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Technical Annex

Immunization Coverage Report for School Pupils in Ontario: 2018–19 School Year

August 2020

Public Health Ontario

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Disclaimer

Contents

Purpose

This document provides technical information to support Public Health Ontario's (PHO) Immunization Coverage Report for School Pupils: 2018–19 School Year. Technical information includes an in-depth explanation of the analytic methods used to derive the contents of the report and a description of the limitations of immunization coverage data in Ontario. These details are not included in the coverage report.

Background

In Ontario, immunization information for students is collected from parents and guardians at the time of school enrolment and/or when assessment activities are carried out by public health units (PHUs), as directed under the *Immunization of School Pupils Act* (ISPA). PHUs determine the timing of requests for immunization information based on their student population, staffing complement and current public health priorities. Parents and guardians submit immunization information to the PHU where the child's school is located in, which the PHU enters into the Digital Health Immunization Repository (DHIR). Alternatively, parents may choose to report their child's immunizations electronically using Immunization Connect Ontario (ICON), a web-based portal for the public to securely report immunization data to PHUs and review their child's immunization records within the DHIR. For school-based immunization programs delivered by PHUs, PHU staff members enter immunization information directly into the DHIR using the web-based application, Panorama. Data entry typically occurs at the time of immunization; however, practices may vary.

Under the ISPA, parents, guardians and students (if 16 years of age or older) may request exemptions from immunizations for several reasons, including conscientious objection or religious beliefs, medical contraindications or evidence of immunity (including a clinical record of previous infection). To be granted an exemption from immunization, parents and guardians must submit a medical exemption form or a Statement of Conscience or Religious Belief. The Statement of Conscience or Religious Belief must be signed and sworn or affirmed before a Commissioner for Taking Affidavits. As of September 2017, parents and guardians must also attend an immunization education session delivered by their local PHU prior to filing the notarized Statement of Conscience or Religious Belief with the PHU.[5] Exemptions are entered into the DHIR by PHUs at the antigen level for the duration of time for which the exemption is requested.

All PHUs in Ontario transitioned from maintaining immunization records in the Immunization Records Information System (IRIS) to DHIR, accessed via Panorama, between 2013 and 2016. Panorama's immunization module allows PHU users to:

- Record immunizations administered at their clinics, including immunizations administered as part of school-based programs
- Enter immunizations reported to PHUs by parents and guardians
- Document consents to receive immunizations
- Document exemptions under ISPA
- Upload student lists received from schools and school boards
- Forecast due dates of future doses of immunizations according to the provincial immunization schedule

The ability to extract person-level immunization records from the DHIR allows PHO to calculate up-to-date coverage, which is the proportion of children who have received a specified number of valid vaccine doses based on the vaccine or antigen in question and their age at the time of assessment. Up-

to-date coverage is the measure used by many other jurisdictions within Canada and globally, and has been used to assess coverage in Ontario since the 2013–14 school year. These estimates are not directly comparable to previous Ontario coverage estimates produced using the complete-for-age measure in IRIS (applicable to school years prior to 2013–14). More information on the complete-for-age measure can be found in the Immunization Coverage Report for the 2012–13 School Year.

Methods

Data Management

Data used to generate all coverage and exemption estimates for the 2018–19 school year were extracted from the DHIR using the Panorama Enhanced Analytical Reporting (PEAR) tool. Extracted data includes demographic information, immunization records, immunization exemptions, education records and school information for students in the 7- to 17-year-old age cohorts for the 2018–19 school year. Data were compiled and analyzed using the statistical software program SAS® version 9.4.

Data extraction dates for the 2018–19 school year:

- June 28, 2019: demographic information, education records, school information
- September 1, 2019: immunizations, special considerations/exemptions

Demographic information, education records and school information were extracted on June 28, 2019, which is after the last day of school prior to summer break for most students. Immunization and exemption records were extracted on September 1, 2019. This dual data extraction process started with the 2017–18 school year report; since 2017–18, the timing of data extraction was changed compared to previous coverage reports (2013–14 to 2016–17 school years), where all data were extracted on September 1. This change in data extraction dates was implemented after learning that some PHUs initiate the school board upload process, a process that updates the DHIR with student rosters for the upcoming school year, during the summer (in July and August) in preparation for the upcoming school year. Given this information, it is possible that data extracted on September 1 may have included students who were new to the DHIR and who had not yet been assessed by the PHU, which could have resulted in underestimation of immunization coverage. Therefore, we changed our data extraction date for the student cohorts from September 1 to the end of June to better capture accurate school rosters during the school year of assessment. The extraction date for immunizations and exemptions data was kept consistent to allow PHUs and parents/guardians the same amount of time as in our previous reports to submit and enter records into the DHIR prior to our assessment of immunization records.

Age Cohorts

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, those children who had their seventh birthday between January 1 and December 31, 2018 are represented in the 7-year-old cohort for the 2018–19 school year. This method ensures that all children included in our assessment have, at minimum, reached the age milestone at the time of

assessment. Although eligibility for school-based programs is determined by school grade, age cohorts were used to represent grades due to data quality issues with the school grade field in the DHIR. 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. By using the 12-year-old age cohort to assess immunization programs for which eligibility is determined by school grade, some children (i.e., those that are 12 years or older, but have not yet reached Grade 7) are included in the calculation of coverage estimates for school-based programs that they were not yet eligible to receive. The birth years corresponding to the milestone ages assessed in the report for the 2018–19 school year are:

- 7-year-olds = students born in 2011
- 12-year-olds = students born in 2006
- 17-year-olds = students born in 2001

Student Assignment to Public Health Unit

Students were assigned to PHUs to calculate PHU-specific coverage estimates based on the location of the school each student attended during the 2018–19 school year. The use of school-based PHU assignment, as opposed to assigning students to PHUs on the basis of 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 DHIR-extracted education records.

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' or the school was not assigned to one of Ontario's 35 PHUs. School records that conflicted with the student's age were also removed (e.g., school records for a 17-year-old student with a school type field value of 'elementary school').

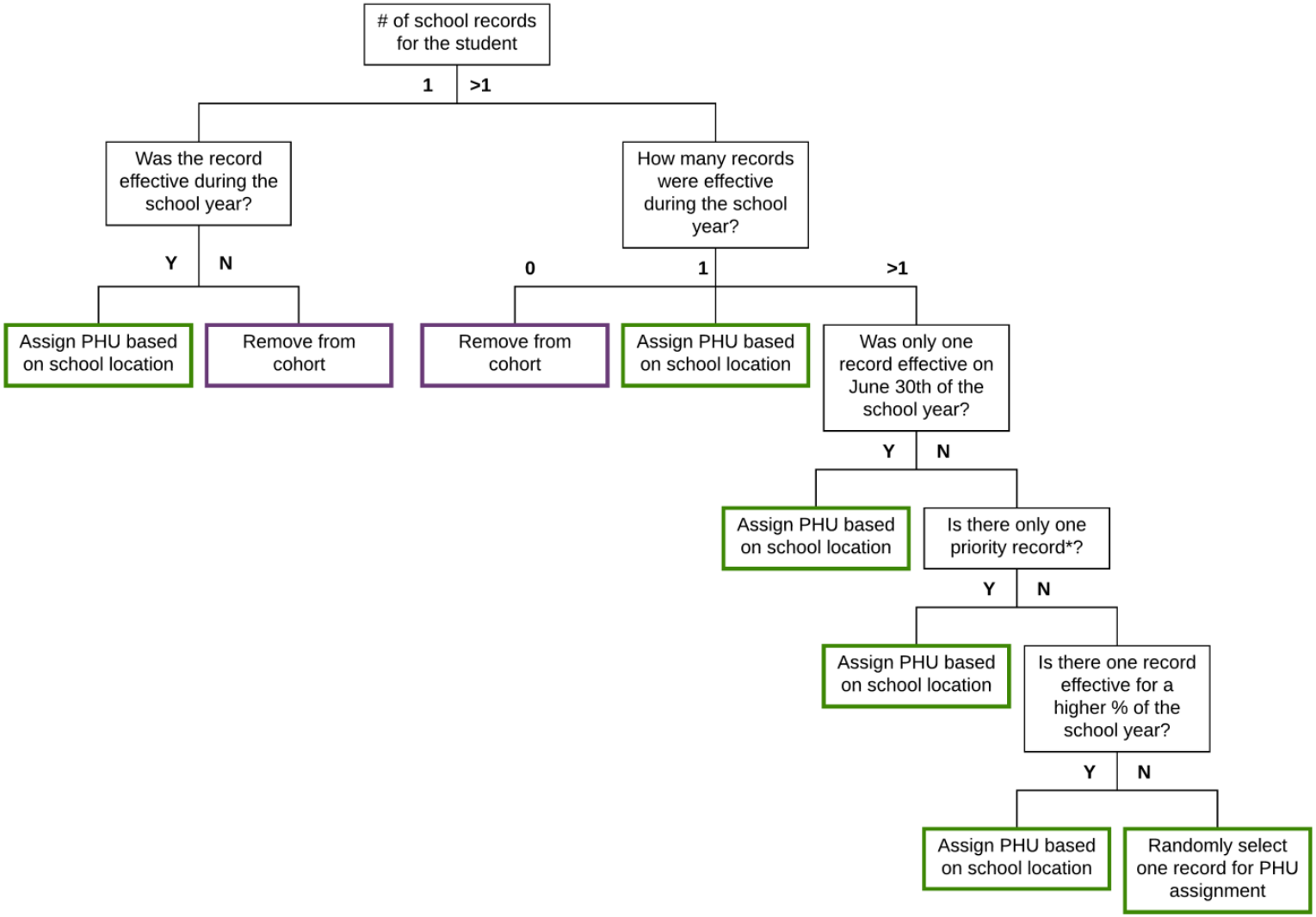
After the above data cleaning was applied, a student was included in the assessment if they had evidence of school attendance at any time during the 2018–19 school year, as determined by the education record's Effective From and Effective To dates. Next, education records were processed using a set of decisions presented in Figure 1 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 were effective for the same time period in some cases.

Students were included in the analysis for the 2018–19 school year if they had an education record that met the following criteria:

- Effective From: On or after September 1, 2018 or missing, AND
- Effective To: On or before August 31, 2019

Across all ages and cohorts, most students had straightforward school records; 89.7% of students had only one school record effective during the 2018–19 school year. The remaining 10.3% of students had more than one education record during the school year and one record was chosen based on the school attended on June 30, 2019, the age-appropriateness of the school type and/or the length of time at the school during the school year. Age-appropriateness of the school was assessed by preferentially selecting school records that were most plausible based on the student's age. For example, the first priority for a 12-year-old student would be any record with a school type field value of 'elementary school,' 'elementary & secondary school,' 'private school authority' or 'public school board,' whereas a 'secondary school' record would be used for PHU assignment if none of the first priority records were present.

Figure 1. Algorithm to Assign Students to PHUs Based on Education Records



* Priority records are preferentially selected based on age appropriateness of the school type, as explained in the text above.

Immunizations

For this report, immunization information was extracted to derive coverage estimates for the following:

- Diphtheria
- *Haemophilus influenzae* type b (Hib)
- Hepatitis B
- Human papillomavirus (HPV)
- Measles
- Meningococcal conjugate C (MCC)
- Meningococcal conjugate quadrivalent (MCV4)
- Mumps
- Pertussis
- Pneumococcal conjugate
- Polio
- Rubella
- Tetanus
- Varicella

Immunizations with administration dates on or before August 31, 2019 are included in the calculation of coverage estimates. Although vaccines contain antigens that confer immunologic protection against one or more diseases, in most instances, 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).

Up-to-Date Coverage Estimates by Antigen

Up-to-date 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 up-to-date) 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 the 2018–19 school year.

Definitions of up-to-date coverage for each antigen or vaccine, as appropriate, are outlined in Appendix 1. The definitions specify the number of doses, minimum intervals between doses and other conditions required for students to be assessed as up-to-date, by age. All minimum intervals less than one year in length were calculated using a 28-day month (one month = 28 days; six months = 168 days). Up-to-date definitions were developed after consulting multiple resources, including vaccine product monographs,

the Ontario publicly-funded immunization schedule,[2] the *Canadian Immunization Guide,*[3] the *Panorama Ontario Immunization Schedules Logic: Reference Document*[4] and program-area experts from PHO.

Up-to-Date Coverage Estimates for all ISPA-Designated Diseases

At the provincial and PHU-level, coverage was calculated for 7- and 17-year-olds, who are up-to-date for all ISPA-designated diseases, 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 for all ISPA-designated diseases (i.e., are up-to-date) 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 the 2018–19 school year.

- Definitions of up-to-date coverage for each antigen or vaccine, as appropriate, are outlined in Appendix 1. For the 2018–19 school year, ISPA-designated diseases include:
    - For 7-year-olds: measles, mumps, rubella, diphtheria, tetanus, polio, pertussis, MCC, varicella
    - For 17-year-olds: measles, mumps, rubella, diphtheria, tetanus, polio, pertussis, MCV4

Series Initiation and Completion

Series initiation (i.e., one-dose coverage) and completion was calculated for hepatitis B and HPV school-based programs. Series initiation is defined as the proportion of the students in the specified age cohort (i.e., same denominator as up-to-date coverage) who have received at least one valid dose of the relevant vaccine series, as defined in Appendix 1.

Series completion was defined as the proportion of students who received all recommended vaccine doses, as determined by age (i.e., are up-to-date). Eligible, but unimmunized, was defined as the proportion of students that were eligible for the vaccine, but did not receive any doses, as per the information in the DHIR.

Vaccine Interactions

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 up-to-date coverage. Refer to the antigen-specific tables in Appendix 1 for a

list of immunizing agents, interactions relevant to vaccines (if applicable) and criteria for valid dose assessment.

Evidence of Immunity

For measles, mumps, rubella, varicella and hepatitis B, immunization exemption records were examined for documentation of immunity to these diseases, as natural infection confers long-term protection against subsequent infection. Students with an immunization exemption to one of these diseases due to 'Medical - clinical record of disease' or 'Medical - documented immunity' were considered to be up-to-date, regardless of immunization history, if the immunization exemption had an Effective From date before or on August 31, 2019.

For varicella, the *Canadian Immunization Guide* recommends that children with a history of infection occurring before 12 months of age receive immunization with two doses of varicella-containing vaccine due to an increased risk of a second episode of varicella;[3] however, because we were not able to confidently identify the age of infection using exemption information, it was assumed that all varicella exemptions entered into the DHIR were based on history of disease that occurred at 12 months of age or later.

It should be noted that medical exemptions due to immunity or past hepatitis B infection may under-represent the true number of children who are no longer susceptible to hepatitis B, as hepatitis B is not designated under the ISPA.

Receipt of Multiple Vaccines on the Same Day

In the event that an individual 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 analyses. Refer to the antigen-specific tables in Appendix 1 for further details on the selection of doses administered on the same day.

Geographic Distribution

PHU-specific coverage estimates for the 2018–19 school year were mapped using ArcMap® to visualize the geographic distribution of coverage for the MCV4 vaccine program at age 12. To generate the maps, coverage estimates were grouped into five intervals using the same categories previously used in coverage assessments of the 2013–14 through 2017–18 school years. These intervals were defined for each antigen to identify ranges that best fit the distribution of the data and the fifth category represents coverage estimates that were equal to or above the relevant national coverage goal.

Exemptions

The report presents the percent of students with exemptions due to medical contraindications and exemptions submitted on the basis of conscientious objection or religious beliefs (hereafter referred to as non-medical exemptions) for diseases designated under the ISPA. Students with exemptions due to evidence of immunity to a disease were not included in the estimates of students with medical

exemptions, but were included in calculations of up-to-date coverage estimates where applicable (see Evidence of Immunity for further details). Among those diseases assessed for immunization coverage for each age milestone, we assessed exemptions only for ISPA-designated diseases (subsequently referred to as 'applicable antigens'). For example, at age 12, we assessed immunization coverage for MCV4, hepatitis B and HPV, but only assessed exemptions for MCV4, as it is the only antigen assessed at age 12 and is also designated under the ISPA. Only exemption records effective at any point during the 2018–19 school year (September 1, 2018 through August 31, 2019) were included in the analysis.

> Exemptions were assessed for the following applicable antigens:
>
> **For 7-year-olds:**
> - measles, mumps, rubella, diphtheria, polio, pertussis, tetanus, MCC and varicella
>
> **For 12-year-olds:**
> - MCV4
>
> **For 17-year-olds:**
> - measles, mumps, rubella, diphtheria, polio, tetanus and pertussis

Percent Exempt by Antigen

At the provincial-level, immunization exemptions were calculated for each applicable antigen for 7-, 12- and 17-year-olds using the following formulas:

$$\textbf{Medical exemptions} = \frac{\textbf{Numerator}^{*}}{\textbf{Denominator}^{**}} \times 100\%$$

[*] **Numerator**: The number of students from the denominator with an exemption due to a medical contraindication (designated as 'Medical – clinical decision' in Panorama) for the specified antigen, which was effective at any point during the 2018–19 school year.

[**] **Denominator**: All students in the specified age cohort with an active client record in the DHIR and at least one school record during the 2018–19 school year.

$$\text{Non-medical exemptions} = \frac{\text{Numerator}^{\dagger}}{\text{Denominator}^{\ddagger}} \times 100\%$$

[†]**Numerator**: The number of students from the denominator with an exemption due to conscientious objection or religious beliefs (designated as 'Philosophical reason' in Panorama) for the specified antigen, which was effective at any point during the 2018–19 school year.

[‡]**Denominator**: All students in the specified age cohort with an active client record in the DHIR and at least one school record during the 2018–19 school year.

Percent Exempt to any ISPA Disease by PHU

At the PHU-level, immunization exemptions were calculated for 7- and 17-year-olds with an exemption to at least one applicable antigen, as outlined above, using the following formulas:

$$\text{Medical exemptions} = \frac{\text{Numerator}^{*}}{\text{Denominator}^{**}} \times 100\%$$

[*]**Numerator**: The number of students from the denominator with at least one exemption due to a medical contraindication (designated as 'Medical – clinical decision' in Panorama) for at least one applicable antigen, which was effective at any point during the 2018–19 school year.

[**]**Denominator**: All students in the specified age cohort with an active client record in the DHIR and at least one school record during the 2018–19 school year in the specified PHU.

$$\text{Non-medical exemptions} = \frac{\text{Numerator}^{\dagger}}{\text{Denominator}^{\ddagger}} \times 100\%$$

[†]**Numerator**: The number of students from the denominator with at least one exemption due to conscientious objection or religious beliefs (designated as 'Philosophical reason' in Panorama) for at least one applicable antigen, which was effective at any point during the 2018–19 school year.

[‡]**Denominator**: All students in the specified age cohort with an active client record in the DHIR and at least one school record during the 2018–19 school year in the specified PHU.

Limitations

The immunization coverage and exemption analyses presented in this report are subject to limitations, some of which are explained below.

Cohort Assignment

Public Health Unit

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 had not been involved in immunization delivery or ISPA assessment activities for that student. We believe that the likelihood that these events have introduced an error into the coverage estimates is small, given that 89.7% of 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 enforcement 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. The timing of our extraction dates of school records in the 2017–18 school year and in this report were changed from previous school years in an attempt to minimize the impact of this issue, as explained in the Data Management section above. Further, students who are not actively attending school may be included in school/school board generated school lists. These students would therefore be captured in our analytic cohort; however, for these students, there is no opportunity for PHUs to deliver immunizations or carry out ISPA assessment activities. This scenario would also result in underestimating coverage.

School Grade

An additional limitation related to cohort assignment is that there are data quality issues with the school Grade field in the DHIR. As a result, we used age cohorts to approximate the school grades at which students are eligible for school-based immunization programs for our analysis. The decision not to use Grade to assign age cohorts for this report was based on consistency with methods used for previous coverage reports and because there is notable variability in the correlation between Grade and the client's birth year. As a result, coverage may be underestimated for vaccines given in school-based programs, as children who are 12 years of age, but have not yet reached Grade 7, will not have had an opportunity to be vaccinated.

Data Quality

As with any information system, some data quality issues were 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 and 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 limitations on 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 the IRIS-migrated data. In order to address this issue, certain assumptions were made in developing our decision rules for up-to-date hepatitis B coverage, based on schedule received and age (see the Hepatitis B section of Appendix 1 for further details). The impact of this limitation on the resulting coverage estimates is unclear.

If errors were made by immunization providers, by PHUs during data entry or by parents using web-based portals such as ICON, these may also have impacted immunization coverage estimates. Parents and guardians are asked to provide the date of the immunization event(s), rather than to provide 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 also have included incorrect vaccines administered or documented or errors in transcription of administered doses. The impact of these types of errors on the resulting coverage estimates is unknown.

Data Completeness

It is possible that students who are described as being under-immunized within this report may have been appropriately immunized. Data entry into the DHIR by PHU staff may not have occurred in time to be reflected in the coverage estimates presented within this report because the information may not have been provided to their local PHU or the family may have provided the information and the PHU had not yet entered it. Both of these scenarios would result in underestimating coverage.

The lack of system integration for the documentation of immunizations by health care providers and their inclusion within the DHIR presents important limitations to the timeliness and accuracy of immunization coverage assessment.

A separate issue is that data completeness may vary by antigen. Data completeness is likely to be higher among diseases designated under the ISPA, as documentation of immunization is actively sought by PHUs for these antigens. Practice variation by Ontario PHUs regarding the frequency of immunization coverage assessment activities, including timing of data entry, specific age cohorts assessed and data collection for non-ISPA diseases, was not assessed as part of this report.

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 IRIS. Panorama data standards and best practices recommendations, including drop-down values and field logic, were not applicable to data originally entered into IRIS; 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.[6] 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.

Gaps in Coverage Assessment in Ontario

The focus of Ontario's enabling legislation and existing processes is documenting immunization records of school-aged students; as a result, timely coverage assessment of infants and pre-school children is challenging and there is limited information on coverage in other groups, including adults and individuals with high-risk medical conditions. Although the regulation that falls under the *Child Care and Early Years Act*, Ontario Regulation 37/15[7,8] sets out the requirement for daycare operators to receive proof of immunizations for children who are enrolled in their child care program as defined in the Act, not all young children in Ontario attend child care 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, the age of two years is a nationally and internationally defined benchmark to monitor progress towards meeting immunization coverage goals.[1]

Exemptions

There are several limitations associated with exemptions data that should be considered in the interpretation of the results presented in the report. For this report, exemptions and immunizations were analyzed independently, although they are not mutually exclusive categories. Those with exemptions may be fully un-immunized, partially immunized or fully immunized against vaccine-preventable diseases for which they have exemptions on record. As discussed in the report, medical and non-medical exemptions for immunizations against designated diseases are submitted in compliance with Ontario's ISPA; however, it is possible that students receiving immunizations according to schedules that deviate from publicly-funded programs (e.g., those that receive a dose of vaccine in the days before the minimum age/interval required for a dose to be considered valid or those that choose to vaccinate according to a delayed schedule) may submit a non-medical exemption in order to comply with the ISPA and avoid suspension, despite receiving vaccinations. It is also possible that exemptions may be submitted for all ISPA diseases, including those for which a student has already completed a

series, rather than submitting for a subset of ISPA diseases. Additionally, non-medical exemptions are captured under a single category from which it is not possible to differentiate between those submitted for conscientious/philosophical reasons versus religious beliefs.

To obtain a medical exemption under the ISPA, a Statement of Medical Exemption must be completed and signed by a physician or nurse practitioner, where the rationale must be indicated as either the immunization being 'detrimental to health' (considered to be a medical exemption for this report) or on the basis of laboratory confirmation of immunity for select diseases or having a clinical record of disease (considered to be evidence of prior immunity for this report and counted in the numerator of up-to-date coverage estimates). The accuracy and reliability of medical exemptions in Ontario has not been assessed at this time.

Additionally, there are prior immunity exemptions recorded in the DHIR for diseases not designated under the ISPA. For example, we considered students with prior immunity exemptions to be up-to-date in our coverage calculations for hepatitis B; however, it should be noted that since hepatitis B is not a designated disease under the ISPA, the number of students with prior immunity exemptions may be under-reported for this disease.

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Appendix 1: Analysis Specifications by Antigen

Diphtheria

Last updated: 2018–19 school year

Parameter	Definition
Ages 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 (only if received first valid dose at <7 years old AND received fourth valid dose at ≥4 years old) • 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)* * 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 vaccines	D, D-Hib, DPT, DPT-HB, DPT-Hib, DPT-HB-Hib, DPT-IPV, DPTP, DPTP-Hib, DT, DT-IPV, DTaP, DTaP-HB-IPV-Hib, DTaP-IPV, DTaP-IPV-Hib, DTaP-HB-IPV, DTaP-Hib*****, d, Td, Td-IPV, Tdap, Tdap-IPV, d-unspecified
Vaccine interactions	None
Multiple vaccines on the same day	Keep any one (no distinction made between D, d, and d-unspecified)
Evidence of immunity	Not applicable
Valid dose definitions	Received relevant immunizing agent in accordance with the following criteria: • 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

Parameter	Definition
	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 CIG chapter on diphtheria for children who initiate the series when ≥7 years old, 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*.[3]
Exemption antigens	Diphtheria (D), Diphtheria (d), diphtheria (d-u)

**** New vaccine added in 2018–19 school year***

Haemophilus influenzae type b (Hib)

Last updated: 2018–19 school year

Parameter	Definition
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 vaccines	D-Hib, DPT-HB-Hib, DPT-Hib, DPTP-Hib, DTaP-HB-IPV-Hib, DTaP-IPV-Hib, DTaP-Hib*, Hib, Men-C-CY-Hib
Vaccine interactions	None
Multiple vaccines on the same day	Keep any one
Evidence of immunity	Not applicable

Valid dose definitions	Received relevant immunizing agent in accordance with the following criteria:
	• 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 CIG for those initiating a series at 7 to <12 months, where a two-month interval is recommended. • Specific to Hib, a two-month interval between completion of the primary series and booster dose was applied.

**** New vaccine added in 2018–19 school year***

Hepatitis B

Last updated: 2018–19 school year

Parameter	Definition
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 vaccines	HB, HB-dialysis**, HB-unspecified, DPT-HB, DPT-HB-Hib, DTaP-HB-IPV-Hib, DTaP-HB-IPV, HAHB
Vaccine interactions	None
Multiple vaccines on the same day	Use the following hierarchy to keep only one record: DTaP-HB-IPV-Hib > DTaP-HB-IPV or DPT-HB-Hib > DPT-HB > HAHB > HB-dialysis > HB > HB-unspecified. This hierarchy 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 following: Hepatitis B (HB), Hepatitis B (HB-regular), Hepatitis B (HB-dialysis), Hep B antibody

Valid dose definitions	All students are assessed using both the two- and three-dose schedule. A student is assessed as being 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 or HB-unspecified received at 11 to <16 years old
	• Second valid dose — HB or HB-unspecified 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 or HAHB 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 or HB-unspecified AND one of the following:
	  – HB or HB-unspecified received ≥112 days after first valid dose
	  – HAHB received ≥168 days after first valid dose
	  ○ First valid dose was HAHB AND current dose is HB, HB-unspecified or HAHB received ≥168 days after first valid dose
	
	Three-dose schedule (all students)
	• First valid dose — One of the following:
	  ○ HB, HB-dialysis or HB-unspecified received on or after birth
	  ○ HAHB received at ≥1 years old
	  ○ DTaP-HB-IPV-Hib, DPT-HB, DPT-HB-Hib or DTaP-HB-IPV received at ≥42 days old

Parameter	Definition
	• Second valid dose — One of the following: ○ HB, HB-dialysis or HB-unspecified received ≥28 days after first valid dose ○ HAHB received ≥28 days after first valid dose AND ≥1 year old ○ DTaP-HB-IPV-Hib, DPT-HB, DPT-HB-Hib or DTaP-HB-IPV 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, DTaP-HB-IPV-Hib, DPT-HB, DPT-HB-Hib or DTaP-HB-IPV AND one of the following: – HB, HB-dialysis, HB-unspecified, DTaP-HB-IPV-Hib, DPT-HB, DPT-HB-Hib or DTaP-HB-IPV received ≥112 days after first valid dose AND received ≥28 days after second valid dose – HAHB received ≥168 days after first valid dose AND received ≥28 days after second valid dose AND ≥1 year old ○ First valid dose was HAHB AND current dose is HB, HB-dialysis, HB-unspecified, HAHB, DTaP-HB-IPV-Hib, DPT-HB, DPT-HB-Hib or DTaP-HB-IPV 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, where a 168-day interval is required between the first and last doses in the series whenever HAHB 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 and DTaP-HB-IPV are validated using the logic for DTaP-HB-IPV-Hib.

**** Age cohort(s) assessed updated***

***** Change in vaccine nomenclature***

Human papillomavirus (HPV)

Last updated: 2018–19 school year

Parameter	Definition
Age assessed	12 years old (all students) 17 years olds (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 vaccines	HPV-2, HPV-4, HPV-9, hpv-unspecified
Vaccine interactions	None
Multiple vaccines on the same day	Use the following hierarchy to keep only one record: HPV-9 > hpv-unspecified > HPV-4 > 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	All students are assessed using both the two- and three-dose schedules. A student is assessed as being up-to-date if at least one schedule is satisfied. ***If gender is female:*** <u>Two-dose schedule</u> • 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 <u>Three-dose schedule</u> • 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:*** <u>Two-dose schedule</u> • First valid dose — HPV-4, HPV-9 or hpv-unspecified received at 9 to <15 years old

Parameter	Definition
	• Second valid dose — HPV-4, HPV-9 or hpv-unspecified received ≥168 days after first valid dose <u>Three-dose schedule</u> • 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. • Beginning in the 2016–17 school year, Ontario's HPV vaccination program switched from a program for Grade 8 girls to Grade 7 boys and girls.‡ • Beginning September 5, 2017, HPV-9 replaced the HPV-4 vaccine in Ontario's HPV vaccination program.† • HPV-2 is not incorporated into the valid dose parameters for coverage in males, as it is not authorized for use in males.

**** Age cohort(s) assessed updated***

Measles

Last updated: 2018–19 school year

Parameter	Definition
Ages 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 vaccines	M, MR, MMR, MMR-Var
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, R, Var, YF, Sma, Zos**, Zos-unspecified**, 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	Received relevant immunizing agent in accordance with the following criteria: • 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
Exemption antigens	Measles (M)

**** Age cohort(s) assessed updated***

***** Change in vaccine nomenclature***

Meningococcal C conjugate (MCC)

Last updated: 2017–18 school year

Parameter	Definition
Age assessed	7 years old
Up-to-date definition	≥1 valid dose
Relevant vaccines	Men-C-CY*, Men-C-ACYW-135**, men-ACYW-135 unspecified**, Men-C-AC, Men-C-C, men-c-unspecified, men-AC unspecified, men-unspecified, Men-C-CY-Hib
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-ACYW-135**, men-p-AC unspecified, men-p-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 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	Received relevant immunizing agent in accordance with the following criteria: • 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.
Exemption antigens	Men-C-AC, Men-C-CY, Meningitis (Men-C-GrC), meningitis (men-ACYW135), meningitis (men-C-ACYW135), meningitis (men-C-u), meningitis (men-GrC), meningitis (men-u)†

**** New vaccine added in 2018-19 school year***

***** Change in vaccine nomenclature***

Meningococcal conjugate, quadrivalent (MCV4)

Last updated: 2018–19 school year

Parameter	Definition
Age assessed	12 and 17 years old*
Up-to-date definition	≥1 valid dose
Relevant vaccines	Men-C-ACYW-135**, men-ACYW-135 unspecified**
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-AC unspecified, men-p-unspecified, men-p-A 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	Received relevant immunizing agent in accordance with the following criteria: • 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 (CIG recommends a booster dose every five years for those vaccinated at 7 years of age and older), 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.
Exemption antigens	meningitis (men-ACYW135), meningitis (men-C-ACYW135), meningitis (men-C-u), meningitis (men-u)

**** Age cohort(s) assessed updated***

***** Change in vaccine nomenclature***

Mumps

Last updated: 2018–19 school year

Parameter	Definition
Ages 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 vaccines	Mu, MMR, MMR-Var
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-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	Received relevant immunizing agent in accordance with the following criteria: • 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
Exemption antigens	Mumps (Mu)†

**** Change in vaccine nomenclature***

Pertussis

Last updated: 2018–19 school year

Parameter	Definition
Ages 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 (only if received first valid dose at <7 years old AND received fourth valid dose at ≥4 years old)
	• 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)*
	
	* 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 vaccines	aP, DTaP, DTaP-HB-IPV-Hib, DTaP-IPV, DTaP-HB-IPV, DTaP-IPV-Hib, DTaP-Hib*, ap, Tdap, Tdap-IPV, ap-unspecified, DPT, DPT-HB, DPT-HB-Hib, DPT-Hib, DPT-IPV, DPTP, DPTP-Hib, pertussis-unspecified, wP
Vaccine interactions	None
Multiple vaccines on the same day	Keep any one (no distinction between aP, ap, pertussis-unspecified and wP)
Evidence of immunity	Not applicable

Valid dose definitions	Received relevant immunizing agent in accordance with the following criteria:
	• 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

Parameter	Definition
	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 CIG chapter on pertussis for children who initiate the series when ≥7 years old, 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*.[3]*****
Exemption antigens	Pertussis (aP), pertussis (P), pertussis (ap), pertussis (ap-u), pertussis (pertussis-u), Pertussis (wP)

**** New vaccine added in the 2018–19 school year***

Polio

Last updated: 2017–18 school year

Parameter	Definition
Ages 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 vaccines	OPV, DPT-IPV, DT-IPV, DTaP-HB-IPV-Hib, DTaP-IPV, DTaP-HB-IPV, DTaP-IPV-Hib, IPV, T-IPV, Td-IPV, Tdap-IPV, DPTP, DPTP-Hib, p-unspecified
Vaccine interactions	None
Multiple vaccines on the same day	Keep any one (no distinction between OPV and IPV)
Evidence of immunity	Not applicable
Valid dose definitions	Received relevant immunizing agent in accordance with the following criteria: • 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 CIG, the dose administered at ≥4 years old does not need to be IPV (i.e., can be either IPV or OPV).
Exemption antigens	Polio (IPV), polio (p-u), live poliovirus (OPV)

Pneumococcal conjugate

Last updated: 2016–17 school year

Parameter	Definition
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 vaccines	Pneu-C-7, Pneu-C-10, Pneu-C-13, pneu-unspecified, pneu-c-unspecified
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. Polysaccharide pneumococcal 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	A child is assessed according to multiple schedules and is considered up-to-date if at least one of the following schedules is satisfied. <u>3+1 schedule</u> • 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 <u>2+1 schedule</u> • First valid dose — Received at ≥42 days to <1 year old AND received on the

Parameter	Definition
	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 <u>Two-dose schedule</u> • 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 <u>One-dose schedule</u> • 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 CIG chapter on pneumococcal vaccines and vaccine-specific product monographs. In general, the interval that would allow for the greatest number of valid doses was selected when discrepancies were noted.

Rubella

Last updated: 2018–19 school year

Parameter	Definition
Ages 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 vaccines	R, MR, MMR, MMR-Var
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-unspecified*r, 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	Received relevant immunizing agent in accordance with the following criteria: • 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
Exemption antigens	Rubella (R)†

† Change in vaccine nomenclature

Tetanus

Last updated: 2018–19 school year

Parameter	Definition
Ages 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 (only if received first valid dose at <7 years old AND received fourth valid dose at ≥4 years old) • 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)* * 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 vaccines	DPT, DPT-HB, DPT-HB-Hib, DPT-Hib, DPT-IPV, DPTP, DPTP-Hib, DT, DT-IPV, DTaP, DTaP-HB-IPV-Hib, DTaP-IPV, DTaP-HB-IPV, DTaP-IPV-Hib, DTaP-Hib*, T, T-IPV, Td, Td-IPV, Tdap, Tdap-IPV
Vaccine interactions	None
Multiple vaccines on the same day	Keep any one
Evidence of immunity	Not applicable
Valid dose definitions	Received relevant immunizing agent in accordance with the following criteria: • 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

Parameter	Definition
	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 CIG chapter for tetanus for children who initiate the series when ≥7 years old, 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*.[3]
Exemption antigens	Tetanus (T), Tetanus antibody

**** New vaccine added in the 2018–19 school year***

Varicella

Last updated: 2018–19 school year

Parameter	Definition
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 vaccines	Var, MMR-Var
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-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 following: Varicella (Var), Varicella-zoster antibody, Zoster (Zos)
Valid dose definitions	Received relevant immunizing agent in accordance with the following criteria: • 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

Change in vaccine nomenclature

Appendix 2: Immunization Abbreviations and Descriptions

Abbreviation	Description of antigen(s)	Source
aP	Acellular pertussis	Panorama
ap	Acellular pertussis (reduced)	Panorama
ap-unspecified	Reduced acellular pertussis-containing agent (agent formulation unknown)	Panorama
BCG vaccine	Bacillus Calmette-Guérin	Panorama
D	Diphtheria toxoid	Panorama
d	Diphtheria toxoid (reduced)	Panorama
D-Hib	Diphtheria toxoid, *Haemophilus influenzae* type b	Panorama
DPT	Diphtheria toxoid, tetanus toxoids, whole-cell pertussis	Panorama
DPT-HB	Diphtheria toxoid, tetanus toxoid, whole-cell pertussis, hepatitis B	Panorama
DPT-HB-Hib	Diphtheria toxoid, tetanus toxoid, whole-cell pertussis, hepatitis B, *Haemophilus influenzae* type b	Panorama
DPT-Hib	Diphtheria toxoid, tetanus toxoid, whole-cell pertussis, *Haemophilus influenzae* type b	Panorama
DPT-IPV	Diphtheria toxoid, tetanus toxoid, whole-cell pertussis, inactivated poliomyelitis	Panorama
DPTP	Diphtheria toxoid, tetanus toxoid, whole-cell pertussis, poliomyelitis	Panorama
DPTP-Hib	Diphtheria toxoid, tetanus toxoid, whole-cell pertussis, poliomyelitis, *Haemophilus influenzae* type b	Panorama
DT	Diphtheria, tetanus	Panorama
DTaP	Diphtheria, tetanus, acellular pertussis	Panorama

Abbreviation	Description of antigen(s)	Source
DTaP-HB-IPV	Diphtheria toxoid, tetanus toxoid, acellular pertussis, hepatitis B, inactivated poliomyelitis	Panorama
DTaP-HB-IPV-Hib	Diphtheria toxoid, tetanus toxoid, acellular pertussis, hepatitis B, inactivated poliomyelitis, *Haemophilus influenzae* type b	Panorama
DTaP-Hib	Diphtheria toxoid, tetanus toxoid, acellular pertussis, *Haemophilus influenzae* type b	Panorama
DTaP-IPV	Diphtheria toxoid, tetanus toxoid, acellular pertussis, inactivated poliomyelitis	Panorama
DTaP-IPV-Hib	Diphtheria toxoid, tetanus toxoid, acellular pertussis, inactivated poliomyelitis, *Haemophilus influenzae* type b	Panorama
DT-IPV	Diphtheria toxoid, tetanus toxoid, inactivated poliomyelitis	Panorama
d-unspecified	Diphtheria toxoid-containing agent (agent formulation unknown)	Panorama
HAHB	Hepatitis A, hepatitis B	Panorama
HB	Hepatitis B	Panorama
HB-dialysis	Hepatitis B (dialysis formulation)	Panorama
HB-unspecified	Hepatitis B-containing agent (agent formulation unknown)	Panorama
Hib	*Haemophilus influenzae* type b	Panorama; coverage assessment
HPV	Human papillomavirus	Coverage assessment
HPV-2	Bivalent human papillomavirus [types 16, 18]	Panorama
HPV-4	Quadrivalent human papillomavirus [types 6, 11, 16, 18]	Panorama
HPV-9	Nonavalent human papillomavirus [types 6, 11, 16, 18, 31, 33, 45, 52, 58]	Panorama

Abbreviation	Description of antigen(s)	Source
hpv-unspecified	Human papillomavirus-containing agent (agent formulation unknown)	Panorama
IPV	Inactivated poliomyelitis	Panorama
M	Measles	Panorama
MCC	Meningococcal-C-conjugate	Coverage assessment
MCV4	Quadrivalent meningococcal conjugate	Coverage assessment
men-AC-unspecified	Meningococcal groups A, C-containing agent (agent formulation unknown)	Panorama
men-ACYW-135 unspecified	Quadrivalent meningococcal-agent (agent formulation unknown)	Panorama
Men-C-AC	Meningococcal conjugate bivalent (groups A, C)	Panorama
Men-C-ACYW-135	Meningococcal conjugate, quadrivalent (groups A, C, Y, W-135)	Panorama
Men-C-C	Meningococcal conjugate, monovalent (group C)	Panorama
Men-C-CY	Meningococcal conjugate (groups C, Y)	Panorama
Men-C-CY-Hib	Meningococcal conjugate (groups C, Y), *Haemophilus influenzae* type b	Panorama
men-c-unspecified	Meningococcal conjugate agent (agent formulation unknown)	Panorama
Men-P-AC unspecified	Meningococcal polysaccharide, bivalent (groups A, C)	Panorama
Men-P-unspecified	Meningococcal polysaccharide agent (agent formulation unknown)	Panorama
Men-P-ACYW-135	Meningococcal polysaccharide, quadrivalent (groups A, C, Y, W-135)	Panorama
men-p-A-unspecified	Meningococcal polysaccharide group A-containing agent (agent formulation unknown)	Panorama

Abbreviation	Description of antigen(s)	Source
men-unspecified	Meningococcal agent (agent formulation unknown)	Panorama
MMR	Measles, mumps, rubella	Panorama
MMR-Var	Measles, mumps, rubella, varicella	Panorama
MR	Measles, rubella	Panorama
Mu	Mumps	Panorama
OPV	Live attenuated oral poliomyelitis	Panorama
p	Polio	Panorama
pertussis-unspecified	Pertussis-containing agent (agent formulation unknown)	Panorama
Pneu-C-10	Pneumococcal conjugate, 10-valent	Panorama
Pneu-C-13	Pneumococcal conjugate, 13-valent	Panorama
Pneu-C-7	Pneumococcal conjugate, 7-valent	Panorama
Pneu-c-unspecified	Pneumococcal conjugate agent (agent formulation unknown)	Panorama
Pneu-P-23	Pneumococcal polysaccharide, 23-valent	Panorama
Pneu-p-unspecified	Pneumococcal polysaccharide agent (agent formulation unknown)	Panorama
Pneu-unspecified	Pneumococcal agent (agent formulation unknown)	Panorama
p-unspecified	Poliomyelitis-containing agent (agent formulation unknown)	Panorama
R	Rubella	Panorama
Sma	Smallpox	Panorama
T	Tetanus	Panorama
Td	Tetanus toxoid, reduced diphtheria toxoid	Panorama
Tdap	Tetanus toxoid, reduced diphtheria toxoid, reduced	Panorama

Abbreviation	Description of antigen(s)	Source
	acellular pertussis	
Tdap-IPV	Tetanus toxoid, reduced diphtheria toxoid, reduced acellular pertussis, inactivated poliomyelitis	Panorama
Td-IPV	Tetanus toxoid, reduced diphtheria toxoid, inactivated poliomyelitis	Panorama
T-IPV	Tetanus toxoid, inactivated poliomyelitis	Panorama
Var	Varicella	Panorama
wP	Whole-cell pertussis	Panorama
YF	Yellow Fever	Panorama
Zos	Herpes zoster	Panorama
Zos-unspecified	Herpes zoster (agent formulation unknown)	Panorama

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