live attenuated) to the Universal Influenza Immunization Program (UIIP) for children ages six months to 17 years and two to 17 years, respectively.
- HPV-4 program for Grade 8 girls switched from a three-dose to a two-dose schedule.

2014:

- Updates to the meningococcal program including:
    - Addition of Men-B vaccine for high-risk children two months to 17 years of age.
    - Men-C-ACYW vaccine for high-risk individuals nine months to 55 years of age (previously two to 55 years); booster doses and expanded high risk criteria.
- One dose of pertussis (Tdap) vaccine for all adults ≥18 years of age, regardless of whether Tdap was received in adolescence.
- Pneu-C-13 vaccine for high-risk individuals ≥50 years of age.

Appendix D: Adverse Events and Categories

Adverse event category: Allergic events

- **Adverse events:**
    - Allergic reaction – skin/mucosal
    - Event managed as anaphylaxis
    - Oculorespiratory syndrome (ORS)
    - Allergic reaction – other (discontinued as of January 1, 2013)

Adverse event category: Injection site reactions

- **Adverse events:**
    - Infected abscess
    - Sterile abscess
    - Adenopathy/lymphadenopathy
    - Cellulitis
    - Nodule
    - Pain/erythema/swelling

Adverse event category: Neurologic events

- **Adverse events:**
    - Acute disseminated encephalomyelitis (ADEM)
    - Anaesthesia/paraesthesia
    - Bell's palsy
    - Convulsions/seizure
    - Encephalopathy/encephalitis
    - Guillain-Barré syndrome (GBS)
    - Meningitis
    - Myelitis/Transverse Myelitis
    - Paralysis

Adverse event category: Other events of interest

- **Adverse events:**
    - Arthritis/arthralgia
    - Coagulation disorder (including thrombotic events)
    - Erythema multiforme
    - Intussusception
    - Kawasaki disease
    - Multisystem inflammatory syndrome in children/adults
    - Myocarditis/pericarditis
    - Single organ cutaneous vasculitis
    - Syncope (fainting) with injury
    - Thrombocytopenia
    - Thrombosis with Thrombocytopenia Syndrome (TTS)
    - Other severe or unusual events

Adverse event category: Systemic events

- **Adverse events:**
    - Fever in conjunction with another reportable event
    - Hypotonic-hyporesponsive episode (HHE)
    - Parotitis
    - Persistent crying/screaming
    - Rash
    - Severe vomiting/diarrhea

Adverse event category: COVID-19 adverse events of special interest (discontinued as of July 21, 2025)

- **Adverse events:**
    - COVID-19 adverse events of special interest (discontinued as of July 21, 2025)

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