Are we covered?
Immunization coverage and exemptions among Ontario’s school pupils in 2012–13

Jill Fediurek and Sarah Wilson

Moderator: Shelley Deeks

PHO Ground Rounds August 19, 2014
Outline

• Overview of immunization coverage assessment in Ontario
• Results from the 2012-13 school year
  • Programs initiated in infancy and early childhood
  • School-based immunization programs
• Limitations
• Conclusions and next steps
Immunization delivery in Ontario

- Delivery—predominantly by healthcare providers
  - Exception: 3 school-based programs
- Dynamic publicly-funded immunization schedule
  - Several changes in August 2011

<table>
<thead>
<tr>
<th>Schedule 1. Routine Schedule for Children Beginning Immunization in Early Infancy (Starting at 2 months of age)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age at vaccination: Completed months and years</td>
</tr>
<tr>
<td>2 months old</td>
</tr>
<tr>
<td>4 months old</td>
</tr>
<tr>
<td>6 months old</td>
</tr>
<tr>
<td>12 months old</td>
</tr>
<tr>
<td>15 months old</td>
</tr>
<tr>
<td>18 months old</td>
</tr>
<tr>
<td>4-6 years old</td>
</tr>
<tr>
<td>Grade 7 students</td>
</tr>
<tr>
<td>Grade 8 females</td>
</tr>
<tr>
<td>14-16 years old (10 years after 4-6 year old booster)</td>
</tr>
<tr>
<td>Every year (in autumn)</td>
</tr>
</tbody>
</table>

<sup>1</sup>DTwP-IPV preferably given at 4 years of age; administer to children <6 years old, see Schedule 3.  
<sup>1</sup>For Pneu-C-13 high risk schedule, see Table 3.  
<sup>1</sup>MMRV preferably given at 4 years of age.  
<sup>1</sup>Administered through school-based program.  
<sup>1</sup>See Schedule 4 for adult Td immunization.  
<sup>1</sup>Previously unimmunized children <9 years receive 2 doses of Inf 4 weeks apart.
Immunization coverage

- Immunization coverage
  - Refers to the proportion of an age-specific population that is appropriately immunized against a specific vaccine-preventable disease (VPD), in a given year

- Why is it important?
  - Program evaluation and monitoring
  - Provides indirect evidence of population susceptibility to VPDs
  - Provider feedback, targeted interventions to address areas of low coverage

- Methods used internationally
  - Comprehensive population-based immunization registries
  - Administrative data (provider reports, doses distributed)
  - Coverage surveys
Immunization Coverage: Canadian Context

• National standards for immunization coverage assessment\(^1\)
  • Assessment at age 2, 7 and 17 years of age
  • Up-to-date and on-time immunization coverage

• National coverage targets established through F/P/T processes\(^2-4\)
  • Targets set 7-15 years ago, have not always kept pace with new programs\(^2,3\)
  • Some coverage targets more ambitious than established herd immunity thresholds

• Canadian coverage assessment
  • Childhood and Adult National Immunization Coverage Surveys (c/aNICS)
  • 2013 cNICS will allow P/T reporting for first time

1. CCDR 2005;31(9):93-7
3. CCDR 1997;23(S4)
Immunization Coverage: Ontario Context

- Responsibility for immunization coverage surveillance
  - Transferred to Public Health Ontario in 2012
  - Previously Ontario Ministry of Health and Long-Term Care (MOHLTC)

- Public Health Unit (PHU)-MOHLTC accountability agreements
  - Have included school-based immunization coverage estimates

- Immunization module of Panorama
  - Implementation over the course of 2013 and 2014 by Ontario PHUs
  - The 2012-13 Immunization Coverage Report of School Pupils will be the final report produced using data from the Immunization Records Information System (IRIS)
Immunization of School Pupils Act

- Requires annual immunization coverage assessment for school pupils
- Immunization records are collected by Public Health Units
- 6 “designated diseases” under the Immunization of School Pupils Act (ISPA) at the time of report’s assessment
  - diphtheria, tetanus, polio, measles, mumps, rubella
  - varicella, invasive meningococcal disease and pertussis added effective July 1, 2014
- Students require documentation of immunization or a “Statement of Conscience or Religious Belief Affidavit”, or risk school suspension
  - Mandatory choice, not mandatory immunization

1. Immunization of School Pupils Act, R.S.O. 1990.
Immunization Records Information System (IRIS)

- System of de-centralized databases
- Reports to identify “overdue” students
- Coverage reports based on “complete for age” logic\(^1\)
- Immunization data used for numerator
- School board enrollment data forms denominator
- Outdated platform (1992), to be replaced by Immunization Module of Panorama

IRIS Complete for Age Logic

• Assessed based on student date of birth, immunization history (including date of immunization delivery)

• 3 classifications in IRIS: eligible, due, overdue

• Students are assessed as complete until they become overdue

• Examples of “complete for age”
  • Students who have received an age-appropriate number of doses
  • Students who have received an incomplete series, but who are not yet overdue for their next dose
  • Students who are unimmunized but who are not yet at the overdue age
  • Students who are unimmunized but who are no longer eligible for a vaccine
Assessing coverage using IRIS forecasting logic

Scenario: 1 dose MCV4 program, grade 7
IRIS overdue age of 13

Unvaccinated: Red
Vaccinated: Green
Assessing coverage using IRIS forecasting logic

Scenario: 1 dose MCV4 program, grade 7
IRIS overdue age of 13

Sept 2012: 11 unvaccinated, 12 vaccinated (50% coverage)
Dec. 2012: 12 vaccinated
March 2013: 13 vaccinated
June 2013: 12 vaccinated (50% coverage) + 2 not overdue

4 vaccinated in total => 100% complete for age (IRIS)
Immunization coverage report for school pupils: 2012-13 school year
Scope of 2012-13 immunization coverage assessment

ISPA-designated antigens

- Diphtheria
- Tetanus
- Polio
- Measles
- Mumps
- Rubella

Diseases not designated under the ISPA at the time of assessment

- Pertussis
- *Haemophilus influenzae* type b (Hib)
- Varicella
- Invasive pneumococcal disease
- Invasive meningococcal disease
  - Meningococcal C (MenC) vaccine in toddlers
  - Quadrivalent meningococcal (MCV4) vaccine in grade 7 program
- Human papillomavirus (HPV)
- Hepatitis B
Methods

- In June 2013, PHUs were contacted to request coverage and exemptions data from IRIS
- Coverage reports included immunizations administered as of June 30, 2013
- Assessed for each antigen and selected birth cohort(s)
- Exemptions data explored for students at age 7 in 2012-13 school year
  - All exemption classifications explored across ISPA antigens at age 7
  - Medical and non-medical exemptions for measles antigen at age 7, by PHU explored
- Historical data were used to describe temporal trends
- In November 2013, compiled data provided to PHUs for review and validation
- SAS version 9.2 used for analysis
Immunization coverage: Programs initiated in infancy and early childhood
Immunization coverage in Ontario among 7 and 17 year old students: 2012-13

- Diphtheria
- Tetanus
- Polio
- Pertussis
- Measles (2 doses)
- Mumps (2 doses)
- Rubella (≥1 dose)

Comparison between 7-year-olds (2005 birth year) and 17-year-olds (1995 birth year).
Temporal trends: vaccines started in infancy and early childhood among 7-year-olds

<table>
<thead>
<tr>
<th>Year</th>
<th>Diphtheria</th>
<th>Tetanus</th>
<th>Pertussis</th>
<th>Polio</th>
<th>Measles</th>
<th>Mumps</th>
<th>Rubella</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008-09</td>
<td>83.5</td>
<td>83.5</td>
<td>79.6</td>
<td>83.2</td>
<td>83.1</td>
<td>82.7</td>
<td>95.6</td>
</tr>
<tr>
<td>2009-10</td>
<td>75.0</td>
<td>79.0</td>
<td>76.1</td>
<td>74.5</td>
<td>76.4</td>
<td>76.0</td>
<td>94.7</td>
</tr>
<tr>
<td>2010-11</td>
<td>81.1</td>
<td>80.9</td>
<td>77.4</td>
<td>80.4</td>
<td>86.2</td>
<td>85.8</td>
<td>95.0</td>
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<td>2011-12</td>
<td>79.7</td>
<td>79.7</td>
<td>76.0</td>
<td>79.2</td>
<td>89.1</td>
<td>88.6</td>
<td>95.1</td>
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<tr>
<td>2012-13</td>
<td>74.6</td>
<td>74.6</td>
<td>72.6</td>
<td>74.2</td>
<td>88.3</td>
<td>87.9</td>
<td>95.2</td>
</tr>
</tbody>
</table>
Temporal trends: vaccines started in infancy and early childhood among 17-year-olds

<table>
<thead>
<tr>
<th>Year</th>
<th>Diphtheria (%)</th>
<th>Tetanus (%)</th>
<th>Pertussis (%)</th>
<th>Polio (%)</th>
<th>Measles (%)</th>
<th>Mumps (%)</th>
<th>Rubella (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008-09</td>
<td>83.6</td>
<td>83.7</td>
<td>62.7</td>
<td>94.0</td>
<td>95.1</td>
<td>41.0</td>
<td>97.2</td>
</tr>
<tr>
<td>2009-10</td>
<td>82.2</td>
<td>82.1</td>
<td>68.9</td>
<td>93.2</td>
<td>94.4</td>
<td>91.5</td>
<td>96.6</td>
</tr>
<tr>
<td>2010-11</td>
<td>83.0</td>
<td>83.5</td>
<td>66.5</td>
<td>93.2</td>
<td>94.2</td>
<td>92.0</td>
<td>96.7</td>
</tr>
<tr>
<td>2011-12</td>
<td>82.6</td>
<td>82.6</td>
<td>67.7</td>
<td>93.5</td>
<td>94.8</td>
<td>92.9</td>
<td>96.8</td>
</tr>
<tr>
<td>2012-13</td>
<td>84.0</td>
<td>84.0</td>
<td>69.9</td>
<td>94.3</td>
<td>95.4</td>
<td>93.7</td>
<td>97.1</td>
</tr>
</tbody>
</table>
Immunization coverage in 2012-13: Hib, pneumococcal, meningococcal and varicella

- **Hib**: 80% (4-year-olds, 2008 birth year)
- **Pneumococcal**: 80% (5-year-olds, 2007 birth year)
- **Meningococcal**: 80% (7-year-olds, 2005 birth year)
- **Varicella**: 70% (7-year-olds, 2005 birth year)
## Immunization coverage (%) in Ontario: Vaccines started in infancy and early childhood

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Diseases designated under the ISPA</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diphtheria</td>
<td>-</td>
<td>74.6</td>
<td>84.0</td>
<td>99¹</td>
</tr>
<tr>
<td>Tetanus</td>
<td>-</td>
<td>74.6</td>
<td>84.0</td>
<td>99¹</td>
</tr>
<tr>
<td>Polio</td>
<td>-</td>
<td>74.2</td>
<td>94.3</td>
<td>99¹</td>
</tr>
<tr>
<td>Measles</td>
<td>-</td>
<td>88.3</td>
<td>95.4</td>
<td>99¹</td>
</tr>
<tr>
<td>Mumps</td>
<td>-</td>
<td>87.9</td>
<td>93.7</td>
<td>99¹</td>
</tr>
<tr>
<td>Rubella</td>
<td>-</td>
<td>95.2</td>
<td>97.1</td>
<td>97²</td>
</tr>
<tr>
<td><strong>Diseases not designated under the ISPA</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pertussis</td>
<td>-</td>
<td>72.6</td>
<td>69.9</td>
<td>85-95²</td>
</tr>
<tr>
<td>Meningococcal</td>
<td>-</td>
<td>81.5</td>
<td>n/a</td>
<td>97²</td>
</tr>
<tr>
<td>Varicella (age 5)</td>
<td>77.8</td>
<td>-</td>
<td>n/a</td>
<td>85²</td>
</tr>
<tr>
<td>Hib (age 4)</td>
<td>84.6</td>
<td>-</td>
<td>n/a</td>
<td>97¹</td>
</tr>
<tr>
<td>Pneumococcal (age 4)</td>
<td>79.8</td>
<td>-</td>
<td>n/a</td>
<td>90²</td>
</tr>
</tbody>
</table>

Immunization coverage: School-based programs
Ontario’s school-based immunization programs

• Hepatitis B vaccine (1994; 2 doses)
  • Delivery in grade 7, extended eligibility until end of grade 8
  • National coverage target: “Achieve and maintain 95% hepatitis B immunization of populations targeted in universal programs by 1997” ¹

• Invasive meningococcal disease (2005, MCV4 since 2009; 1 dose)
  • Delivery in grade 7, once eligible, always eligible
  • National coverage target: 90% for MCC vaccine at age 17 by 2012²

• Human papillomavirus (2007: HPV4, 3 doses)
  • Delivery to grade 8 girls, extended eligibility until end of grade 12
  • National coverage target: 80% within 2 years and 90% within 5 years³

¹ Health Canada. CCDR 1997;23S4.
² PHAC. CCDR 2007;33S3:1-56.
Rationale and benefits of school-based immunization delivery

- Provide a platform to reach adolescents
  - Adolescents have low HCP attendance\(^1\), especially males\(^2\)

- Convenience leading to increased coverage\(^1\)

- Improved health equity?
  - Reverse gradient found for HPV vaccine uptake in BC\(^3\), not ON\(^4\)

- Cost-effectiveness as compared to HCP-delivered
  - Demonstrated for Hepatitis B\(^5,6\) and meningococcal conjugate\(^7\)

- Peer support at the time of vaccination\(^8\)

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5. Guay et al. CJPH 2003;94:64.
Immunization coverage (%) in Ontario:
School-based immunization programs

<table>
<thead>
<tr>
<th>Program</th>
<th>Target grade</th>
<th>2012-13 school year</th>
<th>Target coverage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hepatitis B</td>
<td>Grade 7</td>
<td>86.9</td>
<td>95(^1)</td>
</tr>
<tr>
<td>MCV4</td>
<td>Grade 7</td>
<td>89.4</td>
<td>90(^2,3)</td>
</tr>
<tr>
<td>HPV</td>
<td>Grade 8</td>
<td>80.2</td>
<td>90(^4)</td>
</tr>
</tbody>
</table>

3. This coverage target was identified for Men-C-C vaccine for 17-year-olds.
4. Canadian Immunization Committee. Recommendations on a human papillomavirus immunization program. Her Majesty the Queen in Right of Canada, represented by the Minister of Health; 2008.
Temporal trends: school-based immunization programs

<table>
<thead>
<tr>
<th>Year</th>
<th>Hepatitis B</th>
<th>Meningococcal</th>
<th>HPV</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007-08</td>
<td>80.0</td>
<td>85.9</td>
<td>48.0</td>
</tr>
<tr>
<td>2008-09</td>
<td>78.1</td>
<td>86.5</td>
<td>52.5</td>
</tr>
<tr>
<td>2009-10</td>
<td>74.2</td>
<td>83.3</td>
<td>55.2</td>
</tr>
<tr>
<td>2010-11</td>
<td>76.6</td>
<td>n/a</td>
<td>58.4</td>
</tr>
<tr>
<td>2011-12</td>
<td>86.6</td>
<td>84.4</td>
<td>70.2</td>
</tr>
<tr>
<td>2012-13</td>
<td>86.9</td>
<td>89.4</td>
<td>80.2</td>
</tr>
</tbody>
</table>
Immunization exemptions in Ontario: 2012-13 school year and recent trends
Reasons for exemptions among 7 year old students for ISPA antigens: 2012-13

<table>
<thead>
<tr>
<th>Antigen</th>
<th>Religious/Conscientious</th>
<th>Medical</th>
<th>Prior Immunity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diphtheria</td>
<td>1.70</td>
<td>0.20</td>
<td>0.00</td>
</tr>
<tr>
<td>Tetanus</td>
<td>1.70</td>
<td>0.20</td>
<td>0.00</td>
</tr>
<tr>
<td>Polio</td>
<td>1.95</td>
<td>0.39</td>
<td>0.00</td>
</tr>
<tr>
<td>Measles</td>
<td>1.54</td>
<td>0.16</td>
<td>0.06</td>
</tr>
<tr>
<td>Mumps</td>
<td>1.26</td>
<td>0.05</td>
<td>0.05</td>
</tr>
<tr>
<td>Rubella</td>
<td>1.26</td>
<td>0.05</td>
<td>0.05</td>
</tr>
</tbody>
</table>

Proportion (%)
Temporal trends in exemptions due to religious beliefs and conscientious objection among children 7 years old

<table>
<thead>
<tr>
<th>Year</th>
<th>Measles/MMR</th>
<th>Tetanus</th>
<th>Polio</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008-09</td>
<td>1.4</td>
<td>1.3</td>
<td>1.4</td>
</tr>
<tr>
<td>2009-10</td>
<td>1.7</td>
<td>1.4</td>
<td>1.6</td>
</tr>
<tr>
<td>2010-11</td>
<td>1.4</td>
<td>1.5</td>
<td>1.8</td>
</tr>
<tr>
<td>2011-12</td>
<td>1.4</td>
<td>1.6</td>
<td>1.8</td>
</tr>
<tr>
<td>2012-13</td>
<td>1.5</td>
<td>1.7</td>
<td>2.0</td>
</tr>
</tbody>
</table>
Discussion: Routine programs

- Great variability in coverage by vaccine and by age groups
  - Coverage generally higher among 17-year-olds versus 7-year-olds
  - Among 7-year-olds, coverage for all antigens (except rubella), decreased relative to 2011-12
  - Among 17-year-olds, coverage for all antigens increased from 2011-12
  - With the exception of rubella for 17-year-olds, national targets not met
Discussion: School-based programs

- HepB, MCV4 and HPV coverage all increased relative to 2011-12
- Ontario’s coverage estimate for its adolescent meningococcal program meets the national coverage target
- HPV coverage at all time high and over 80% (32% increase since program’s introduction)
Discussion: Exemptions

- Total exemptions in Ontario <2% provincially
  - Immunization exemptions due to religious/conscientious objection remain low in Ontario, but with large regional variability
  - And appear to have increased over time

- Further exploration of temporal trends in exemptions have confirmed small but significant increase over time

- IRIS reports on immunization exemptions:
  - Aggregate only: Can’t validate with student immunization history
  - By disease: Can’t quantify number of students with an exemption to at least 1 VPD
  - Cannot differentiate exemptions due to religious belief from conscientious objection
Limitations

- **Lack of system integration for the documentation of immunizations delivered outside of PHUs**
  - Coverage will be under-estimated if students are immunized but have not provided the information to their PHU
  - PHU practices regarding frequency of assessment activities not explored in report

- **Methodological challenges**
  - Duplicate identification and management
  - Use of IRIS forecasting logic
  - Mismatch between program eligibility (grade-based) and coverage calculation (age-based)
  - Inability to distinguish between MenC and MCV4 vaccine programs
Conclusions, next steps and future opportunities

- New information system (Panorama) presents opportunities for more detailed assessment of coverage
  - On time and up-to-date coverage assessment
  - Analysis of predictors of uptake

- Certain challenges likely to remain
  - Timely assessment of coverage at age 2 years
  - Reliance on PHU assessment activities to ensure accurate coverage estimates
Acknowledgements

- VPD managers and staff at Ontario’s 36 PHUs
- Immunization coverage and Communications team at PHO
  - Chi Yon Seo
  - Gillian Lim
  - Shelley Deeks
  - Natasha Crowcroft
  - Keisha Mair
  - Steven Janovsky
  - Michael Gibbs
  - Cathy Mallove
- Immunization Policy and Programs Section, MOHLTC