Estimates and projections of susceptibility to polio among the childhood population in British Columbia, Alberta and Ontario

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Objective

We combined data on vaccine coverage and population projections to project how childhood susceptibility to polio in 3 Canadian provinces could change in the next 10 years if current vaccination levels remain constant.

Key Messages

In British Columbia and Ontario, polio susceptibility by 2035 is projected to rise in line with population growth; in Alberta, a 43% increase in the number of potentially susceptible children is expected, driven by higher expected population growth and sub-optimal coverage in certain areas.

Characterizing future risk of vaccine-preventable diseases requires understanding of changes in population susceptibility over time, considering vaccine-induced protection and demographic changes.

Background

- Despite decades of progress towards polio eradication, wild and vaccine-derived polioviruses still circulate in numerous regions, posing ongoing risk for countries that have eliminated polio
- Recent environmental detections of circulating Vaccine-Derived Poliovirus 2 (cVDPV2) in North Ameria and Europe raise concerns regarding the potential for poliovirus introduction and transmission in settings with historically high levels of immunization with inactivated polio vaccine (IPV), including Canada (1–5)
- Three doses of inactivated polio vaccine (IPV) provide high, possibly life-long protection against polio paralysis, but IPV-vaccinated individuals can still be infected with and transmit polioviruses (6,7)
- Undetected transmission of polioviruses, if it occurred, would pose low risk to fully vaccinated individuals, but could be a concern in communities with low immunity to polio (8)

- Characterizing immunity gaps and pockets of susceptibility is important for understanding the risks posed by potential polio transmission events in Canada

Methods

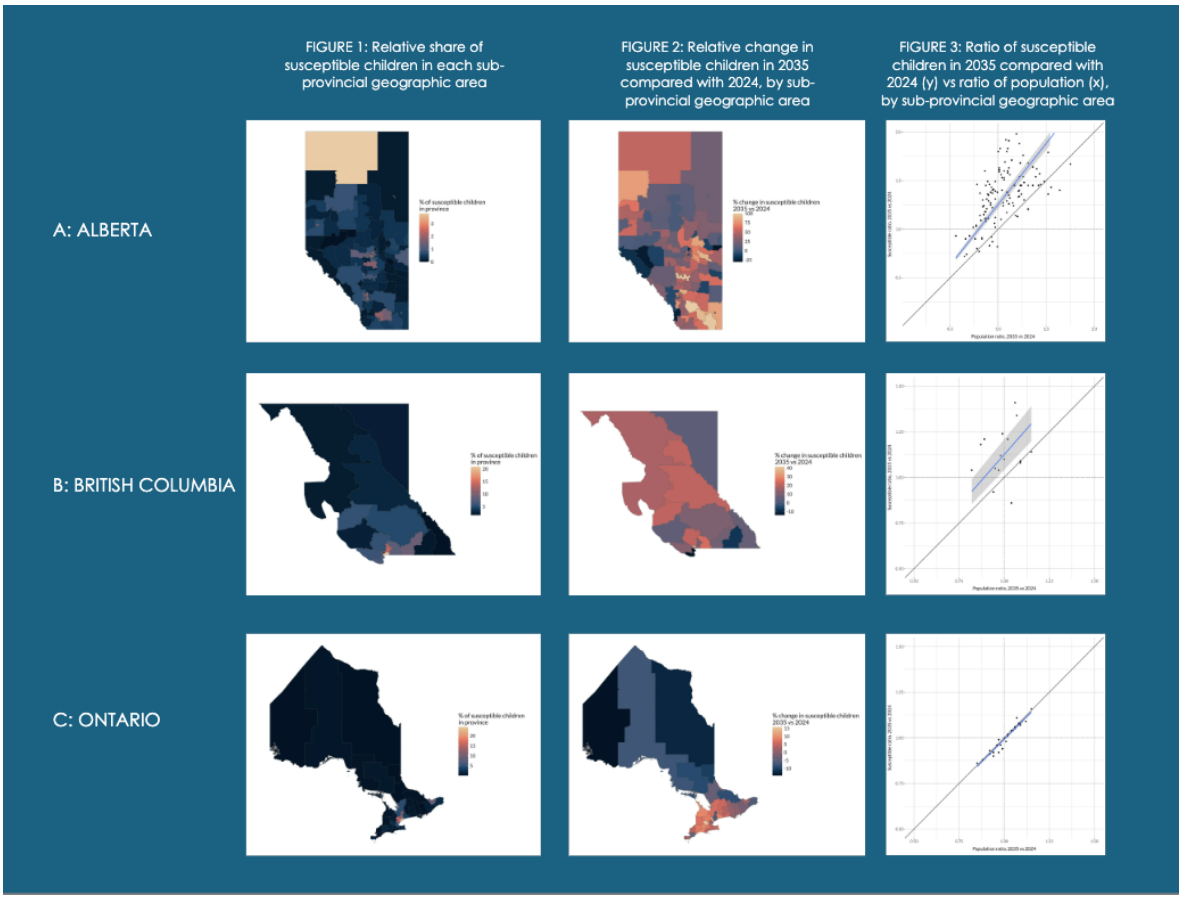
- We applied publicly available data on sub-provincial polio vaccine coverage in successive birth cohorts (9–11) to age-specific population sizes to estimate the number and percentage of children susceptible to polio in 2024
- Susceptibility was defined as not up-to-date for age according to provincial vaccination schedules (see limitations) (12–14)
- We used sub-provincial population projections (15–17) to project the number of potentially polio-susceptible children in 2035 if vaccination coverage remains at current levels

Findings

	Estimated susceptible children in 2024 N (%)	Projected susceptible children in 2035 N (%)	Overall % change in susceptible children, 2035 vs 2024	Median (IQR) change in susceptibility across geographic areas
Alberta (<18 years)	146,000 (14%)	207,000 (18%)	43%	37% (15% - 54%)
British Columbia (<18 years)	237,000 (26%)	270,000 (28%)	14%	11% (5% - 21%)
Ontario (7-17 years)	331,000 (18%)	335,000 (18%)	1%	2% (-5.5% - 6.8%)

Table 1: Estimates of potentially polio-susceptible children in 2024 and 2035, and relative change in size of susceptible population

- In 2024, susceptible populations were primarily concentrated in more highly-populated areas in southern BC and Ontario, large urban centres in Alberta, and certain regions in northern, central and southern Alberta (Figure 1)
- If current vaccination levels remain constant, by 2035 the greatest relative increases in susceptible children are expected in areas of southern Alberta, BC and Ontario (Figure 2), but the overall geographic distribution in all 3 provinces is expected to be similar to that in 2024 (not shown)
- In BC and Ontario, increases in polio susceptibility by 2035 are in line with projected population growth (Figure 3, panels B and C)
- In Alberta, the number of susceptible children is projected to rise by 43%; population growth accounts for ~75% of this increase, with sub-optimal vaccine coverage in certain areas having a greater influence relative to the other provinces (Figure 3, panel A)



Conclusions

- Estimates presented are not forecasts, but provide a picture of how polio susceptibility in Canada could change over the next 10 years if current vaccination levels remain constant
- Vaccine coverage data and serological surveys can provide useful information about population immunity to vaccine-preventable diseases, but have certain limitations:
    - Coverage data are crucial indicators of immunization program performance, but provide limited information about how the size of the susceptible population changes over time
    - Serological surveys can provide information about immunity across different age groups, but are conducted infrequently and have limited geographic resolution
- Characterizing future risk from polio and other vaccine-preventable diseases requires further understanding of how the size and distribution of the susceptible population will change over time, considering vaccine-induced protection in successive birth cohorts and demographic changes
- Spatially-stratified projections of susceptibility to polio can help inform assessments of future risk and immunization priorities, and can be incorporated into the development of mathematical models, to study the potential for transmission within Canada and the role of different monitoring and control strategies

Limitations

- This analysis assumes that those who are not 'up-to-date' for age for polio vaccination are completely susceptible, which does not account for partial protection provided by incomplete or delayed vaccination
- Estimates are not directly comparable between provinces due to differences in data availability and reporting
- There are limited coverage data in adult populations and certain groups are likely to be under-represented in coverage estimates (i.e. populations living on-reserve, children not actively attending school, recent immigrants)
- Coverage data likely underestimate immunity levels due to delayed vaccination, incomplete or delayed reporting
- The influence of migration on population susceptibility estimates is unclear; our analysis assumes that vaccine uptake among in-migrants is the same as the host population, which is more likely to be the case if migration occurs at a younger age

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