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Immunization data capture: registry versus physician EMR. Ontario, Canada

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Background: Ontario

- Canada's most populous province
  - Population 13.4 million
- Single payer public funding of health care services
  - Publicly-funded immunization schedule
  - Infant/childhood vaccines: delivered by primary care providers
- School-entry immunization legislation
  - *Immunization of School Pupils Act (ISPA)*
  - Applies to immunizations for 9 vaccine-preventable diseases
  - Permits both religious/conscientious and medical exemptions
  - Enforced by local Public Health Units


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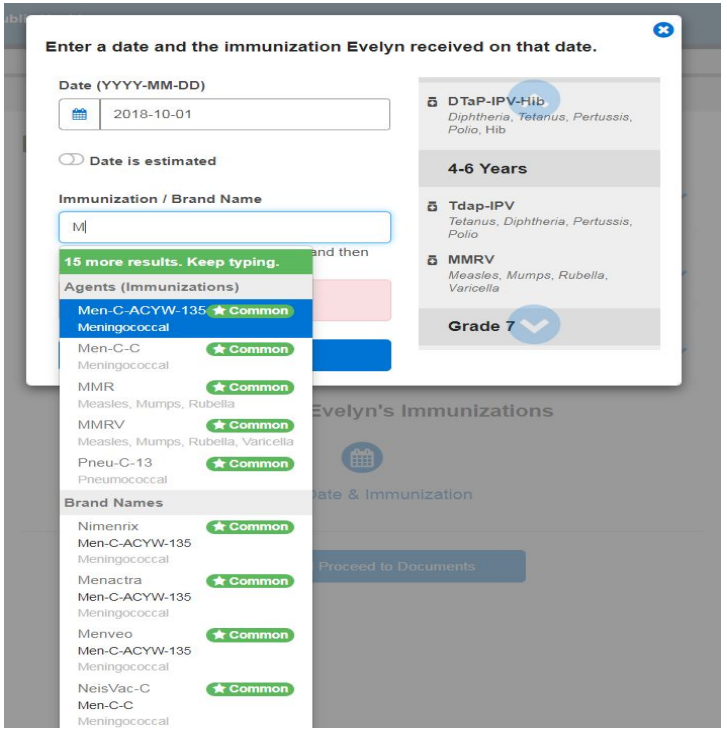
Digital Health Immunization Repository (DHIR)

- Used by 35 Ontario Public Health Units (PHUs) to:
  - Assess and enforce school-entry requirements
  - Record immunizations delivered by community providers and by PHUs
- Parents/guardians are responsible for reporting immunizations
  - Healthcare provider validation/documentation is not required
- Healthcare provider reporting/viewing: not at present
  - Pilot project to integrate electronic medical records (EMRs) and registry recently announced

Parent reporting of immunizations in Ontario in 2019

- Paper documentation sent by fax or mail

- Web-based reporting



Objective

- To assess the completeness of immunization data within Ontario's immunization registry, as compared to immunization data in a network of family physician EMRs

METHODS

Electronic Medical Records-Primary Care (EMRPC) database

- A centralized repository of EMR data
  - >350 family physicians in Ontario who use Practice Solutions Suite® (most widely used EMR in Ontario)
  - Individual level data in EMRPC collected annually and linked to health administrative data
  - Formally evaluated for data quality and completeness [1,2] and used in previous immunization research[3,4]

1. Tu K, et al. Am J Manag Care 2014;20:e15-21. 2.Tu K, et al. BMC Med Inform Decis Mak 2015;15:67.
3. Schwartz K, et al. Hum Vaccin Immunother 2015;11(7):1840-7. 4. Wilson SE, et al. PLoS One. 2018 Feb 14;13(2):e0192809.

General approach to analysis

- Through data linkage, identified a group of children who:
  - Received primary care (from birth through to age 7) from an EMRPC physician (based on EMRPC data)

    and
  - Attended school in Ontario at age 7 (based on DHIR data)

- Calculated immunization coverage at age 7 (by vaccine and overall) using immunizations entered in the two systems (separately) to compare estimates

Cohort creation: children born in years 2006-2008

EMRPC: Exclusions*

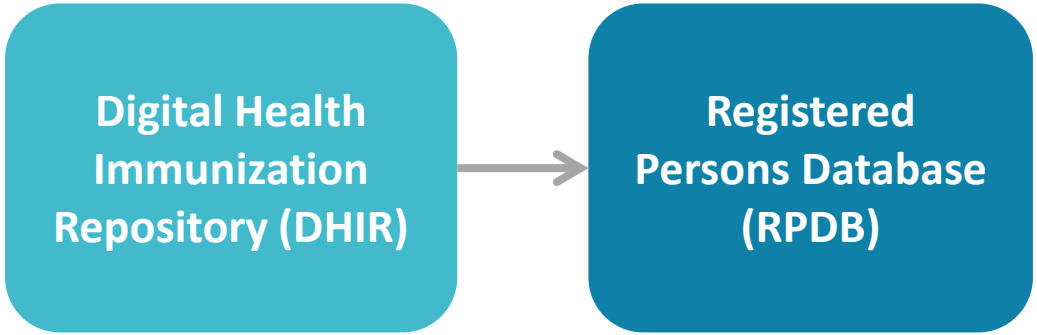
- Death before age 7
- EMR start > 8 weeks after birth
- No valid Ontario Health Card
- < 2 visits in first year of life
- No EMR visit between age 1 and 2
- No EMR visit between age 4 and 7
- Not rostered to an EMRPC physician

Linked DHIR at ICES: Exclusions*

- Discrepant birth date or sex between DHIR and RPDB
- Not in the RPDB eligibility file
- Not OHIP eligible within 90 days of birth or end of OHIP before age 7
- Non-Ontario residence at 7
- Death before age 7
- No school record at age 7

*Data cleaning exclusions also applied (e.g. removing those with multiple/missing unique identifiers)

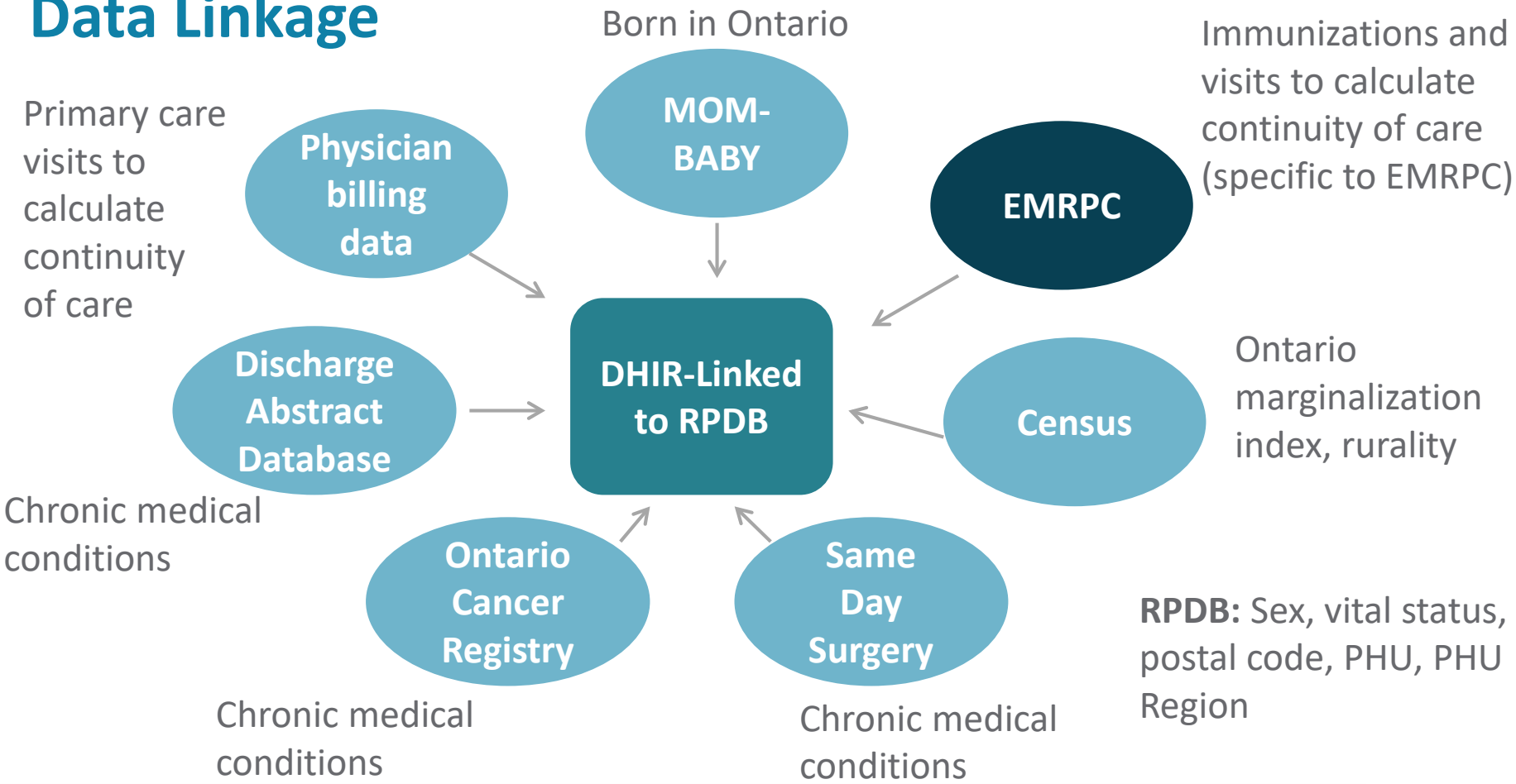
Data Linkage at ICES



Data extract from the DHIR was linked to the RPDB in 2018

- 94.9% linkage rate

Data Linkage



Methods: immunization coverage assessment

- Scope: immunizations for ISPA diseases
  - Calculated up-to-date coverage at 7th birthday
  - MMR vaccine (2 doses), DTaP (4 or 5 doses), Polio (4 doses), Meningococcal C conjugate vaccine (1 dose)

- DHIR data
  - Immunizations recorded using Systematized Nomenclature of Medicine-Clinical Terms (SNOMED-CT) codes

- EMRPC
  - Immunizations in the Cumulative Patient Profile (CPP), treatments/prescriptions fields and structured text within well baby/child progress notes
  - Vaccine terms: generic and trade names and spelling errors

RESULTS

Cohort creation following DHIR-RPDB linkage

Initial EMRPC cohort:
EMR start date on/before 8 weeks after birth, among those with a birth year of 2005-2008 and alive at age 7
(N=4,083)

Exclusions:
- Invalid Ontario Health Card (n=74)
- < 2 EMR visits in 1st year of life (n=108)
- No EMR visit between ages 1 and 2 (n=282)
- No EMR visit between ages 4 and 7 (n=448)
- Not rostered to an EMRPC physician (n=337)

Eligible children from EMRPC
(n=2,834)

Initial DHIR cohort:
DHIR data after linkage to RPDB, among those with a birth year of 2005-2008
(N=622,788)

Exclusions:
- Discrepant birth date or sex between DHIR and RPDB (n=3,113)
- Not in RPDB eligibility file (n=543)
- Not OHIP eligible within 90 days of birth (n=98,866)
- End of OHIP eligibility before age 7 (14,512)
- Non-Ontario residence at age 7 (n=945)
- Death before age 7 (n=7)
- Linkage to multiple identifiers (n=1,921)
- No school record at age 7 (n=31,668)

Eligible children from DHIR
(n=471,213)

Final EMRPC-DHIR cohort n=2,657

Characteristics of the study cohort

N=2,657	Percentage (%)	Median (IQR)
Male	51.1	
Born in Ontario	98.2	
Chronic medical condition	8.3	
Rural residence	27.6	
# Primary care visits from birth to age 7 (all providers)		22 (17-31)
# Primary care visits from birth to age 7 (EMRPC providers)		18 (11-25)
Quintile of Material Deprivation (n=2,656*) Q1 (most affluent) Q2 Q3 Q4 Q5 (most deprived)	 24.8 15.2 22.1 20.6 17.2	

*Missing Quintile of Material Deprivation for n=1

Up-to-date (UTD) coverage, by vaccine and data source. All clinics (n=2,657)

Vaccine	EMR UTD (%)	Registry UTD (%)	Difference (EMR - Registry)
DTaP 4 (or 5) doses	78.1	85.0	-6.9
Polio 3 (or 4) doses	79.4	84.8	-5.4
MMR 2 doses	88.3	97.0	-8.7
Men-C 1 dose	96.9	96.6	0.3
All ISPA vaccines	67.6	82.0	-14.4

Exploration of Children UTD in Registry, but not UTD in EMR

Question: Are some clinics capturing immunizations in the EMR differently than others?

- Focus: Children with “false positive” MMR records (UTD in registry, not UTD in EMR), n=251
  - 201/251 (80%) children with “false positive” MMR records receive care from 2 clinics (A+B)
  - Remaining 50 children receive care from one of 41 clinics
- What is the impact of excluding these 2 clinics (A+B)?

UTD coverage, by vaccine and data source
After excluding clinics A+B (n=2,220)

Vaccine	EMR UTD (%)	Registry UTD (%)	Difference (EMR - Registry)
DTaP 4 (or 5) doses	85.1	85.6	-0.5
Polio 3 (or 4) doses	82.0	85.5	-3.5
MMR 2 doses	96.1	97.5	-1.4
Men-C 1 dose	97.0	96.7	0.3
All ISPA vaccines	76.8	83.0	-6.2

Discussion

- Measures of coverage were higher using immunizations in the registry, with the exception of Men-C vaccine

- Possible explanations for observed differences in coverage:
  - Immunizations given by non-EMRPC providers
  - Non-standard vaccine terminology in use in EMRs
  - Non-standard immunization documentation in EMRs
  - Parental error in reporting immunizations
  - Combination of all of the above

Non-standard vaccine terminology and non-standard vaccine documentation in EMRPC

- Vaccines often recorded using all capital or all lower case letters (e.g. dtap, DTAP, tdap, TDAP)
  - Difficult to assess if appropriate vaccine (for age) given (e.g. DTaP versus Tdap)

- Infant immunizations for this cohort were recorded 8-10 yrs ago
  - Has clinician entry of immunizations (including vaccine terminology used) improved over time?

Conclusions

- Ontario's registry (populated using parental report of immunizations) appears to be a relatively complete and comprehensive source of infant/early childhood immunizations

- After excluding 2 outlier clinics, measures of coverage were more similar to those calculated using family physician EMRs

- Non-standard vaccine terminology and documentation in EMRs were identified in our analyses and may be relevant for future plans for registry-EMR integration

Disclosures

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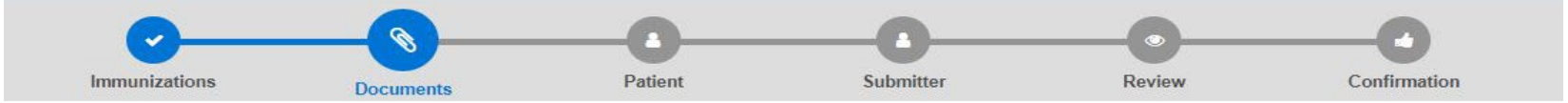
- Parts of this material are based on data and/or information compiled and provided by the Canadian Institute for Health Information (CIHI). However, the analyses, conclusions, opinions and statements expressed in the material are those of the author(s), and not necessarily those of CIHI.

QUESTIONS?

SUPPLEMENTAL MATERIALS



Documents (optional)

Including documents helps your local Public Health Unit confirm the immunization records you have provided. If you have documents you would like to include with your immunization information, click on the "Choose File" button below to add up to two documents.

Documents Include

A photo of a Yellow Card

A document from your doctor displaying immunizations only. This can be a photo of the document.

Do Not Include

Any document that does not relate to immunization information.

For Confirmation Only

Methods: coverage assessment using EMRPC

- Free text entries from EMRPC individually reviewed
  - If an antigen was not specified in the vaccine name/abbreviation, it was assumed to have not been given (exception: typos)
    - Dtap-hpv-hib
    - DTaP-IPC-Hib
    - DTaP-IPVN-Hib

    Examples of inactivated poliovirus (IPV) typos

    - DPT + HB + HIB

    Polio not clearly listed in this record

Standardized vaccine terminology in DHIR for serogroup C-containing meningococcal vaccines

- Men-C-ACYW135
- Men-C-C
- Men-C-CY-Hib
- Men-C-AC
- men-c-unspecified
- men-AC unspecified
- men-ACYW135 unspecified
- men-unspecified

Non-standard vaccine terminology in EMRPC for serogroup C-containing meningococcal vaccines

MenC

Men-C

Men C

Meng C

Menjugate

Mengugate

Menguate

Meninjugate

Minjigate

Meningitec

Menactra

mengugte

NeisVac-C Vaccine

NeisVac-C

NeisVac C

NeisVacC

Neis Vac-C

Men-C-C

Men C congugate

meningococcal c [men-c]

meningococcal conjugate

meningitis C vaccine

Menectra

Menigitis A & C

Menveo

Menigococcal C Conjugate

Meningococcal conjugate group C vaccine

Meningococcal conjugate a,c,y,w-135 vaccine

Menjugate Men-C-C

meningococcal virus vaccine

Meninogococcal Conjugate

Meningococcal C Conjugate

Meninigococcal C-Conjugate

Meninigococcal Conjugate

meniningococcal conjugate

meninococcal conjugate

Meninogococcal Conjugate

meninogoccal conjugate

meningococcal - conjugate [men-c]

Meningotec

Mennicoccal C

menningcoccal ACYW135

Neis_Vac

Neisvac Aug 2009 and May 2010

MEN AC

Meningitis

meningitis vaccine

meningococcal

UTD coverage (all ISPA vaccines) by data source, stratified by select covariates: All clinics (n=2,657)

Variable	Value	EMRPC UTD	DHIR UTD	Difference
Birth year	2005	65.6	83.0	-17.4
	2006	60.6	80.5	-19.9
	2007	71.7	82.3	-10.6
	2008	68.0	82.2	-14.2
Rurality	Urban	66.4	81.9	-15.5
	Rural	70.7	82.3	-11.6
Ontario Marginalization Index	Q1 most affluent	62.9	83.4	-20.5
	Q2	71.2	84.4	-13.2
	Q3	61.2	79.9	-18.7
	Q4	71.8	83.5	-11.7
	Q5 most deprived	74.3	78.7	-4.4
Continuity of Care	High	67.1	82.7	-15.6
	Low	69.4	79.3	-9.9

UTD coverage (all ISPA vaccines) by data source, stratified by select variables: after excluding clinics A+B (n=2,220)

Variable	Value	EMRPC UTD (%)	DHIR UTD (%)	Difference (EMRPC -DHIR)
Birth year	2005	75.6	84.9	-9.3
	2006	75.3	79.8	-4.5
	2007	79.8	82.5	-2.7
	2008	75.4	84.2	-8.8
Rurality	Urban	75.8	83.0	-7.2
	Rural	79.4	83.2	-3.8
Ontario Marginalization Index	Q1 most affluent	75.3	83.2	-7.9
	Q2	81.5	86.4	-4.9
	Q3	82.8	83.6	-0.8
	Q4	73.1	83.9	-10.8
	Q5 most deprived	74.3	78.7	-4.4
Continuity of Care	High	76.6	83.5	-6.9
	Low	77.9	81.4	-3.5