

Canada's Best Shot: Policies to Improve Childhood Immunization Coverage

by

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Abstract

Despite high coverage overall, routine childhood immunization coverage rates vary across Canada, and are in decline in some regions. Numerous systematic and social factors affect vaccine uptake, including access to healthcare services, vaccine hesitancy, and misinformation. Interviews with public health stakeholders, a review of international best practices in selected countries, and case studies of British Columbia, Alberta, Manitoba, and Ontario identify relative successes and limitations to inform potential policy interventions. This study assesses four policies: mobile immunization clinics, school reporting structures, provider incentives, and extended recall-reminder programs. While jurisdictions have improved accessibility of immunization services, further steps are needed to prompt behavioural change among hesitant parents of under-immunized children. To promote widespread immunization coverage, facilitate data collection, and enhance outbreak management, mobile outreach and immunization clinics are recommended, along with province-wide immunization requirements for school entry. Developing electronic immunization registries remains a foundational priority to target policies for under-vaccinated populations.

Keywords: immunization; vaccination; health policy; vaccine hesitancy; public health; routine childhood immunization

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List of Acronyms

| | |
|--------------|--|
| ACIR | Australian Childhood Immunisation Register |
| BCCDC | British Columbia Centre for Disease Control |
| CDC | Center for Disease Control (US) |
| cNICS | Childhood National Immunization Coverage Survey |
| DTaP-IPV-Hib | Diphtheria, Tetanus, Acellular Pertussis, Inactivated Polio Vaccine, Haemophilus Influenza B |
| HSDA | Health Service Delivery Area (British Columbia) |
| IRIS | Immunization Records Information System |
| ISPA | Immunization of School Pupils Act (Ontario) |
| NACI | National Advisory Committee on Immunization |
| NIS | (Canadian) National Immunization Strategy |
| MIMS | Manitoba Immunization Monitoring System |
| MMR | Mumps, Measles, Rubella Vaccine |
| PHAC | Public Health Agency of Canada |
| PHU | Public Health Unit (Ontario) |
| RHA | Regional Health Authority |
| UTD | Up-To-Date |
| VCH | Vancouver Coastal Health |
| VPD | Vaccine-Preventable Disease(s) |

Glossary

| | |
|----------------------------|---|
| Fully Immunized | Children are considered fully immunized or “up-to-date for age” once they receive the full schedule of provincially recommended vaccines and doses by a specified age. |
| Healthcare Provider | Any individual providing preventive, curative, or promotional services to individuals and communities, including but not limited to nurses, public health nurses, physicians, nurse practitioners. |
| Herd Immunity | Community immunity is achieved when a significant portion of the population is immunized against a disease, providing a measure of protection for individuals who have not developed immunity. |
| Immunization Coverage Rate | The proportion of people who receive one or more vaccine(s) of interest in relation to the overall population. Routinely measured for 2-year olds, 7-year olds, and 17-year olds. |
| Primary Care Provider | A doctor or nurse providing comprehensive health care services such as basic diagnosis or treatment of common illnesses and conditions in a clinical setting; also referred to as a general practitioner. |
| Recalls and Reminders | Notifications used to inform individuals or families of upcoming and overdue immunizations. |
| Under-Immunized | Children are considered under-immunized if they miss one or more of the vaccines recommended by their respective provincial immunization schedule. |
| Vaccination | The administration of agent-specific antigenic components that in vaccinated individuals can induce protective immunity against the corresponding infectious agent. In practice, the terms “vaccination” and “immunization” are often used interchangeably. |

Executive Summary

Routine childhood vaccination programs confer both individual and herd immunity benefits, preventing widespread outbreaks of infectious disease. With many vaccine-preventable diseases still circulating globally, and the ongoing introduction of new vaccines, immunization programs remain a vital instrument of preventative public health. Assessed nationally, Canadian coverage against vaccine-preventable diseases appears high, but such figures mask regional disparities in immunization rates, as well as program delivery. Most Canadian provinces do not meet immunization targets necessary to avert disease transmission. As a consequence, outbreaks of vaccine-preventable diseases like measles, pertussis, and mumps persist in Canada, bringing associated morbidity, mortality, and healthcare costs.

Studies on vaccine hesitancy recognize the effects of individual, social, and health system factors on behaviour through confidence, complacency, and convenience. To identify prominent features that may pose barriers or opportunities for improvement in Canada, this study employs provincial case studies of British Columbia, Alberta, Manitoba, and Ontario, a cross-jurisdictional review of international best practices, and stakeholder interviews with healthcare experts. Results of these methods inform the selection of policy options and policy analyses for uptake across provincial health regions.

Internationally, childhood immunization programs in Australia, New Zealand, and England demonstrate the importance of: a centralized registry capable of reporting on national, regional, and priority populations; setting local coverage targets; and directing financial incentives at the public and physicians in support of high immunization rates among children. Through case study analysis, this study explores features that support higher immunization rates in Canada, including centralized program delivery through public health, clear public messaging, school entry requirements, and electronic registries. Case study findings also identify deficiencies related to differing protocol in immunization reporting and surveillance, data collection, and program delivery and enforcement mechanisms. Stakeholder interviews reveal misinformation among the

public and some healthcare providers, resource constraints, and concerns over information privacy are key barriers to reaching immunization targets. Both provincial case studies and stakeholder interviews indicate that vaccine refusal rates remain relatively low despite small increases, but approximately 30-40% of 2-year olds, depending on the province, may be missing doses of some antigens. Interventions should therefore focus on vaccine hesitance.

Until more granular and comprehensive data are available, governments should direct efforts towards under-immunized individuals who lack some or all vaccines because of accessibility barriers or hesitancy, rather than groups objecting to immunization on religious or conscientious grounds. To increase immunization coverage rates, four options are proposed:

- Extended Recall and Reminder Programs: intensify the use and reach of various notifications aimed at parents of children overdue and soon due for immunizations;
- School Entry Requirements: legislation governing immunization record collection that mandates routine vaccinations or authorized exemptions prior to school entry
- Provider Incentives: population outcome and immunization completion payments, payable as incentives to healthcare providers; and
- Mobile Immunization Clinics and Outreach: initiatives delivering vaccines to communities with empirically low immunization rates.

To measure and compare potential policy options, five criteria were selected to inform the policy analysis: effectiveness in increasing coverage and vaccine acceptance; health equity implications; acceptability among the public, governments, and healthcare providers; cost; and complexity of implementation. Trade-offs between alternatives emerge due to efficiency, breadth of impact, and feasibility within existing provincial registries.

As few provinces have fully functional electronic registries, interventions are warranted in the interim. Based on the policy evaluation, two recommendations were reached for provincial health agencies:

- 1) Deliver immunization outreach and mobile clinics to communities where access and vaccine series completion remain low, such as rural

and remote areas or under-resourced urban neighbourhoods. Prioritize young children and infants not yet in school or pre-school.

2) Establish and legislate school entry requirements. While complex to introduce, this offers the widest improvement across provinces, enhances reporting structures, and establishes penalties for non-compliance. Programs should refer immunization objectors to healthcare providers for counselling before permitting exemptions.

To support these recommendations, provinces should recommit to the goal of achieving interoperable electronic immunization registries capable of real-time surveillance, issuing recalls and reminders, and immunization program evaluation. At the federal level, streamlined and consistent information on vaccine efficacy and safety should provide a single, authoritative source of information to the Canadian public and vaccine providers. No singular intervention will achieve sufficiently high immunization levels over the long run. Provinces should introduce comprehensive immunization strategies that make wide participation a convenient and default option.

Chapter 1.

Introduction

Vaccination programs are among the most effective public health initiatives undertaken, credited with eradicating small pox, virtually eliminating polio, and substantially reducing the illness burden of infectious diseases such as diphtheria, pertussis, and measles. According to the Public Health Agency of Canada (PHAC), immunization saved more lives in the past fifty years than any other medical intervention. Routine childhood immunizations are free in Canada, but the National Immunization Coverage Goals are not being reached. In certain subpopulations or regions of the country, outbreaks of vaccine-preventable diseases persist where coverage rates are especially low, a reality not captured by national indicators. This suggests other barriers to immunization exist beyond cost and vaccine availability. Though immunization provides documented benefits, the effectiveness of new and existing programs depends on public endorsement and government surveillance.

Given the major population health improvements attributed to the introduction of vaccines, namely reduced mortality, morbidity, and negative health outcomes, a number of Canadians assume efforts to maintain vaccine coverage levels are unwarranted. Recent data suggest population coverage, the ratio of those vaccinated to those not vaccinated, is declining. A 2013 report from UNICEF assessed early childhood immunization rates as an indicator of the availability and effectiveness of a country's basic preventive health services. Compared to other affluent countries, Canada ranked poorly, at 28th out of 29 countries (UNICEF 2013). The report cited Canada's immunization rate at 84%, compared to 96% in the United Kingdom and 93% in the United States and Australia. Only three countries had rates below 90%.

Like many public health and preventive health programs, vaccination confers direct protection for the individual inoculated, as well as wider benefits to the community. Through herd immunity, vaccination interrupts contagion when large numbers of a population are immune or less susceptible to the disease. Sustaining this threshold is important for defending the health of those who cannot be immunized, such as young infants and people with compromised immune systems. When fewer people participate in vaccination programs and coverage falls below protective target levels, overall herd immunity decreases and more people are likely to be infected in an outbreak. In Canada, this has led to recent outbreaks of infectious diseases previously considered eliminated, such as measles, and the persistence of conditions such as pertussis (whooping cough) that pose the greatest health risks to those too young to be vaccinated.

Improving vaccination rates and reducing vaccine-preventable disease (VPD) outbreaks will not only reduce costs to the Canadian healthcare system, but also improve communal health outcomes nation-wide. The benefits of immunization are well-documented and clear, demonstrating reduced incidence of disease leading to fewer hospital and doctor's office visits, disability, death, and inequity (Andre, et al. 2008). On account of the low cost of individual vaccines, the expense of providing immunization programs is greatly outweighed by health benefits achieved by averting disease and its treatment.

In Canada, the Public Health Agency (PHAC) sets immunization standards and targets, with programs administered by provinces and local health authorities or units. Outcomes vary considerably across the country, as a result of differing immunization strategies and policies. Difficulties in assessing Canada's immunization status may be attributed to discrepancies in the frequency and methods of calculating provincial coverage rates, as well as local social factors and beliefs. The heterogeneity of Canada's immunization programs, combined with the clustering of social groups influencing vaccination decision-making, requires the attention and intervention of preventive health service providers and policy-makers across Canada.

Reports from PHAC indicate under-vaccinated and unvaccinated children play a role in VPD outbreaks. Though both of these decisions contribute to declining herd

immunity by reducing vaccination coverage rates, research suggests non-vaccinating parents and under-vaccinating parents may refuse or delay immunization for different reasons, based on socio-environmental, personal, and institutional factors. This relationship between parents – the primary gatekeepers of childhood immunization – and the public health system’s role in providing and monitoring immunizations, is particularly important in developing policies to empower both groups towards responsible and informed decision-making.

Exploring the factors behind declining vaccine coverage in Canada provides evidence for policies that could reverse this trend. Data used to compare the effectiveness and acceptability of various policy interventions is derived from provincial case studies, the experiences and results of international jurisdictions, and findings from in-depth stakeholder interviews with healthcare experts. Improvements are urgently needed in overall immunization coverage rates and programs, with particular emphasis on communities where children are under or unvaccinated. This study examines some of the prevalent barriers faced by Canadian provinces in increasing regional vaccination uptake, and develops recommendations for alternate policy interventions of national benefit.

Chapter 2.

The Case for Immunization

Immunization is proven to cost-effectively improve longevity and quality of life, as well as save lives. Widespread use of vaccines can reduce pressures on the healthcare system through averted hospitalizations and long-term disability, along with decreased reliance on antibiotics to treat vaccine-preventable diseases (PHAC 2013). The incidence of various infectious diseases dropped dramatically following the advent of routine immunization programs. Common infectious diseases that were at one time a major cause of illness and death now occur much less frequently (see Appendix C). The viruses and bacteria causing these diseases remain present, however, and circulate within Canada and globally, putting those who are not protected by immunization at risk of infection. In the 2011 measles outbreak in Quebec, for example, 11% of cases required hospitalization (Government of Quebec 2012). Until vaccine-preventable diseases are eradicated worldwide, vigilance to sustain high rates of immunization remains necessary.

2.1. Reduced Public Health Burden

Annually, vaccines prevent as many as 6 million deaths worldwide, with direct savings in the order of tens of billions of dollars (Ehret 2003). By conferring immunity to vaccinated individuals, and herd immunity protection to the broader community that cannot be vaccinated for medical reasons, immunization programs provide health benefits of reduced morbidity and mortality, along with improved population health overall (Fine et al. 2011). The savings achieved through immunization programs greatly outweigh the costs of treating illness or injury that would occur if the program had not been implemented. Using two standard childhood vaccines as examples, the cost savings of the measles, mumps, and rubella (MMR) vaccine is \$16 per dollar spent, with

diphtheria, pertussis, and tetanus (DPT) achieving savings of \$6 per dollar spent (PHAC 2014a). With the rise of international travel in recent decades, immunization also provides the benefit of protection against imported cases of VPD from outbreaks in other countries, and regions where such conditions remain endemic.

In 1998, the National Advisory Committee on Immunization (NACI) approved the varicella (chickenpox) vaccine for use in Canada, and recommended widespread uptake in 1999. Before the vaccine's introduction, PHAC reported a total 350,000 cases of chickenpox nationally. Of these, 1550 were hospitalized each year, with older cohorts typically experiencing more complicated cases (PHAC 2012a). Individuals over 20 years of age were 13 times more likely to be hospitalized for chickenpox and 25 times more likely to die than those under 12 years of age. Along with the health implications, chickenpox bore estimated yearly costs of \$122 million or \$353 per case, 19% of which were ambulatory (9%) and hospital related (10%) (PHAC 2012a). A relatively new vaccine, the varicella antigen provides a compelling case for the health savings achieved through immunization.

Several studies (Waye et al. 2013; Tan et al. 2012) demonstrate the impacts of the varicella vaccine on hospitalization rates in Canada, with similar effects found in research conducted in the United States (Davis et al. 2004; Nguyen et al. 2005). Despite the recognized benefits, varicella vaccination failed to appear on all provincial immunization schedules until 2007, largely because of the lack of public funding. In 2003, the federal government provided \$45 million to develop the National Immunization Strategy (NIS), in response to the growing disparity in public immunization between provinces and territories. The introduction of the NIS, followed by universal publicly funded varicella vaccination by all provinces, resulted in hospitalization declines by 34 to 83% across all provinces. Also important is the reduction of hospitalization for non-vaccinated groups, such as infants under twelve months who are too young to be inoculated. Infants under one year of age experienced 78% less varicella-related hospitalizations between 2000 and 2008, indicating decreased circulation of the virus and a strong case for protection through herd immunity (Tan et al. 2008). Overall, vaccinating against chicken pox shows a reduced burden to the healthcare system, with the cost per year of life saved approximately \$16,000 (PHAC 2014a).

2.2. Protection of the Unvaccinated Population

Vaccination also protects those individuals for whom inoculation was unsuccessful, and people who cannot be immunized. While the vast majority of people vaccinated achieve immunity to the disease, vaccines are not 100% effective (PHAC 2014a). Immunization programs therefore provide beneficial community health externalities to populations with an increased susceptibility to communicable diseases. In a study examining the effect of the 1995 introduction of the one-dose varicella vaccine in the United States, mortality rates declined by 97% between 2002 and 2007 (Marin et al. 2011). Notably, there were zero infant varicella deaths in the US during this period, an outcome directly attributable to the rise in nationwide coverage from 27% in 1997 to 90% in 2007. This is significant because the varicella vaccine is only approved for children 12 months and older; infants under 12 months of age rely on population-wide immunization coverage to prevent infection.

Herd immunity is achieved when a significant portion of the population is immunized against a disease, providing a measure of protection for individuals who have not developed immunity. A population's resistance to the spread of an infectious disease is calculated by the percentage of those who are immune and the probability that those who remain susceptible will come into contact with an infected person. Thus, the proportion of the population that must be immune to achieve herd immunity depends primarily on the reproductive rate of the disease. Extremely infectious diseases like measles have a higher reproductive rate and require especially high population immunity – over 95% coverage – to achieve herd immunity. Above this epidemic threshold, widespread transmission of measles will not occur.

Immunization coverage refers to the proportion of a particular population who are vaccinated against a specific disease. For example, immunization coverage for influenza among seniors is measured as:

$$\frac{\text{People aged 65 years and over receiving influenza vaccine in past season}}{\text{Total population aged 65 years and over}} \times 100\%$$

Combined, herd immunity and immunization coverage can expose a gap between a minimum specified coverage and the actual coverage rate, and provide the epidemiological basis for vaccination target rates. Where a large disparity exists, a population is more susceptible to disease outbreak. Allowing for vaccine failures, targets must be especially stringent. For example, Canada would need to reach a uniform 97% two-dose measles coverage level to sustain an elimination threshold.

In addition to individual guards against infectious diseases, herd immunity also prevents the spread of infection throughout a community and indirectly protects:

- infants who are too young to be vaccinated;
- individuals who cannot be vaccinated for medical reasons (such as immunosuppressed people unable to receive live vaccines like cancer patients or people living with HIV);
- those individuals for whom immunization was ineffective;
- people who do not respond adequately to immunization (such as the elderly).

Children that are not vaccinated or are not vaccinated according to the federally recommended schedule are at increased risk of contracting and transmitting vaccine preventable diseases.

2.3. Immunization Program Administration

The Public Health Agency of Canada (PHAC) is the principal federal government agency responsible for immunization guidelines. As mentioned, PHAC introduced the National Immunization Strategy (NIS) in 2003 to improve collaboration between federal, provincial and territorial governments and key stakeholders towards more effective and efficient immunization programs. Complete immunization coverage and accessibility are chief objectives of the NIS. Supporting PHAC is the National Advisory Committee on Immunization (NACI), providing scientific evidence and advice regarding the use of vaccines in Canada, guidance on the need for national immunization strategies, and recommendations for vaccine research development. Together, PHAC and Health Canada share responsibility for monitoring vaccine safety and effectiveness.

With provincial and territorial (P/T) governments constitutionally responsible for the delivery and administration of healthcare, immunization programs also fall within this jurisdiction. Policies and schedules must conform to the NACI, but because regional needs and resource constraints vary, program implementation depends on the priorities set by the P/T health ministries. The design and maintenance of immunization registries or databases, for example, differs by province. Similarly, vaccination campaigns, training, and education, as well as disease surveillance, fall under the purview of provinces and territories. The federal government holds broad constitutional powers to monitor designated notifiable diseases, such as those preventable through vaccination, but immunization policies are ultimately preventative programs categorized within routine health services. Consequently, federal jurisdiction to regulate immunization beyond the targets and objectives put forth through the National Immunization Strategy is heavily circumscribed (Keelan 2008).

Chapter 3.

Immunization in Canada: Emerging Challenges

3.1. Vaccination Heterogeneity in Canada

Despite the recognized benefits of immunization, such as those achieved with varicella vaccination, Canada faces considerable barriers to reaching high coverage rates and herd immunity. Most provinces do not meet national coverage targets for many vaccines, and disease outbreaks recur as a result. Reasons for vaccination inconsistencies include staggered introduction of vaccines across provinces, sparse coverage data that varies regionally, and geographical pockets where public attitudes of vaccine hesitancy and complacency, including refusal or underimmunization, are increasingly common. The growing complexity of immunization programs – a mix of providers deliver more routine publicly funded vaccines than ever before – makes monitoring and delivery more challenging. With an incomplete understanding of Canada’s immunization status, program evaluation and policy development are strained.

Incomplete Coverage, Data, and Registries

The Childhood National Immunization Coverage Survey (cNICS), a biennial study conducted by Statistics Canada, evaluates progress toward national immunization goals, guides new policy, and identifies populations with low coverage. Because electronic immunization registries are not yet in place across Canada – only six provinces and territories had some form of registry in place in 2013 – random sample surveying is used to present a composite picture of national vaccination coverage, knowledge, and beliefs (PHAC 2013). With an overall response rate of 65% in the 2011 cycle, results compiled findings on knowledge, attitude, and behaviours from 1467 respondents, 1027 of who provided information on vaccination history and status (the remaining 440 did not have access to their child’s immunization records).

Overall, results from the 2011 cNICS demonstrate Canadian immunization falls below national targets, and coverage declines with age. Canadian 2 year-olds meet some antigen uptake targets as a national average, but coverage levels decline at the 7 year-old and 17 year-old markers. Where this survey falls short is its very limited exploration of Canadian subpopulations. The survey does not sufficiently capture regional variation in vaccination rates and perspectives. Though cNICS representatively samples communities throughout Canada, the limited number of participants means a respondent's answers may falsely represent the immunization status of the broader town or region.

A more robust instrument of measuring vaccination coverage and estimating herd immunity, such as immunization registries, is warranted. Sampling vaccination coverage rates is an insufficient measure of regional herd immunity. Overlooking behavioural clustering caused by imitation and peer influence significantly underestimates the levels of vaccination coverage required to attain herd immunity and prevent outbreaks (Ndeffo Mbah et al. 2012). Electronic immunization registries function as confidential, population-based computerized information systems, containing identified data sent directly by immunization providers (Hull et al. 2009). Giddings (2014) suggests overcoming vaccine complacency and hesitancy through a national vaccination registry to improve disease surveillance and prevention by targeting specific groups or regions, along with the harmonization of vaccine schedules across the country for simplified messaging, education, and programming. Coordination between vaccination providers and public health agencies through electronic registries may also assist in reducing vaccine-preventable disease (Groom et al. 2014).

A further benefit of electronic databases is reduced errors and inaccuracies – while 88% of cNIC-surveyed parents believed their child was up to date for their age, data show coverage rates are actually much lower for many vaccines (PHAC 2015). Through added technological capability and oversight of large populations, immunization information systems (IIS) are potentially useful tools for programming patient reminder and recall notices by mail or phone, as well as provider reminder systems that can prompt physicians about due or past due vaccinations before seeing a patient. Among the findings of 108 published articles (Groom et al. 2014), thirteen studies demonstrated

that despite added costs and administrative capacity requirements, IIS systems increase vaccination rates by a median improvement of 6%. An obvious limitation of the findings is the declining marginal improvement; jurisdictions looking to close a small gap to reach herd immunity target levels are less likely to achieve such wide gains. Nonetheless, IIS records can effectively assess potential disparities in vaccination coverage rates by neighbourhood, or expose “pockets of need”, particularly important during disease outbreaks.

Variation in Subpopulation Immunization Coverage

Provincial data from health ministries and regional health authorities (RHAs) show wide ranges in coverage for many childhood immunizations, variable by regions and communities. Correspondingly, outbreaks tend to occur where vaccination rates are low and children are susceptible to VPD. During the 2011 outbreak of measles in Quebec, the largest in Canada since 1995, 80% of the 776 reported cases were not fully vaccinated (Pereira, et al. 2013). Outbreaks since occurred in BC, Saskatchewan, Alberta, Manitoba and Ontario in 2014, drawing attention to districts where uptake of the measles, mumps, and rubella (MMR) vaccine falls well below the national target of 95%. Table 3.1 displays provincial coverage rates:

Table 3.1. Childhood Immunization Coverage Rates Across Canadian Provinces

| Province | DTaP-IPV-Hib | MMR | Varicella | Pneu | Men. C |
|--|--------------|------|-----------|------|--------|
| National Target (2010, 2 yrs) | 95% | 97% | 85% | 90% | 97% |
| Alberta (2013, 2 yrs) | 74.3 | 85.7 | 84.8 | 83.4 | 80.8 |
| British Columbia ¹ (2013, 2 yrs) | 74.0 | 86.0 | 83.0 | 84.0 | 86.0 |
| Manitoba (2013, 2 yrs) | 73.0 | 81.1 | 77.6 | 85.4 | 83.8 |
| New Brunswick (2011-12 at age of school entry, 4-5 yrs) | 78.0 | 69.3 | N/A | N/A | 75.7 |
| Newfoundland (2 yrs, 2011-12) | 96.6 | 95.5 | 96.2 | 96.1 | 96.5 |
| Nova Scotia (2 yrs, 2008) | 69.3 | 85.9 | N/A | 65.9 | 80.5 |
| Ontario ² (2012-13, 7 yrs) | 76.1 | 90.5 | 77.8 | 79.8 | 81.5 |
| Prince Edward Island (2008, 2 yrs) | 81.0 | 79.0 | 93.0 | 81.0 | 93.0 |

| | | | | | |
|--|-------|------|------|------|------|
| Quebec (2012, 2 yrs, survey data) | 85.0% | 83.9 | 92.0 | 93.1 | 94.4 |
| Saskatchewan (2008-09, 2 yrs) | 78.9 | 79.3 | 89.3 | 77.3 | 89.7 |
| Canada (cNICS, 2011) | 89.6 | 95.2 | 88.6 | 76.5 | 80.5 |

Notes: Coverage rates are based on the number of doses required to be considered “up-to-date for age” within the respective province. ¹Data for British Columbia excludes Vancouver Coastal Health Authority; ²pneumococcal, varicella and hib data based on 4 and 5 year olds due to transition to 2-dose system and data limitations.

Sources: See Appendix C.

Evidently, national survey data do not accurately reflect considerable provincial variation, and for some antigens like DTaP-IPV-Hib, contradict the lower levels of immunization presented regionally. A discussion of contributing factors follows below.

3.2. Social Factors Influencing Uptake

Data from the American National Immunization Survey found fully unvaccinated children usually had parents who outright objected to immunization, but under-vaccinated children not up-to-date on all doses were likely to have missed vaccination due to healthcare system factors or socioeconomic characteristics (Omer, et al. 2009). Smith et al. (2003) examined significant characteristics of fully, under, and non-vaccinated children in the US and found under-vaccinated children were more likely to come from low-income families or rural areas than children with up to date coverage. Compared to under-vaccinated children, non-vaccinated children were more likely to come from higher-income families with white, college-educated mothers. Exploring equitable access to immunization programs in Canada merits investigation, as research is more limited.

Vaccine Hesitancy and Refusal

Vaccine hesitancy is a term used to describe refusal or delay in regular immunization schedules due to concerns about vaccination (PHAC 2014a). The distinction between non- and under-vaccinated groups is also important for understanding immunization heterogeneity. Instead of refusing vaccination altogether, some parents delay vaccination through novel schedules not developed by expert committees such as NACI. These decisions often involve administering vaccinations

over a longer period, or skipping some doses altogether. Under-immunization and delayed vaccines were relatively common among cNICS respondents; 24.2% of Canadian parents indicated their child had not received at least one of the recommended vaccinations, and 1% stated their child had never received any vaccines.

Immunization is not compulsory in Canada, although certain regulations help establish high protection from vaccines and VPD (PHAC 2012b). Only New Brunswick and Ontario have legislation requiring proof of immunization for school entry. If parents cannot provide documents supporting their child's up-to-date immunization status, they must acquire the necessary vaccines within a specified time period, declare a formal exemption, or risk the student's suspension. Other jurisdictions expect parents to follow the immunization schedule provided by their province or territory, with no formal recourse for overdue vaccines¹.

Some parents justify exempting their children based on philosophical or personal beliefs. Where proof of immunization is a requirement of school entry, research indicates these clauses are more likely to be exercised when made available to conscientious objectors, as is permitted in Ontario (Thompson, et al. 2007). Some scholars suggest individuals should be better informed of the risks resulting from vaccine refusal. By incorporating risk-benefit education into the process of opting out, exemptions are reframed to emphasize the broader community consequences of non-vaccination beyond those limited to the individual (Rodal and Wilson 2010; Constable, et al. 2014). This recommendation is a point of tension in the literature. Some (Luthy et al. 2012; Ritvo, et al. 2003) advocate for better education and clearer presentation of facts on vaccination; others (Poland and Jacobson 2001; Kata 2009) remain skeptical because of the anti-government and anti-authority stance expressed by certain non-vaccinating groups.

¹ The exception is Manitoba, where children who are not up-to-date for immunizations can be required to stay home should an outbreak occur. This is not intended as a punitive measure, but instead protects unimmunized children from getting sick and to keep the outbreak from spreading.

Policies aimed at improving education and targeting non-vaccinators may overlook or antagonize deep-rooted beliefs among parents opposed to immunization. Pro-vaccination advocates focused on education may overlook medical and scientific mistrust among parents who hold alternative models of health (Kata 2009; Smith et al. 2010). Similarly, an American study testing the effectiveness of public health communications designed to reduce vaccine misperceptions and increase vaccination rates for MMR found none of the interventions increased parental intent to vaccinate a future child (Nyhan et al. 2014). Rather than prompting concern, the use of dramatic narratives and images of sick children to demonstrate the medical dangers of not vaccinating in fact increased self-reported concerns about vaccine side effects such as links to autism². These findings suggest a need to reconsider the methods physicians use to appeal to vaccine-hesitant parents, and whether community-based or national methods of immunization promotion and education are most effective.

Perceived Vaccine Risks and Safety

As the incidence of VPD declines, individuals predictably no longer see the justification for immunization, and focus instead on the risks, despite being small (Sturm et al. 2005). Vaccine safety is a concern more commonly cited by vaccine hesitant parents who delay or refuse immunizations, and a primary tenet of the anti-vaccine movement. Compared with parents who followed the recommended childhood immunization schedule, parents who delayed and refused vaccines are significantly less likely to believe vaccines are safe (71% versus 90%) (Smith et al. 2010). Andrew Wakefield's discredited study (Wakefield et al. 1998) linking the MMR vaccine with autism galvanized fears about immunization safety, beliefs that persist despite extensive research disproving the association (Luthy et al. 2012; Gilmour et al. 2011). Similarly, fears about negative health effects of preservatives used in vaccines, such as thimerosal, a mercury-containing organic compound, remain a source of anxiety and common barrier among parents mistrustful of vaccines (Rodal and Wilson 2010).

² The authors noted that providing the information through other means might produce different outcomes. The messages originated from the Center for Disease Control's factsheets and information; presenting such risks through a physician's authority and advice, for example, could heed different responses.

In a research study surveying Canadian parents on preventive vaccines, authors concluded support for vaccines was “broad but shallow”, based on poorly informed responses to questions on vaccine safety and confidence (Ritvo, et al. 2003). As many as 45% of respondents did not know enough to comment definitively on the safety of vaccines, and 22% felt they had little grasp of what vaccines are and how they work. Furthermore, public opinion research suggests support for immunization may be weaker than in the past. In a 2011 survey commissioned by the Public Health Agency of Canada, half of parents indicated concern that newer vaccines are not as safe as older vaccines, and among those with children who had missed immunizations, 17% cited vaccine safety as a barrier. Similarly, for those who found immunization decision-making difficult, concerns over side-effects were the most common reason, cited by 22% (EKOS 2011).

A 2015 public opinion poll conducted by the Angus Reid Institute found 39% of surveyed Canadians agreed with the statement “the science on vaccinations isn’t quite clear”, and 28% expressed concern over the risk of “serious” side effects accompanying vaccinations (Angus Reid Institute 2015). Although strong sentiments about vaccine risks represent the minority, uncertainty is pervasive, implying a need for better access to information in Canada. In reality, vaccines are among the safest healthcare measures available, with serious side effects occurring in fewer than one in a million immunizations in Canada (BC Provincial Health Officer 1998). Though minor side effects from vaccines can and do occur, they are negligible compared to the risks of contracting the disease.

Vaccine Efficacy, Child Susceptibility, and Disease Severity

As the widespread use of a vaccine diminishes or eliminates the risk of a disease, individuals tend to perceive a lower value of immunization. When diseases become less common, such as in cases when herd immunity is highest, the public no longer observes the disease or its aftermath, and infers little benefit from vaccines. Poland and Jacobson (2001) assert that as a vaccination program becomes more effective, its perceived value is actually diluted, and immunization coverage falls. In a public survey commissioned by the Ontario Ministry of Health and Long-Term Care, many residents questioned the value of vaccines: 42% of Ontarians felt many vaccines are not needed, and 33% believe there are too many vaccines (Government of Ontario

2014). Research shows parents who delay or refuse vaccines are less likely to believe: their child is at risk of getting a VPD; that VPDs are an important health concern making vaccinations desirable; and that vaccinating can reduce the threat of a VPD (Smith et al. 2010).

Vaccines commonly refused by respondents of the cNICS survey were seasonal influenza and the newer varicella (chicken pox) vaccines, for beliefs such as low confidence in the vaccine's efficacy, and low severity of the disease, respectively. In a study of Albertan communities, some individuals associated diseases such as polio and diphtheria with under-developed countries, and believed the Hepatitis B vaccination was meant for high-risk individuals such as sex workers and people with drug addictions (Kulig, et al. 2002). These beliefs and sentiments contrast evidence of rising hepatitis B rates, demonstrated benefits of varicella vaccination, and the herd immunity conferred through influenza vaccination that offers population-wide protection.

Peer Influence

When social contact networks hold common beliefs or misinformation about vaccines, this can produce susceptible clusters of non-vaccinating and under-immunized individuals that facilitate relatively large outbreaks of VPD. Through quantitative modeling, Ndeffo Mbah et al. (2012) demonstrate the effect of peer influence on vaccination uptake, where an individual's decision to vaccinate is affected by the strategies their neighbours adopt or the perceived net benefits of vaccination. In this model, imitation exacerbates disease transmission when vaccination is inexpensive or low risk through the social clustering of non-vaccinators. The detrimental effects of imitation are most prominent when population coverage is close to the herd immunity threshold, and non-vaccinating free riders exploit high coverage.

Social contact networks are sources of cultural or religious beliefs held by peers in close proximity, and can influence decision-making by parents to negatively impact vaccination rates. From a series of interviews in a non-vaccinating region of Southwest Alberta, outcomes revealed shared concerns about the overuse of vaccines, their ingredients, and negative side-effects among parents with alternative health providers, Dutch communities, and a Hutterite religious network (Kulig, et al. 2002). Increasingly,

vaccine providers and advocates need to articulate the value of immunization to non-vaccinators, hospital boards, legislative bodies, and schools, raising the important issue of identifying and targeting groups that can effectively influence vaccine uptake among parents (Poland and Jacobson 2001).

Chapter 4.

Methodology

4.1. Research Questions

The methodology of this study includes three components of exploration and comparison: provincial case studies, a cross-jurisdictional analysis of international best practices, and in-depth stakeholder interviews with public sector officials and health professionals. This study addresses the following research questions relevant for Canadian immunization programs:

- Where, in selected Canadian provinces, do unvaccinated and under-vaccinated subpopulations persist, and what are the features of these areas?
- What prominent socio-environmental and/or personal factors influence parental-guardian decisions to vaccinate or not vaccinate their child?
- What practices are effective in improving immunization rates in other countries?
- How can Canada and provinces improve and harmonize childhood immunization coverage, and what are the barriers in doing so?

Findings from these questions inform the policy options for consideration, and structure the analysis and evaluation. These questions are investigated through methods detailed below.

4.2. International Best Practices

A comparison of international jurisdictions identifies alternative strategies for improving vaccination coverage levels and investigates the third research question pertaining to international efficacy, namely, which aspects of childhood immunization policy observed in other countries might be useful in improving Canada's programs?

Relevant government documents, research reports, and statistics provide the basis for this analysis. Although cultural conditions and health administration systems differ somewhat, assessing policies used in New Zealand, the United Kingdom, and Australia captures an expanse of research and innovations not yet widely attempted or studied in Canada. These countries demonstrate similar trends of historical health improvements through widespread vaccination programs, followed by periods of declining coverage rates and increased VPD outbreaks in more recent years. Research into the problems faced by these countries also uncovers some of the social factors influencing vaccine refusal or deferral. The objective of exploring the implementation difficulties encountered by these countries is informing some of the political, economic, and legal barriers relevant for reforms to the Canadian vaccination system, and extracting successful methods of improving immunization coverage.

4.3. Stakeholder Interviews

Interviews with key stakeholders involved in public health and immunization programs serve as an integral data source in this study. Interview participants were not sought from the general public because such attitudes and beliefs about vaccination are generally well documented through scientific research studies, and widely represented on the Internet. Instead, a total of nine individuals including program managers, clinician researchers, and public health experts across Canadian provinces participated. These individuals were recruited through publicly available contact information and snowball sampling methods. Questions were open-ended and probed perspectives on vaccine hesitancy, existing provincial programs, and policy alternatives used in other jurisdictions. Appendix D contains an example of the interview schedule.

Stakeholder perspectives add value through work experience in various jurisdictions and roles, familiarity with regional priorities and politics, as well as knowledge of emerging issues. Information derived from these interviews is used to fill gaps not uncovered through the literature and publicly documented mandates. Stakeholder interviews also serve as an opportunity to test the efficacy and feasibility of potential policy recommendations by presenting them to individuals familiar with public health administration. To assess these findings, a thematic analysis discusses common

outcomes and divergences in perspectives. Further details of the recruitment process, a list of identified and anonymous participants, and the interview format are described in Appendix E.

4.4. Provincial Case Studies

Finally, case studies examine policies used by health ministries and public health agencies in British Columbia, Alberta, Manitoba, and Ontario. These provinces are selected for their availability of data on both vaccination coverage and sub-regional disease occurrences, both of which the case studies explore. Used as a snapshot of Canada’s heterogeneity in vaccination coverage, the selected case studies also feature immunization challenges prevalent across the country: dispersed populations across rural and urban areas; constrained health budgets; and the common responsibility of balancing public health with individual rights. Having each experienced recent incidences of VPD outbreaks, such as measles and pertussis, these areas of Canada suggest varying levels of vaccination coverage.

Multiple-case studies, as used here among four Canadian provinces, allow analysis within each setting and across settings (Yin 2009). Similarly, *collective case* studies (Stake 2006) provide a mechanism to better understand or theorize about a larger collection of cases. The selected provinces are meant not to generalize more broadly about other Canadian jurisdictions, but reveal the heterogeneity of Canadian vaccine administration, compare outcomes of unique approaches, and extract common challenges and successes. The chosen provinces – British Columbia, Alberta, Ontario and Manitoba – provide a snapshot of public health approaches to vaccination, including the prevailing issues within differing political, economic, and legal contexts. Summarized in Table 4.1 below is the framework of analysis:

Table 4.1. Provincial Case Comparison Evaluation Framework

| Characteristic | Measure |
|--|---|
| Vaccination Coverage and Disease Outbreaks | How widely does vaccine coverage vary by region? |
| | Has provincial coverage increased or decreased in recent years? |
| | Where have recent VPD outbreaks occurred? |

| | |
|---|---|
| | What factors affect immunization coverage? |
| Immunization Data Collection | How are immunizations reported? |
| | How is immunization coverage tracked and monitored? |
| Program Delivery and Enforcement | Where are vaccines given and by whom? |
| | What mechanisms are used to promote or enforce immunization? |
| | Are vaccine exemptions permitted? |
| Accessibility | Are measures in place to improve access to immunization programs? |

4.5. Methodological Limitations

As mentioned in Chapter 3, outdated immunization information systems constrain provincial action, making tracking, monitoring, and evaluation of the impacts of programs and services difficult. Furthermore, provinces measure immunization coverage differently. To facilitate the collection of vaccine coverage data from the provinces and territories, PHAC and the Canadian Immunization Registry Network developed national immunization coverage reporting standards. While these standards provide guidance to jurisdictions in reporting vaccine coverage, the standards have yet to be fully adopted (Laroche and Diniz 2012).

Data presented for the four provinces reflect the most accurate and comparable information available, with the caveat that establishing an accurate denominator within certain regions or populations – the baseline number of a cohort birth population – is problematic for some provinces. Depending on the age at which doses are required and when vaccine reporting occurs, cross-provincial comparisons are more accessible for some diseases than others. In most cases, immunization coverage rates at two years of age are used, as this is considered a benchmark for receiving routine infant vaccines in a timely manner and during a critical window for disease protection. Because Ontario does not routinely collect data until children enter school, exceptions are noted and clarified. In some cases, Ontario is excluded from inter-provincial analysis, but retained for overall case study analysis for its unique approaches to immunization policy.

Unfortunately, no representatives from Manitoba’s immunization programs responded to requests for interviews, limiting the ability to confirm or clarify certain case

study findings. These case studies represent a sample of Canadian immunization programs, recognizing that many exceptions exist beyond the scope of this project, such as policies used by territories and provinces not included in this analysis.

Chapter 5.

International Best Practices in Immunization

5.1. England

Surveillance and Data Collection

England differs from Canada by its population density, but exemplifies a case where historical and recent public health initiatives confronted extensive parental resistance to vaccination. The country does not have laws governing immunization, and provides one schedule of vaccines, free of charge, across the country³ (Freed 2005). Primary care physicians deliver the majority of routine childhood immunizations, with delivery recorded electronically in the general practitioner register, as well as the population-based child health information systems (CHISs), record systems used to support a range of promotion and prevention activities. In addition, parents hold a paper copy of the child's vaccination history.

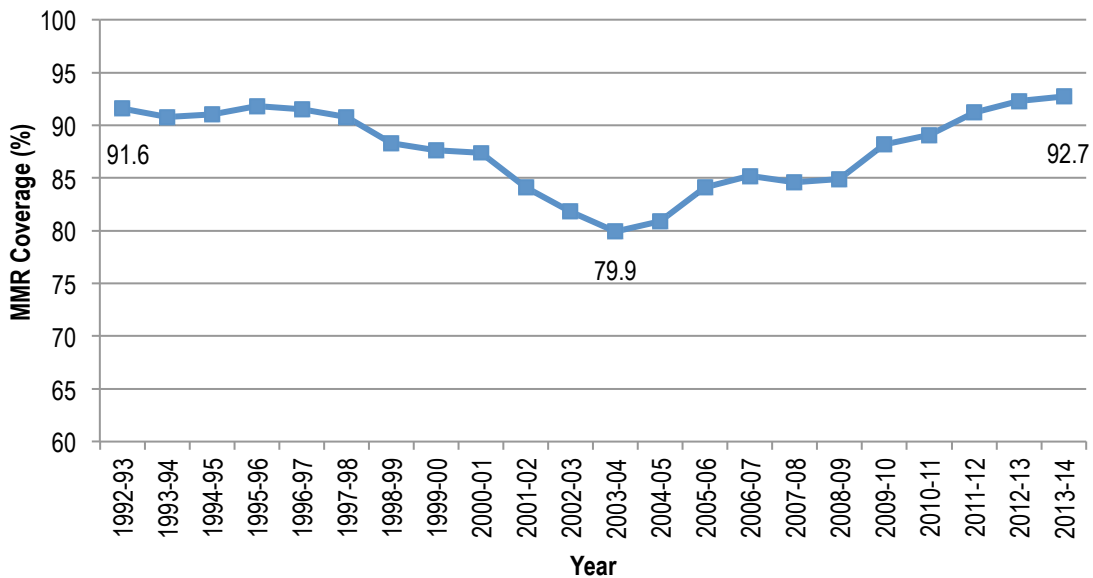
Information on childhood immunisation coverage at ages one, two, and five is collected through the Cover of Vaccination Evaluated Rapidly (COVER) data collection from Child Health Information Systems (CHISs) for most Primary Care Trusts, or from general practitioner (GP) systems for a small number of trusts. Accurate assessment of vaccine coverage is attained through frequent exchange of information between CHISs and primary care providers, allowing quarterly reports on coverage levels (Amirthalingam et al. 2012). Coverage statistics are then reported for national, regional (health authority) and local (PCT) levels.

³ These policies extend throughout the United Kingdom.

Immunization Policies

Targeted policy interventions depend on the local, regional, and national data derived from these registries, such as recalls and reminders to children overdue or near due for vaccinations, as well as catch-up campaigns in areas where coverage rates decline. Andrew Wakefield's discredited study linking the MMR vaccine to autism put England in the epicentre of escalating negative media coverage on vaccines. In response, public health administrators intervened to provide a national catch-up program in 2008. By promoting immunization through media advertisements and materials, the campaign restored MMR coverage levels to over 92%, an all-time high since the vaccine was introduced in 1988. Combined with local initiatives to improve coverage, England sustained yearly increases to MMR coverage since 2007-08. Excepting the health region of London, where immunization coverage levels are lower in some locales, vaccine coverage is uniformly high across local authorities. In 2013-14, MMR coverage exceeded 90% for 119 of 149 local authorities, and DTaP/IPV/Hib coverage was 96.1% nationally, with rates between 80-89% in only six of 149 local authorities (UK Government 2014). Figure 5.1 below demonstrates England's longitudinal MMR coverage trends.

Figure 5.1. Measles, Mumps, and Rubella (MMR) 2-Year Old Coverage By Year in England, 1992-93 to 2013-14



Source: UK Government 2014.

In addition to local targets and disease-specific catch-up campaigns, England uses childhood immunization target payments, paid to physicians based on the number of 2-year and 5-year old children in their practice who complete the recommended immunization courses. The National Health Service makes payments to physicians who have 70% and 90% of each 2-year and 5-year olds complete-for-age in their practice. Quarterly payments are scaled to the number of applicable children in a practice, with a higher amount payable to the upper 90% target, and larger incentive payments for 2-year old targets. These are contingent on reporting vaccine delivery (England NHS 2013).

England exemplifies effective data collection and its strategic use, such as responding to adverse vaccine publicity in the early 2000s. Accurate coverage information disseminated through quarterly reports equips local public health teams to prevent and control outbreaks, and respond directly to localized hesitancy. Some limitations persist, however, in comparative application to Canadian provinces. First, healthcare is nationally administered and highly centralized, unlike the provincial jurisdiction held by Canadian provinces. This allows regular and consistent communication between government officials and vaccine providers about immunization policy developments. This level of centralization may be better translated to the provincial level of administration. Second, some of the obstacles faced by Canada are of considerably lesser significance in England, such as delivering health services to rural and remote communities. These factors are discussed in the cases of Australia and New Zealand, below.

5.2. Australia

Surveillance and Data Collection

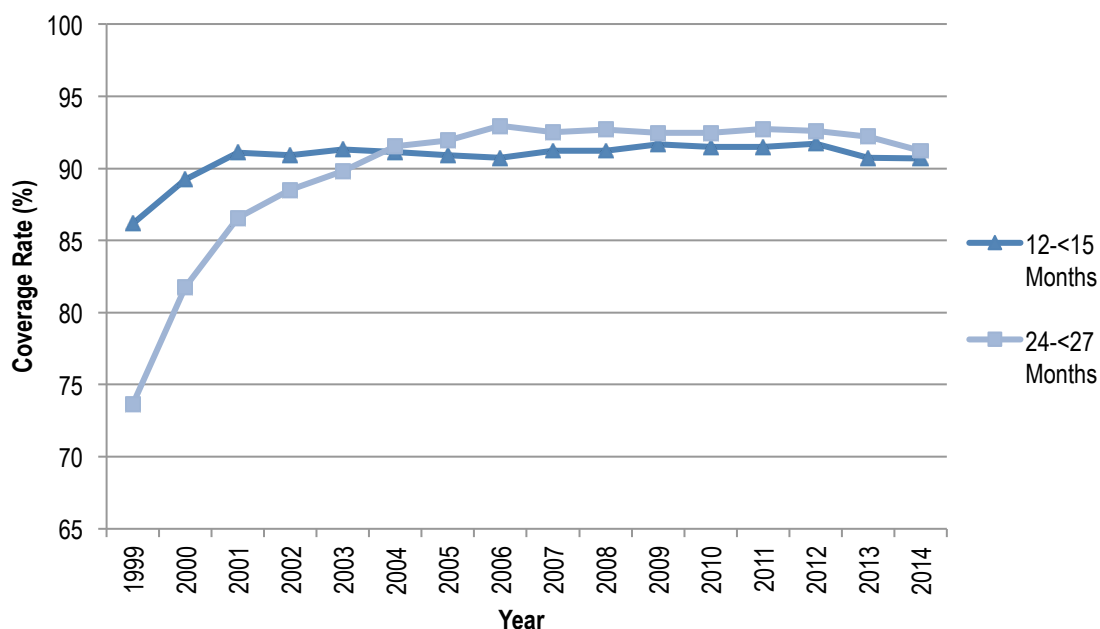
Australia uses a universal immunization registry to track and monitor national vaccination coverage data. In 1993, Australia launched its Immunise Australia: Seven Point Plan, with the goal of attaining 90% coverage of 2-year old children by the year

2000⁴. At the time of introduction, only 53% of Australian children aged 0 to 4 years were fully immunized, and coverage stood as low as 46% in one territory (Australian Government 1993). As part of the Seven Point Plan, the Australian Childhood Immunisation Register (ACIR) replaced decentralized regional registers and periodic national household surveys with a database tied to the country's Medicare registry platform. Given the decentralized nature of immunization provision in the Australian healthcare system, decision makers saw a national electronic registry as the sole method of accurately tracking immunization status across local and state or territory boundaries (Hull et al. 2009).

In addition to increased coverage rates and better management of vaccination programs, the ACIR also allows providers and parents to determine a child's status in real time; enables a recall and reminder system for upcoming and overdue vaccines; and provides national coverage and exemption data at regular intervals by age, vaccine, and region, which serve program management and targeted campaign efforts (Hull et al. 2009). In a review of 49 studies conducted in Australia between 1997 and 2011, those with the greatest positive effect on coverage levels enlisted strategies to increase community demand for immunization; among these, recalls and reminders were most widely and consistently effective (Ward et al. 2012). Shown below in Figure 5.2, the introduction of the ACIR and associated programs like recalls and reminders correspond with rapid increases in immunization coverage; 90% national target levels were met and sustained.

⁴ For publicly funded vaccination against measles, mumps, rubella, polio, tetanus, and diphtheria.

Figure 5.2. Australian Immunization Coverage, Percentage of Children Complete for Age, 1999-2014



Source: ACIR 2015.

Immunization Policies

To improve and maintain immunization coverage rates, Australia also implemented a combination of financial incentives targeting GPs and other vaccine providers, as well as parents. Two credits payable to households, the Maternity Immunization Allowance (MIA) and the childcare benefit (CCB), are contingent on vaccination status, a condition introduced in 1998. The MIA is payable at 18 to 24 months of a child’s age if all immunizations due at or before 18 months have been received, or a medical or belief-based exemption applies. Because these provisions extend also to parents who exempt their children from immunizations, the rebates necessitate an active decision on whether or not to immunize, and ensure equitable access across all populations, regardless of their choice.

Adding to parental demand-side incentives, three payment forms target healthcare providers directly: 1) Service Incentive Payments, payable to GPs for reporting the completion of age-appropriate vaccination for children under 7 years of age; 2) Outcomes Payments to medical practices achieving 90% vaccination coverage

of children in the practice; and 3) Information Payments, similar to a fee-for-service, made to all providers who notify the Australian Childhood Immunisation Register of a vaccination. Because GPs administer most vaccines in Australia (71% in 2009), directing incentives at vaccine providers is a relatively contained and straightforward process. By 2003, 90% of physician practices achieved the goal of 90% proportions of full immunization (Smith and Heartfield 2009). Unlike fine-based methods that can create punitive and inequitable economic outcomes, payments encourage and recognize widespread participation in immunization programs; the only exceptions to universal immunization should be medical contraindications or cases where parents express clear conscientious objection.

Accessibility Initiatives

Australian protocol directs parents seeking vaccination exemption to medical professionals to complete the documentation, providing an added opportunity for vaccine education on risks and benefits. Along with financial incentives, Australia conducted a major community education campaign aimed at diverse cultural and linguistic backgrounds; piloted a series of immunisation days to increase uptake; and undertook a measles control campaign offering MMR vaccination to all primary school aged children. As a result of the campaign, 1.7 million children aged 5-12 years were vaccinated, nearing herd immunity thresholds at 94% coverage (Australian Government 2013a).

Like Canada, Australia has a large Aboriginal population facing greater health access barriers and poorer outcomes overall. Data from ACIR show indigenous people are less likely to be complete for immunizations. Immunization rates are an estimated 20% lower among Aboriginal children living on reserve in Canada (UNICEF 2009); without a comprehensive picture of vaccination coverage in Canada, it is unknown whether a similar trend extends to off-reserve populations who may be at higher risk of VPD. Despite this beneficial indicator, a considerable limitation of the ACIR is its lack of socio-economic data beyond age, sex, and Indigenous status that an immunization survey like cNICS or the American NIS provide (Hull et al. 2009). An obvious strength of the ACIR is that it functions like a census, rather than a sample of the target population compromised by survey methods; the register accounts for an estimated 99% of Australian children.

5.3. New Zealand

Surveillance and Data Collection

In New Zealand, family doctors and associated practice nurses provide routine childhood immunizations free of charge. Since 2005, the National Immunization Register tracks all registered immunization enrolments and events of children. Data are tracked nationally and by District Health Boards, with figures given by age milestones, ethnicity, including Maori and Pacific, and level of socioeconomic deprivation. The national registry supports authorized users, such as vaccinators, by providing access to complete coverage information. The system is capable of tracking children whose family has moved to another area or changed healthcare providers (New Zealand Ministry of Health 2012).

Targeting Priority Populations

New Zealand successfully closed gaps between areas of the country where coverage rates were lower on account of socioeconomic deprivation. In 2009, national coverage among the most deprived sub-regions of the country was ten percent lower than least deprived areas, 76% and 85% respectively. By 2014, coverage was 92-93% nationally across all levels of socioeconomic deprivation. Publishing coverage rates by ethnic group and deprivation level is a strong component of New Zealand's system, as it allows healthcare providers to track priority populations and respond as necessary.

Success stems from setting local targets, as well as improving immunization providers' ability to access and utilize accurate regional data. Local health bodies combined this with an emphasis on encouraging early enrolment of all children with a primary healthcare provider. Physicians use recalls and reminders to inform families of upcoming and overdue vaccinations, and if necessary, refer them to outreach services for vaccination within the community (New Zealand Ministry of Health 2011). In some areas like the West Coast where coverage rates are historically low due to remote communities, providers accommodate parents by meeting them in a convenient and safe location to deliver necessary vaccines.

5.4. Summary of International Best Practices

The international case studies above demonstrate common features of successful immunization strategies, including:

- **Comprehensive Data Collection and Comparable Metrics:** complete population coverage from birth to create consistent and standardized records of each child's immunization history.
- **Frequent, Nation-Wide Reporting:** quarterly reporting periods providing both national and regional figures allow public health programmers to rapidly detect changes in local and national immunization coverage, and execute timely interventions in areas experiencing declines.
- **Special Population Reporting:** collecting and publicizing figures on empirically higher-risk populations. In Australia, coverage rates for Aboriginal populations are routinely calculated, as well as Maori in New Zealand. New Zealand also reports immunization coverage by regional level of deprivation.
- **Community Outreach:** designating healthcare workers to a) partner with communities less likely to immunize; and b) offer immunization services and education within these locales.
- **Local Immunization Targets:** quantifiable outcomes set according to the performance of individual health units and regions. These targets make reducing variation in coverage rates a policy priority by calling attention to under-performing areas.
- **Financial Supply and Demand-Side Immunization Incentives:** policies that work to improve vaccination uptake by motivating providers and recipients with behavioural economics strategies.
- **Recall and Reminder Programs:** assigning dedicated administrators to notify families overdue and due for vaccines.

Chapter 6.

Stakeholder Interviews

6.1. Interview Responses: Thematic Results

Identified Barriers to Immunization

When asked why children fail to receive immunizations or become vaccinated on time, many respondents emphasized the impact of misinformation, attitudes, and beliefs as resounding factors preventing widespread and uniform immunization coverage. In particular, the internet is a powerful source of incorrect information on immunization commonly consulted by hesitant parents. As one stakeholder described the problem, misinformation then places a greater burden of communication on physicians who must work with patients to overcome concerns over purported harms of immunization or vaccine ineffectiveness.

Comments also suggest misinformation permeates beyond the broader public, to misguided recommendations given by healthcare providers:

Lack of knowledge – that would be the biggest thing, and it's really where the parent or the educators or even the physicians are getting their own information from (Stakeholder #3, Dec. 16, 2015).

We try to encourage them to follow the schedule, though some of them decide not to. Some pediatricians, they don't want to follow the schedule, they want to do it their own way. Instead of [months] 2, 4, 6, some will do 2, 3, 4, 5, 6, bring them in every month, give them one vaccine at a time, or something like that (Stakeholder #4, Jan. 15, 2015).

In spite of this, several respondents referenced efforts made by government bodies to provide vaccinators with clear communication tools to respond to myths and misconceptions held by parents. Examples include materials created by the Canadian

Pediatric Association, along with print and web-based provincial resources on immunization safety and protocol.

Interviewees generally view accessibility as a secondary concern to misinformation and misbeliefs, referring to recently implemented strategies to promote access. Responses from health professionals suggest that in some provinces, widening access remains an ongoing challenge. Reasons cited include portions of the population who lack a regular family doctor, larger families for whom mobility is an issue, and the capacity of health regions to keep up with population growth and associated increases in appointments.

Healthcare Provider Role and Influence

Stakeholders expressed divergent views on whether public health providers or primary care physicians were more effective at delivering immunizations. Some felt strongly that public health providers, such as nurses, maintain a more systematic approach towards delivery and messaging that complements processes like recalls and reminders. They felt using one widespread approach to vaccination led to more consistent processes. In contrast, others noted that because immunizations coincide with “well baby care” appointment intervals after a child’s birth, physician-provided immunizations make access to vaccines more convenient and opportunistic.

Several respondents mentioned the role of the regular family care provider as an important source of health information and counselling related to immunization. Furthermore, one health expert pointed out the physician can be held liable for not reporting the risks and benefits of immunization, but also for dismissing a patient based on their decision about vaccination. In contrast, another individual believed the importance of this role might be undermined by insufficient compensation:

One thing we do hear is that providers aren’t sufficiently remunerated for immunizing. It’s about eight dollars per dose administered for physician billings, but it actually takes far more time to complete the whole activity, which includes dialogue with the parent, fully informed consent and information, and discussion, and then vaccination. Recording and reporting vaccination back to public health, managing your vaccine inventory, reporting adverse events if they occur. It’s probably worth more than eight dollars a dose (Stakeholder #5, January 21, 2015).

This individual did not comment on alternative processes or the implications of fee structures, however.

Lastly, mixed public messaging about immunization policies applied to healthcare providers themselves may be cause for concern. Though not posed by the interview questions, participants mentioned that although some provinces impose vaccination requirements on nurses, paramedics, and other healthcare providers, not all provinces have such policies, and not all practitioners follow them. In turn, this sends contradictory messages to parents about vaccine safety and effectiveness.

Categorizing, Prioritizing, and Responding to Under-Immunized Populations

Respondents classified under-immunizers based on two or three general groupings: overt objectors, who refuse all vaccines; those who are undecided or hesitant, but may be persuaded to immunize; and a final category of too busy or forgetful types. Outbreaks in pocketed communities of non-immunizers, such as for reasons of religious beliefs, were mentioned in relation to British Columbia, Alberta, and Ontario. Scholarly evidence and informational interviews each concede objectors are unlikely to change their opinion, even in the face of neutral, evidence-based information (Nyhan et al. 2014). In response to indecisive or hesitant parents with under-immunized children, several interviewees referenced the use of school-reporting structures. They indicated legislation could motivate “fence-sitters” who might otherwise not vaccinate.

System Factors: Resource Limitations, Data Accuracy and Availability

A need for substantial immunization registry improvements is apparent. Though specific problems and severity differ, immunization information collection is a common challenge for many jurisdictions. Furthermore, some respondents felt the accuracy and completeness of registries restricted the options available to target and improve coverage, as well as evaluate policies. As one individual described this:

One of the challenges I think is really having access to the data to be able to be looking at evaluating our publicly funded immunization programs. Are they achieving the targets they were set out to, and looking at our disease incidence as well. We have a huge issue when we're doing

surveillance for vaccine-preventable diseases because of the missing information related to immunization status (Stakeholder #8, Feb. 3, 2015).

Interviewees noted increased costs, delays, and data accuracy concerns related to the transition to the electronic Panorama immunization registry. In general, interviewees providing feedback about the future utility of Panorama expressed optimism but hesitance, and admitted the system's eventual function might not fulfill the original design and intentions.

In addition to infrastructure deficiencies, immunization programs face constraints due to human resource capacity and budgetary limitations. In some regions, such as larger health jurisdictions or units with sizable populations, the ability to effectively monitor the entire population, or meet demand for vaccinations, is a challenge. Several health experts expressed confidence in the effectiveness of recall and reminders as a strategy to mobilize families overdue or behind on vaccination schedules, but noted these sometimes weren't possible due to staffing limitations. As well, the ability to conduct recalls and reminders remain limited by data accuracy.

Privacy and Legislation

A number of individuals raised concerns about provincial privacy legislation as an impediment to establishing functional registries for recall and reminder purposes. Access to physician records not shared in a public health registry, like immunization records, is considered confidential information, which one individual worried would limit the two-way flow of reporting to and from an electronic registry. Reflecting on the ability to apply technology to immunization programs, such as through text messaging, one health expert referenced privacy regulations as a barrier to collecting contact information.

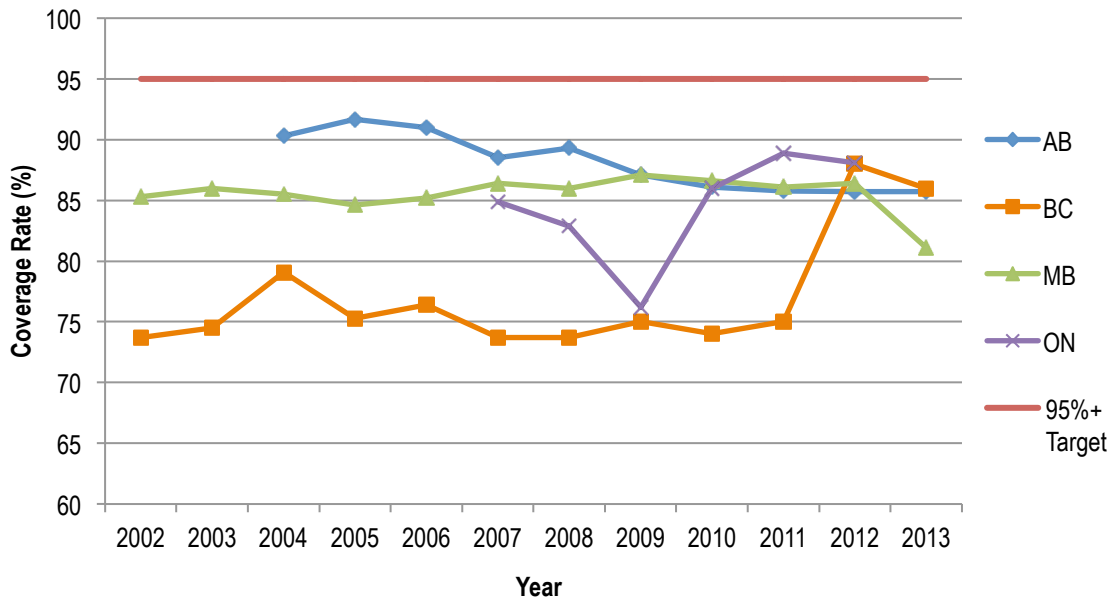
Chapter 7.

Provincial Case Studies

Results from case-selected provinces offer data comparisons and underscore regional variation in program and policy design. Demonstrated in Figure 7.1, provincial coverage varies between the selected cases. As the most accessible and consistent indicator across the jurisdictions⁵, the MMR vaccine serves as a benchmark for immunization rates, but depicts higher coverage than the 60-73% of children were receiving *all* of the recommended vaccines in 2013.

⁵ Not all provinces consistently report the proportion of children considered “up-to-date” for age, and schedules change within and between provinces. As a consequence, a ten-year snapshot of children up-to-date for age by province is not available, with MMR given as a proxy for general immunization uptake.

Figure 7.1. Measles, Mumps and Rubella (MMR) Coverage by Province, 2002-2013 (Proportion of 2 Year Olds Up-To-Date for Age)



Note: due to differences in data collection, Ontario data is based on two MMR doses at age 7.
 Sources: BCCDC n.d.; BCCDC 2014a; Public Health Ontario 2014a; Alberta IHDA 2014; Manitoba MIMS Reports 2002-2013.

Coverage in Alberta declined consistently for the period of study from initially high levels; rates in Manitoba remain relatively constant; Ontario coverage increased since 2007; and British Columbia sustained improvements made in 2011. None of the provinces meet their own or national targets. Though not pictured, coverage rates for diphtheria, tetanus, pertussis and polio vaccines remain much lower than those shown above for MMR, as children require a total of four doses to be considered up-to-date by age two. A province-by-province discussion of underlying factors follows in the preceding sections.

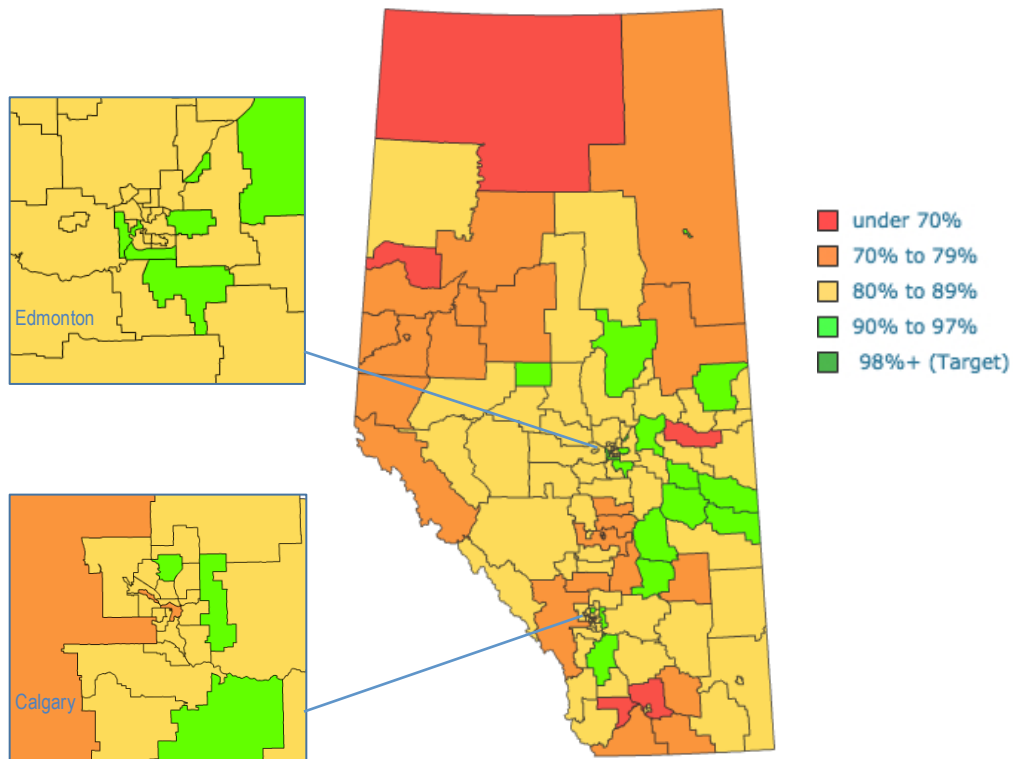
7.1. Alberta

Vaccination Coverage and Disease Outbreaks

In 2013, Alberta declared a measles outbreak after a non-immunized individual was infected in the Netherlands and returned home. A total of 42 cases resulted from this importation, all of which were unimmunized. According to PHAC, the main barriers to vaccination in this community in Southern Alberta were religious convictions and

cultural norms (Kershaw et al. 2014). Regional MMR coverage data for the area surrounding Lethbridge, where the outbreak occurred, revealed particularly low immunization coverage ranging from 64 to 76% (Alberta Health IHDA 2014).

Figure 7.2. MMR Vaccine Dose 1 by Age 2, Alberta, 2013



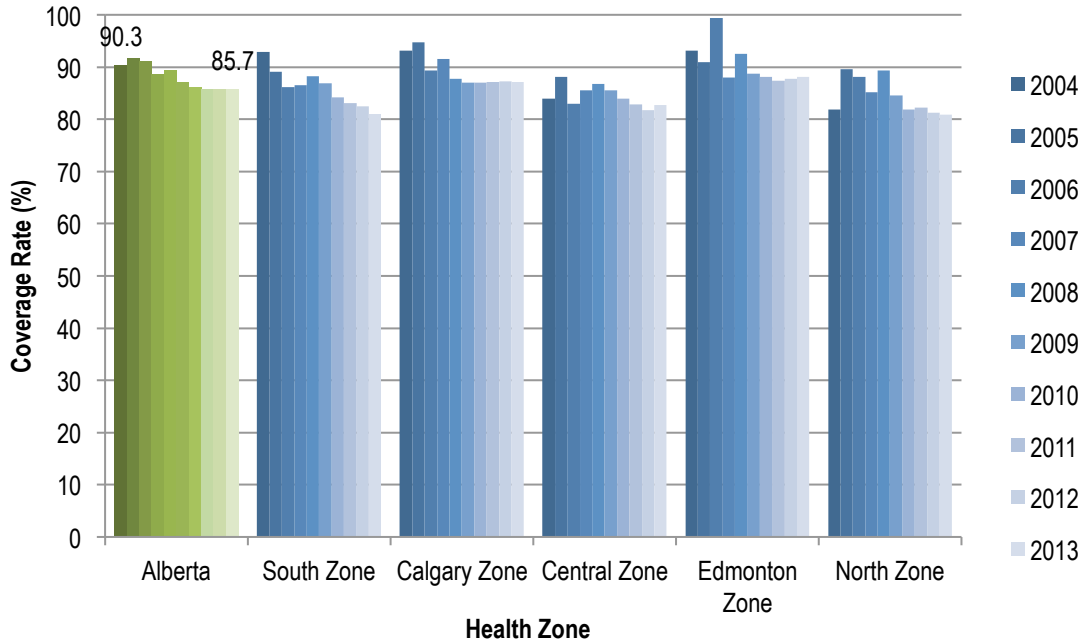
Source: Alberta Health IHDA 2014.

As demonstrated in the above Figure 7.2, none of Alberta's local geographic areas meet the 98% target for one dose of the MMR vaccine⁶. In Southern Alberta, Lethbridge County and Fort MacLeod stand at 66% and 64% coverage, respectively. High Level has the lowest uptake in the province, with only 61% and 32% of children having received the first and fourth doses of DTaP-Hib, and only 50% of children having received one dose of the MMR vaccine by age two (Alberta Health IHDA 2014). Though coverage rates range widely in Alberta, this variance is in part attributable to highly

⁶ In Alberta, one dose of Measles, Mumps, and Rubella (MMR) vaccine and four doses of the pentavalent D/TaP/Hib vaccine are required by 24 months of age for a child to be considered up-to-date (SOURCE THIS).

disaggregated data. Tracking immunization coverage across 130 local geographic area provides much more granular information, making targeted local interventions more manageable and effective. Viewed longitudinally at the health zone level, all zones experienced coverage declines in the past decade:

Figure 7.3. Proportion of Children Up-To-Date for Measles, Mumps and Rubella (MMR) by Health Zone, Alberta, 2004-2013



Source: Alberta Health IHDA 2014.

Coverage rates among school age children are not publicly reported in Alberta.

Immunization Data Collection

Three regional data registries exist in Alberta for Calgary, Edmonton, and rural areas, which collectively feed upwards into a provincial repository, Imm/ARI (Immunization and Adverse Reaction to Immunization). While in combination these systems provide a relatively comprehensive picture of immunization coverage in Alberta, they do not exchange information or provide cross-regional access (Stakeholder #2, December 15, 2014). For instance, if a child relocates from Calgary to Edmonton, there is no automatic transfer of associated patient history and information. Without this

continuity, public health records may falsely reflect a child's immunization history, potentially leading to missed vaccinations or inaccuracies at a wider, population level.

Program Delivery and Enforcement

Alberta Health Services is responsible for operationalizing immunization programs, with public health nurses accountable for implementation (Alberta Health 2014). As a result, public health nurses provide immunizations in Alberta, unlike the other provincial cases, where a mix of providers relies heavily on primary care physicians. As one stakeholder who had worked in a couple of Canadian provinces attested, "it's a lot of work to try and get the information from the doctor's offices," and "the records are more accessible if done through public health" (Stakeholder #7, January 23, 2015). Recall and reminder programs exist in Alberta, but their functionality and mechanisms vary by zone, with some areas issuing reminders by email, and others devoting more resources to making telephone reminders.

Accessibility

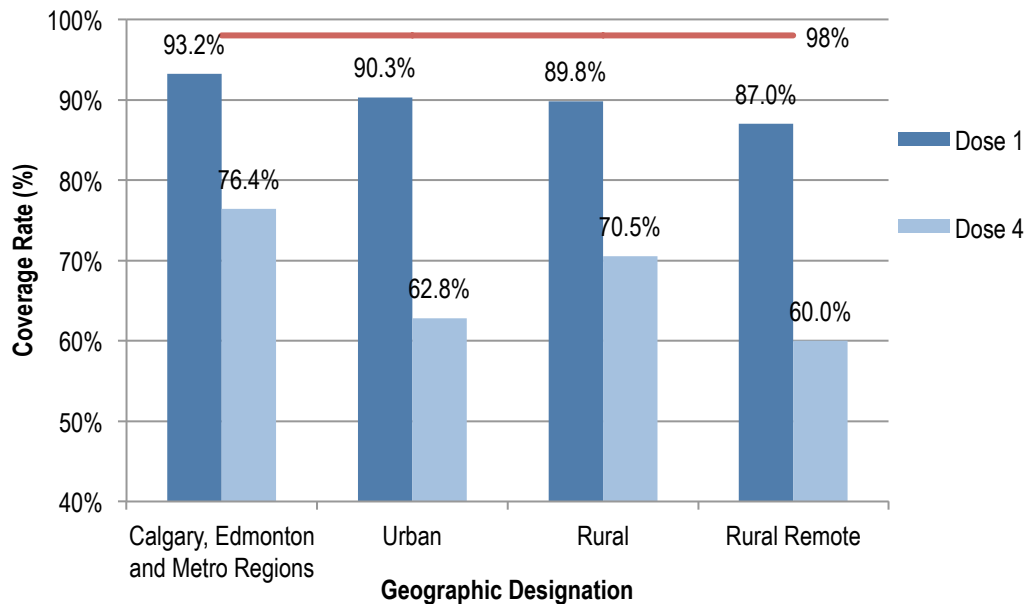
The 2007-2017 Alberta Immunization Strategy prioritized access to vaccination. An \$8 million Innovation in Immunization Fund was created to stimulate approaches that could improve access within the province's nine health regions. Examples of funding applications include drop-in clinics and expanded evening clinics to offer immunization in homes, workplaces, and community agencies such as Native Friendship Centres (Alberta Health Services 2009). The province previously used mobile clinics to deliver immunization in some areas as well. The Immunization Strategy identifies lower socio-economic status as the strongest predictor for under-immunization, and factors related to access (such as transportation, clinic hours) as the greatest barriers (Alberta Health 2007). Capacity issues, as described by an interviewee with the Alberta Ministry of Health, may also constrain access:

Public health is the predominant deliverer of childhood vaccines in Alberta. Community providers such as physicians, pharmacists, emergency departments, etc. do offer some vaccines to adults as they present such as tetanus, influenza, MMR. As our childhood cohort increases and new vaccines get added to the immunization program, the demand on public health staff increases. So we are looking at other innovative strategies to get the vaccines to Albertans. Capacity is a big issue. (Stakeholder #9, Feb. 11, 2015).

Healthcare utilization patterns and family structure also influence access to immunizations in Alberta. Challenges referenced included “household chaos” factors, such as families of three or more children, single-parent households, and a greater degree of family mobility within the province or inter-provincially (Stakeholder #2, Dec. 15, 2014).

Referenced earlier, findings from Smith et al. (2003) found under-immunized children were more likely to reside in rural areas. To test this hypothesis with available data from Alberta’s Interactive Health Data application, coverage rates by local area were categorized by degree of metro influence, from rural remote areas to metropolitan zones and surrounding regions. Figure 7.4 shows the relationship between area of residence and vaccine coverage rates for a selected antigen below:

Figure 7.4. First and Fourth Doses of DTaP-IPV-Hib at 2 Years, Average of Local Area Coverage Rates by Geographic Designation, Alberta 2013



Source: Alberta Health IHDA 2014.

Average coverage rates in rural remote Local Areas are lower for both doses, and are considerably lower than metro regions for the fourth dose; conversely, metro regions

have higher coverage rates on average for DTaP-IPV-Hib⁷. Confirmed by interview and shown in Figure 7.2, coverage is a challenge in the North Zone of Alberta, such as in the High Level local health area, where the proportion of 2-year olds who received the second dose of DTaP-IPV-Hib is 31.2%. Aboriginal communities or reserves in this region are often under-vaccinated, with individuals traveling back and forth between other areas of under-vaccinated populations (Stakeholder #6, Jan. 23, 2015). In combination, these factors increase the risk of regional outbreaks.

7.2. British Columbia

Vaccination Coverage and Disease Outbreaks

In 2014, British Columbia experienced its largest measles outbreak in thirty years, totalling 456 cases by the end of November⁸. Of these, 432⁹ cases occurred within the Fraser Valley East Health Service Delivery Area (HSDA), where the proportion of children up to date for the MMR vaccine in 2013 was the second lowest in the province (84%). Further demonstrating the extent of pocketed under-immunization, MMR coverage in many Fraser East elementary schools was well below herd immunity and the regional average of 84%, including as low as 10% within one school (Carman 2014). According to the BC Centre for Disease Control, the outbreak occurred in a religious community that “avoids medical attention and objects to immunization”; 86% of cases were completely unimmunized, and 13% had an unknown immunization history (BCCDC 2014c).

Most of BC’s HSDAs fall within 80 to 89% coverage for the first dose of MMR by 24 months, although rates range from 79% in Kootenay Boundary to 91% in Thompson Cariboo Shuswap, as pictured in the map below. Lower immunization uptake in these

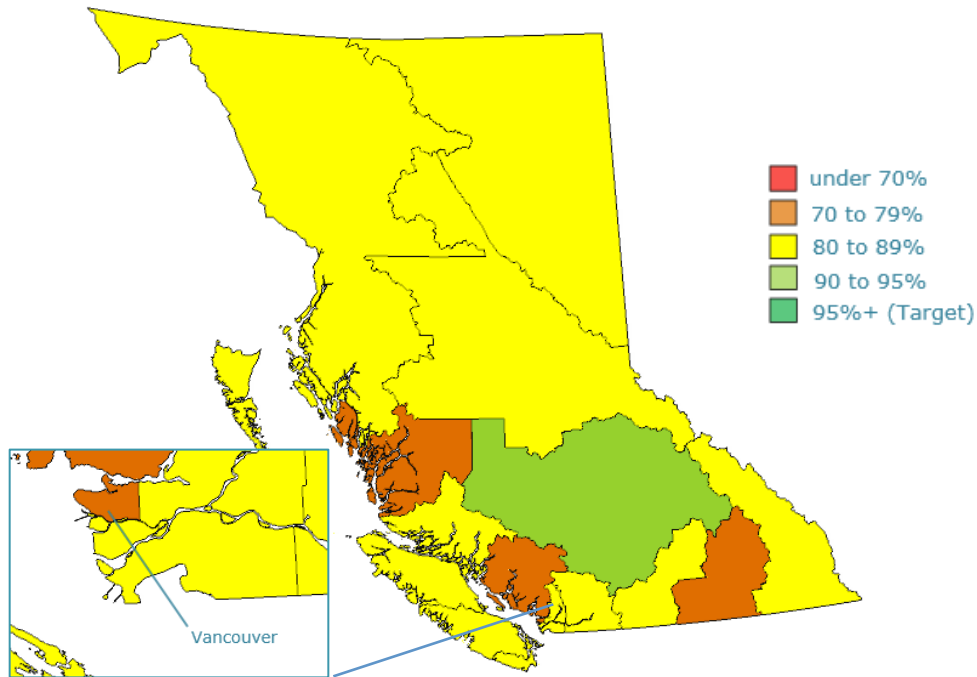
⁷ Geographic designations are based on Alberta Health’s Primary Health Care Community Profiles: <http://www.health.alberta.ca/services/PHC-community-profiles.html>

⁸ Data retrieved from BCCDC Cumulative Report on Selected Surveillance Conditions by Health Service Delivery Area, <http://www.bccdc.ca/dis-cond/DiseaseStatsReports/CDMonthlyReports.htm>

⁹ BCCDC estimates the true number of cases is likely higher due to underreporting.

areas is also reflected in Figure 7.5, for the number of 2-year olds up to date for their age.

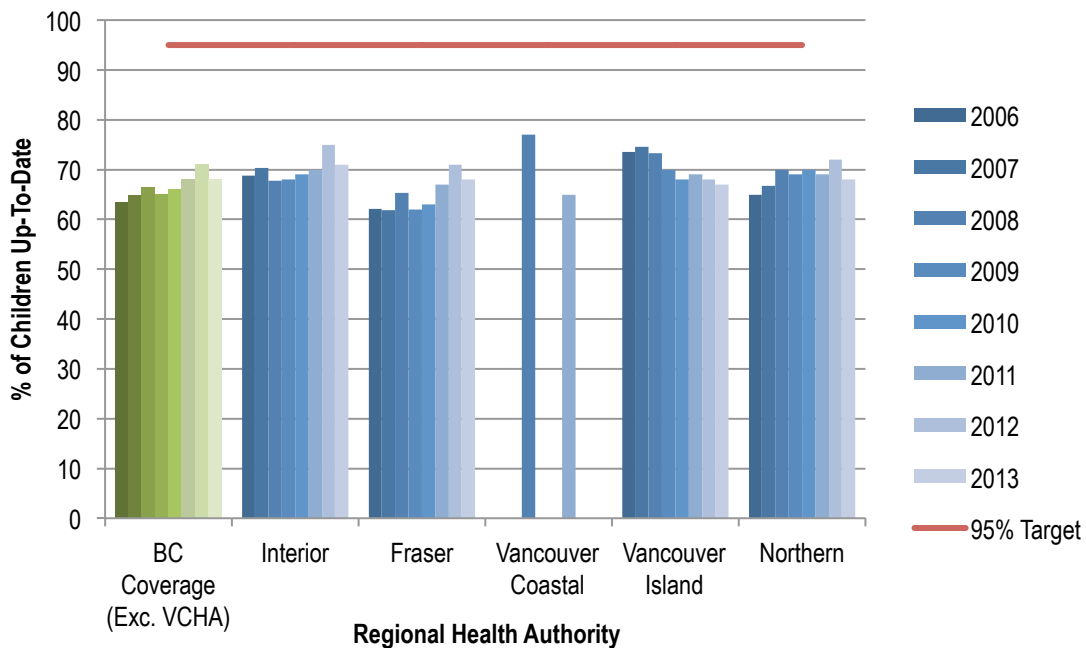
Figure 7.5. MMR Vaccine Dose 1 by Age 2, British Columbia Health Service Delivery Areas, 2013



Note: Data for Vancouver Coastal Health Authority (VCH: Richmond, Vancouver, North Shore, Coast Gariabldi) reflect 2011 figures, and are based on sample survey information among 2-year olds. Because coverage data is not available at the smaller Local Health Areas, of which there are 89 total, a more comprehensive picture is not possible.
Source: BCCDC 2014.

For all antigens by age 2, coverage ranges from 57% in Kootenay Boundary HSDA, to 76% coverage in Thompson Cariboo Shuswap and the Northern Interior HSDAs. Figure 7.6 below details broader regional coverage.

Figure 7.6. Proportion of 2-Year Old Children Up-To-Date for Age by Regional Health Authority, British Columbia, 2006-2013



Note: Complete data are not available for Vancouver Coastal Health Authority (VCHA: Richmond, Vancouver, North Shore, Coast Gariabldi) due to different reporting structures. As these figures represent random sample survey information, VCHA coverage rates should be interpreted with caution and may be an overestimate.
 Source: BCCDC 2014.

Overall, 68% of 2-year olds were up-to-date for immunizations in 2013¹⁰, well below the 95% target set in the 2007 Immunize BC report. Nonetheless, province-wide coverage rates have improved since 2006, with the exception of Vancouver Island RHA, and possibly Vancouver Coastal. Among older children, assessed at 7 years of age, 72% were up-to-date, showing modest cohort improvement with age¹¹.

Immunization Data Collection

The BC Public Health Act does not require reporting of immunizations to public health (BCCDC 2014a). As a result, reporting structures vary, and no comprehensive registry exists for the province. Some areas of the province may request vaccination

¹⁰ Excluding Vancouver Coastal Health Authority (65% were UTD in 2011).

¹¹ Note, however, that the figure for 7-year olds includes VCHA, which could distort the province-wide coverage rate.

records when children enter school, although this is not widely done, and does not involve penalty (BCCDC 2012). In 2007, BC introduced vaccine-specific billing codes to aid in immunization data capture (Naus 2007). Physicians receive remuneration for administering vaccines, like other medical procedures for which fees are paid. In spite of these changes, billing fees represent a small sum and should not be confused with pay-for-performance incentives or bonuses like those used in Australia.

Immunizations delivered by physicians in Vancouver Coastal Health Authority are not captured systematically in VCH's electronic database, PARIS. Instead, VCH examines 2-year old coverage data through periodic coverage studies, similar in function to the National cNICS survey. For the rest of the province, immunized children possess records in the older Integrated Public Health Information System (iPHIS) or the newly implemented Panorama registry, though the completeness of this data set varies due to differences in regional protocol. Whereas some health regions establish a record for all children born in their area, others only enter those who present for service into the system. This limits the ability to create a complete and a comprehensive registry for the province, identified by both BCCDC (2014) and a study of physician focus group participants (Omura et al. 2014).

Because no centralized registry exists in BC, physicians do not always have access to complete immunization records for their patients, making it difficult to provide timely and opportunistic immunization advice (Omura et al. 2014; Guttmann, Shulman, and Manuel 2011). While BC's 2007 report on immunization indicated Panorama will allow all immunization service providers such as physicians to access and update immunization records, Omura et al. (2014) suggests access will only be available to public health immunizers, not doctors.

Program Delivery and Enforcement

In BC, most infants and toddlers receive vaccines from family physicians or at their local health unit (BCCDC 2014b). In urban areas, immunizations tend to be administered by primary care physicians, with rural areas outside of the Lower Mainland and Victoria mostly served by public health nurses. Although there is no empirical difference in coverage rates between the respective groups of recipients, interview

findings and local research suggest physician compensation methods may merit review. Interview comments revealed that with the many steps involved in delivering a vaccine, from consent and guidance to documentation, current remuneration amounts (\$8 per vaccination in BC) are probably insufficient (Stakeholder #5, January 21, 2015).

Programs and policies employed in BC centre on education, promotion, and communication techniques, including media campaigns and advertisements. “I Boost Immunity”, a website operated by the Public Health Association of BC in partnership with ImmunizeBC, a collaborative of the Ministry of Health, BC Centre for Disease Control, Provincial Health Services Authority, regional health authorities, and the First Nations Health Council, launched in 2014. The website promotes education through social media sharing personal stories and findings based on scientific research, with the stated goal of provoking awareness and action in areas with sub-optimal immunization coverage. (Vancouver Coastal Health 2014).

Accessibility

British Columbia uses numerous strategies to ensure equitable and widespread access to immunization. These include evening and weekend clinics, targeting parents who work a 9 to 5 schedule; drop-in clinics, aimed at reducing scheduling difficulties; and health unit policies that ensure parents can receive appointments within two weeks of booking. The Immunization Director from the BC Centre for Disease Control expressed confidence BC’s policies effectively overcome accessibility barriers:

Repeatedly, in the surveys that we’ve done, looking at the difference between people who are un- or under-vaccinated, and those who are fully vaccinated, we don’t find barriers to access – things like transportation, getting an appointment, taking time off work to take my children to immunization, clinic hours, and so on. Those are exceedingly rare. (Stakeholder #5, January 21, 2015).

Rather than healthcare utilization factors, knowledge, attitudes, and beliefs are more substantial issues preventing timely and complete immunizations. A 2009 national

survey¹² of parents on beliefs and attitudes about immunization revealed British Columbians, compared to the Canadian average, were least confident in the effectiveness of vaccines (EKOS 2011).

7.3. Manitoba

Vaccination Coverage and Disease Outbreaks

Findings from the 2011 Manitoba Immunization Study (Hilderman et al. 2011), based on 2007-08 coverage data and socio-demographic indicators, produced statistically significant evidence for the following factors:

- Income: immunization coverage increases with income quintile for all antigens;
- Maternal age: children born to mothers 24 years and younger are less likely to be immunized;
- Vaccine provider/continuity of care: children who received vaccines from a mix of providers (e.g. family doctor, pharmacies, public health nurses) had a higher likelihood of receiving all doses; and
- Family size: children in families with four or more children were less likely to be completely immunized when compared to families with two or three children.

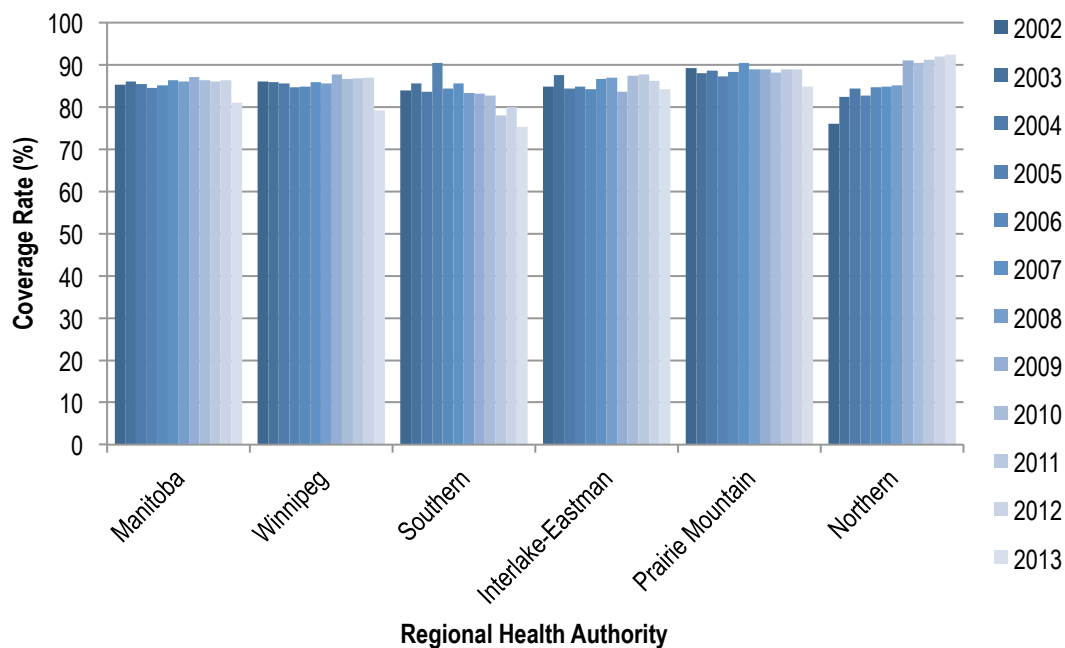
High coverage among children who received vaccines from a mix of providers may be explained by a greater degree of interface with the healthcare system.

Data from Manitoba's yearly immunization reports reveals an ongoing disparity between what are termed "continuous" and "non-continuous" residents. Individuals who moved to Manitoba from a different province, or relocated intermittently have substantially lower immunization rates than those who lived in the province continuously. Some of the reasons offered for these differences include cross-provincial variation in immunization schedules, and lost, incomplete, or out-of-date records (Government of Manitoba 2014).

¹² This is a separate study from the Childhood National Immunization Coverage Survey, conducted by Statistics Canada.

Shown below in Figure 7.7 are regional coverage rates for measles in 2-year old children over an eleven-year period.

Figure 7.7. Proportion of 2-Year Old Children Up-To-Date for Measles, by Regional Health Authority, Manitoba, 2002-2013



Source: MIMS Report 2013.

Overall, measles coverage has plateaued in the range of mid-eighties, with the exception of declines in Southern RHA and substantial improvements of 16.5% in Northern. Complete up-to-date coverage declines with age in Manitoba:

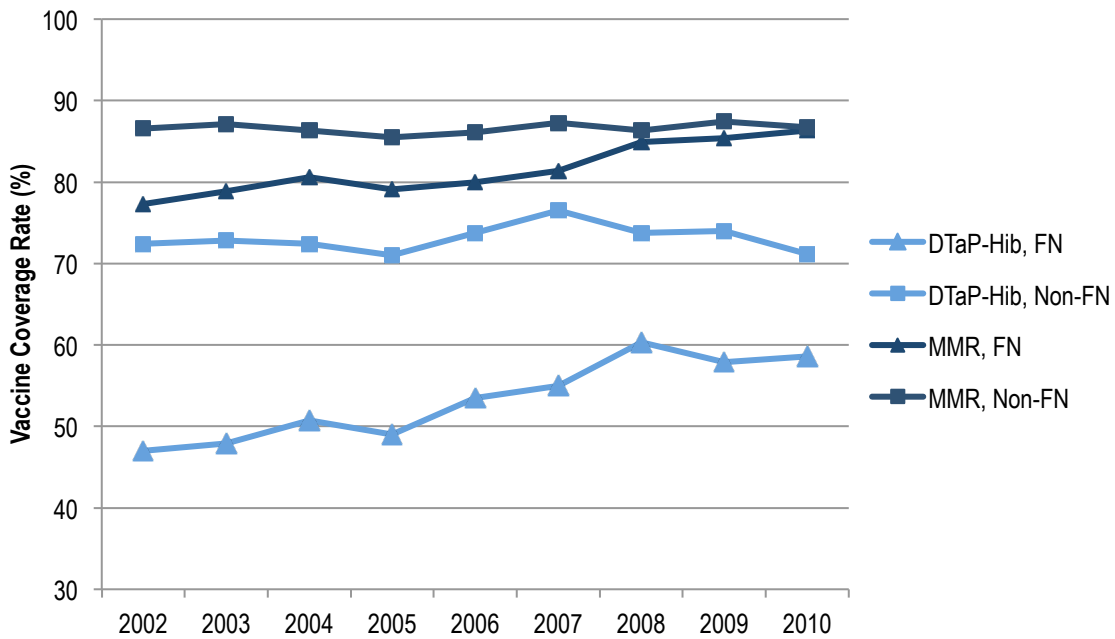
Table 7.1. Proportion of Children Up-To-Date By Age, 2011-2013, Manitoba

| Age | 2011 | 2012 | 2013 |
|----------|-------|--------|--------|
| 1 year | 76.8% | 78.0% | 78.2% |
| 2 years | 58.6% | 63.3% | 60.1% |
| 7 years | 54.6% | 59.6% | 62.3% |
| 11 years | 51.7% | 24.8%* | 27.6%* |
| 17 years | 48.7% | 45.8 | 46.4% |

Note: *Low coverage at age 11 in 2012 and 2013 may reflect added vaccine requirements.
Source: MIMS Report 2011, 2013.

In Manitoba Immunization Monitoring System (MIMS) reports preceding 2011, Manitoba publicly reported immunization rates for First Nations and non-First Nations children. The proportion of immunized non-First Nations children exceeds the proportion of their First Nations peers vaccinated across all regional health authorities. Figure 7.8 below makes this gap apparent:

Figure 7.8. Comparison of First Nations and Non-First Nations Coverage Rates: Proportion of 2-Year Olds Up-to-Date for DTaP-Hib and MMR, 2002-2010, Manitoba



Source: MIMS Reports 2002-2010.

Figure 7.8 displays an increase in coverage rates for First Nations children over the period of analysis. Greater convergence for one dose of MMR, compared with the four doses required to be up-to-date for diphtheria, tetanus, pertussis and hib, suggests barriers may exist to acquiring the subsequent doses. This could imply that in Manitoba

overall, First Nations children have less interface with vaccine providers, although further study would be required to confirm this premise¹³.

Immunization Data Collection

In Manitoba, MIMS records the vaccine provider type, including First Nations/Tribal Councils, physicians, and public health nurses. Also collected are antigen coverage rates for First Nations children. The database captures immunization events in two ways: publicly funded immunizations administered by physicians are entered via physician billing codes, and all other immunizations, such as those provided by public health nurses at clinics, are recorded by data entry staff (Government of Manitoba 2007). Functional since 1990, this system provides relatively consistent and detailed data on populations at ages 1, 2, 7, and 17 years. Manitoba's registry is considered among the most effective in Canada at timely capture of vaccination events, capable of consolidating records from multiple providers (Guttman, Shulman, and Manuel 2011).

Program Delivery and Enforcement

Manitoba monitors immunization status by comparing the system record and the provincial recommended schedule. Missing or incorrectly coded immunizations generate a reminder letter to the family or provider requesting correction or completion. The MIMS system issues reminders for children overdue at ages 15 months, 20 months, and 5.5 years, encouraging them to take action required to be up-to-date. Reminders are distributed through public health offices with amended records returned for data entry. Children whose records remain incomplete are actively followed by public health offices and offered immunization (Government of Manitoba 2007).

By using a variety of vaccine providers, Manitoba has the capacity to reach different population groups. For example, First Nations and Tribal Council providers administered 11% of total vaccinations in 2010, and the majority (60%)¹⁴ in the Northern

¹³ The reports also note that figures for First Nations children may be inaccurate on account of paper records not transferred to the electronic MIMS system, therefore underestimating coverage.

¹⁴ Northern Regional Health Authority figure calculated from Nor-Man and Burntwood Regional Health Authorities. As of 2012, Manitoba amalgamated nine RHAs into a total of five.

Health Region (Government of Manitoba 2010). Providing the balance of vaccines throughout the province were physicians (46%), public health nurses (41%) and other providers (2%).

Accessibility

Starting in early 2014, Manitoba introduced primary care mobile health clinics to better meet the needs of underserved rural and remote communities, including First Nations. The clinics are staffed by nurses and nurse practitioners, and provide a variety of services, including routine vaccination. Adding to the Prairie Mountain Region Clinic that began in 2014, the province will begin two more mobile clinics in Interlake-Eastern and Southern Health Regions. These clinics reduce time and transportation costs for parents by bringing primary care services to their community (Prairie Mountain Health 2015).

7.4. Ontario

Vaccination Coverage and Disease Outbreaks

Ontario experienced a prolonged pertussis outbreak between November 2011 and April of 2013, originating in an under-immunized religious community, and later spreading to the general population and a second religious community in the same region of the province. Totalling 443 cases, 86% of those occurring in the two religious communities were unimmunized, compared to only 32% of cases in the general population. During the 2011-12 school year, the proportion of 7 and 17-year old Ontario students who were up to date for pertussis immunizations was 76.0% and 67.7%, respectively. This coverage level is not high enough to prevent disease transmission, especially in communities of the province where coverage is likely lower than the provincial average¹⁵.

¹⁵ Data on pertussis coverage by individual health unit is not publicly available.

Public Health Ontario provides aggregated provincial-level data for immunization coverage but does not routinely publish regional rates by PHU. As a result, information on regional variation is given as a range.

Table 7.2. Immunization Coverage Rates at Age 7 by School Year, Ontario, 2008-09 to 2012-13

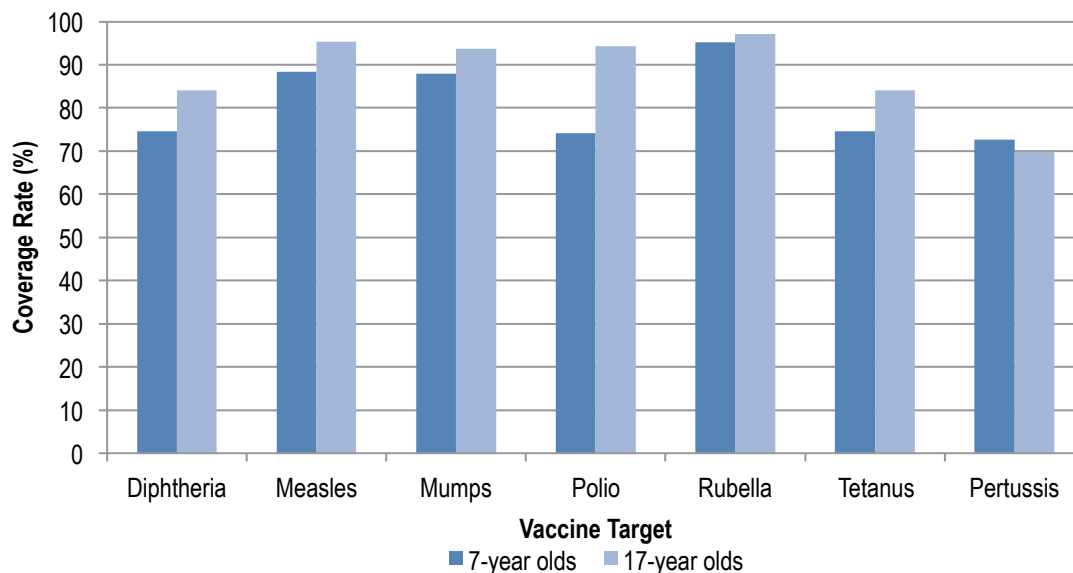
| Disease | 2008-09 | 2009-10 | 2010-11 | 2011-12 | 2012-13 | PHU Range, 2012-13 |
|----------------------|---------|---------|---------|---------|---------|--------------------|
| Diphtheria | 84% | 75% | 81% | 80% | 75% | 38-97% |
| Measles/Mumps | 83% | 76% | 86% | 89% | 88% | 61-98% |
| Rubella | 83% | 76% | 95% | 95% | 95% | 71-99% |
| Polio | 83% | 75% | 80% | 79% | 74% | 38-97% |
| Pertussis | 80% | 76% | 77% | 76% | 73% | 38-97% |

Source: Ontario Auditor General 2014.

Coverage for diphtheria, polio, and pertussis declined over this period, whereas MMR coverage improved. Like Alberta, Ontario has wide-ranging coverage rates at the local health unit level.

Lastly, Ontario's data shows coverage is higher among older 17-year old students than 7-year olds, for all diseases but pertussis, which until 2014 was exempt from the ISPA.

Figure 7.9. Immunization Coverage Rates at Ages 7 and 17, Ontario, 2012-13



Source: Public Health Ontario 2014b.

Age differences could be attributable to school enforcement policies, given the one vaccine for which coverage did not improve with age was pertussis, which is not reported for school entry.

Immunization Data Collection

In Ontario, 36 regional Public Health Units (PHUs) implement immunization programs and collect vaccination records. Parents receive a record of immunization from primary care providers such as physicians, but are themselves responsible for notifying their local public health unit of their child's recent vaccinations. This can be done over the phone or through online reporting available in most PHUs. The exception is when an individual receives immunizations from a vaccine provider at the PHU and records are directly updated. Respective health units provide immunization data to Public Health Ontario, composing the overall provincial coverage figures, although the frequency of this reporting may vary by PHU (Stakeholder #8, February 3, 2015).

The impetus for parents to report vaccinations rests on stipulations of the *Immunization of School Pupils Act* (ISPA), which mandates proof of immunization or notarized exemption for diseases designated under the legislation. Failure to provide an

up-to-date record, or demonstrate a religious, conscientious, or medical exemption, can result in a student's suspension from school. Because the ISPA is used to determine coverage among school-aged children, data on younger populations, such as pre-schoolers and infants, is more difficult to ascertain and the information less complete:

There's again a huge part of the population that we can't talk about in terms of coverage. Our most vulnerable population that currently exists we're not capturing. So until we have a mechanism to start getting our data on our two year olds and up, that's really problematic (Manager of Immunization & Vaccine Preventable Diseases, Ontario Public Health, Interview, February 3, 2015).

Another major challenge associated with the existing system is transferability of information. If, for example, a child relocates from one area of a province to another, doctors do not have immediate access to that individual's immunization history, which can result in missed or delayed vaccines. Recognized as an integral component of meeting provincial vaccination targets, Ontario's Immunization System Review identifies the development of a provincial immunization registry as one of three main priorities (Ontario MOHLTC 2014).

Program Delivery and Enforcement

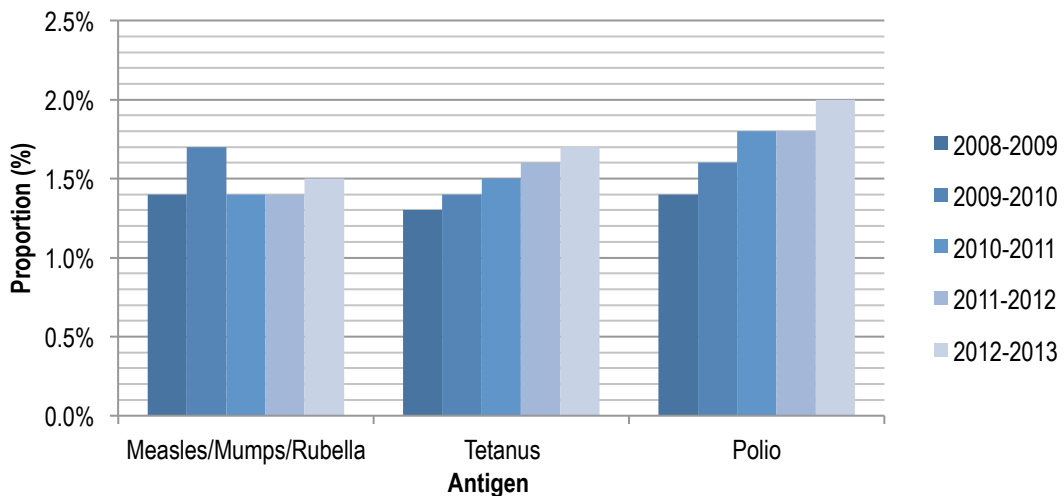
Family physicians provide the majority of routine childhood immunizations in Ontario, along with programs targeting older children delivered by public health nurses in schools. To induce greater supply-side vaccination, Ontario currently offers pay-for-performance incentives to healthcare providers for vaccine administration. Payments are issued for contacting families to schedule immunization appointments, as well as for performance-driven outcomes, based on the proportion of toddlers who are brought-up-to-date for immunizations in their practice. Because this mechanism relies on detailed immunization records, it likely also induces accurate reporting of vaccine administration (MOHLTC 2014).

Conversely, children and adolescents attending primary school in Ontario must provide proof of immunization against diphtheria, tetanus, polio, measles, mumps, and rubella. Through legislation introduced in the 1982 *Immunization of School Pupils Act* (ISPA), Ontario established a formal mechanism of mandating immunization decisions

and screening the vaccination status of children. Although sometimes incorrectly termed “compulsory”, Ontario enforces a voluntary process of vaccination with mandated choice. Students who do not provide documentation of immunization require a notarized “Statement of Conscience or Religious Belief Affidavit”, or otherwise risk school suspension and a fine up to \$1000.

As of the 2014-15 school year, Ontario widened the ISPA requirements to add meningococcal disease, pertussis, and varicella, vaccines with historically lower uptake rates than those required for school attendance. Evidence from Toronto Public Health shows school board-issued vaccination reminders, followed by school suspensions, lead to higher immunization coverage rates when compared to uptake of voluntary antigens, like the influenza and human papilloma virus (HPV) vaccines (Toronto Public Health 2012). The ISPA is a strong component of Ontario’s immunization strategy, but as evidenced by an increasing trend of vaccine exemptions throughout the province, a number of parents still abstain from having their children vaccinated:

Figure 7.10. Temporal Trends in Vaccine Exemptions Due to Religious Beliefs and Conscientious Objections Among 7-Year Olds, Ontario, 2008-09 to 2012-13



Source: Public Health Ontario 2014b.

Data from Toronto Public Health (2012) show exemptions are highest (1.6%) in areas of the city with the highest income and lowest (0.9%) in areas with the lowest income. Though this could imply that financial barriers prevent exemptions in low-income areas; research supports the idea that lower-income households tend to be under-vaccinated on account of accessibility barriers, rather than outright objection (Smith et al. 2013).

Lastly, schools in health units are not equally willing to suspend students, with the application of penalties for non-compliance varying across the province (Ontario Auditor General 2014). This is apparent in the extensive ranges in immunization rates displayed in Table 7.2. The mismatch between coverage rates and documented exemptions implies some parents may fail to immunize without acquiring an exemption. It is therefore difficult to evaluate the effectiveness of public health units' actions to ensure compliance.

Accessibility

Given that Ontario delivers most vaccines through primary-care providers, individuals without access to a regular doctor may be at greater risk of being under-immunized. A broader range of school-based delivery clinics may be more efficient and expansive in reach, although an individual's interface with their primary care provider remains an important source of widely trusted vaccine information (MOHLTC 2014). As a Public Health Nurse from Ontario suggested, access remains limited by the extent to which information is available to parents, both to inform their decision-making about vaccination, as well as on their child's immunization history. In this individual's experience, some parents were unaware of their own or their child's immunization status, suggesting access to health records and communication of schedules may be a barrier for some individuals in attaining timely vaccination (Stakeholder #3, December 16, 2014).

7.5. Summary of Provincial Case Study Findings

Table 7.3. Summary of Provincial Case Study Findings

| | Alberta | British Columbia | Manitoba | Ontario |
|--|---|--|---|---|
| Regional 1-dose MMR Coverage, Age 2, 2013 | 80.9% (North) – 88.1% (Edmonton) | 85.0% (Interior) – 87.0% (Fraser, Vancouver Island, Northern) ¹ | 75.4% (Southern) – 92.5% (Northern) | 80.4% (Toronto) – 97.1% (North West) ² |
| 2-Year Olds UTD, 2013 | 71.7% | 68% ¹ | 60.1% | Not available. |
| 7-Year Olds UTD, 2013 | Not available. | 72% | 62.3% | <72.6% ³ |
| Provincial Vaccine Refusal Rate | 2-3% refused all vaccines. | 3.5% refused all vaccines. | Not available. | 1.3% (mumps and rubella) - 2% (polio) |
| Rural Pop. | 16.9% | 13.9% | 27.6% | 14.1% |
| Pop. Density, 2011 | 4.8 persons/km ² | 5.7 persons/km ² | 2.2 persons/km ² | 14.1 persons/km ² |
| Division of Healthcare Admin. | Provincial: Alberta Health Services, divided into five zones. | Regional: 5 RHAs; First Nations HA; and aggregate Provincial Health Services Authority. | Regional: 5 RHAs | Semi-Regional: 36 Public Health Units within 14 Local Health Information Networks |
| Immunization Surveillance/ Database | Composite registry: Data from Calgary, Edmonton and rural areas feed into Immunization and Adverse Reaction to Immunization (Imm/ARI) provincial registry (2006 onwards). | Composite registry: 2 separate regional registries. Primary Access Regional Information System (PARIS) and integrated Public Health Information System (iPHIS). Transitioning to Panorama. | Centralized electronic registry: MIMS (Manitoba Immunization Monitoring System). Transitioning to Panorama 2014-16. | No centralized registry. IRIS – Immunization Records Information System (1993) maintains student records. Panorama 2013-14 onwards. |
| Immunization Required for School Entry? | Not required. | Not required. | Not required. Previously required only for measles. | Yes: <i>Immunization of School Pupils Act</i> (ISPA), 1982. |
| Immunization Provider Incentives? | No. | No. | No. | Yes: scaled compensation by the percentage of up-to-date patients in a physician's practice. |
| Recall and Reminder System? | Varies regionally based on resource constraints (e.g. | No: elective text messaging reminder service only. | Yes: reminders sent at age intervals for children missing due | Yes: letters sent to students not meeting ISPA |

| | Alberta | British Columbia | Manitoba | Ontario |
|---------------------------------|---|---|---|--|
| | staffing). | | or overdue vaccines. | requirements, followed by suspension notice. |
| Immunization Provider(s) | Public Health Nurses at Community/Public Health Centres. | Dual: primarily physicians in urban areas (71%), rural regions served by Local Public Health Unit nurses. | Mixed: in 2010, 46% physician, 41% public health nurse, 11% first nations/tribal council; 2% other. | Primarily given by primary care providers (family physicians), excepting some school-based clinics for students. |
| Immunization Reporting | Electronically reported by public health units to zones and ministry. | Reported via physician billing codes. | Reported via physician billing codes. Data entry staff record those given by other providers. | Parents responsible for reporting immunizations to local health units and at time of school entry. |

Notes: ¹ British Columbia 2-year old data excludes Vancouver Coastal Health Authority; ² MMR figures for Ontario based on 2 doses at age 7. ³ A figure for the number of children fully immunized in Ontario is not available; instead, the lowest common denominator is used based on the proportion of children who received pertussis and polio containing vaccines.

Sources: Alberta IHDA 2014; BCCDC 2014a; Health Quality Ontario 2014; Manitoba Health 2014; Public Health Ontario 2014a; Statistics Canada 2013.

Chapter 8.

Discussion of Research Findings

Identified from the outset and confirmed through interviews and case studies, data quality is a clear limitation to successfully targeted policies and measurable outcomes. Standardized and timely reporting of vaccinations is challenging for many provinces. The majority of immunization registers in Canada capture information obtained primarily or exclusively from public immunization providers, creating considerable data completion issues in provinces like Ontario, Quebec, British Columbia, where physicians deliver most vaccinations (Laroche and Diniz 2012). In this respect, Alberta's centralized public health delivery offers an advantage of consistent and timely reporting. By comparison, Ontario and BC appear to have more regional variation in reporting procedures and program delivery. Adding to these difficulties, privacy legislation sanctioning information collection and use is a pivotal condition for the future success of provincial electronic registries like Panorama.

Provincial health departments have made comprehensive efforts to expand immunization accessibility, demonstrated by improved clinic operations. Despite these advancements, some individuals at the margin may remain under-served, evidenced by regional data from Alberta and Manitoba. There is evidence that coverage declines or plateaus with age in Manitoba and BC, but appears to improve with age in Ontario. Moreover, findings indicate immunization rates persistently below coverage targets may signify other challenges related to public vaccine delivery and acceptance. Although provinces have a general idea of their communities vocally opposed to vaccines, such as some religious groups, interviewees spoke to widespread misinformation among the Canadian public, and inconsistencies in provider knowledge. Hesitant parents may be more heterogeneous in their characteristics and distribution, requiring wider counter-strategies.

That coverage is especially low in Manitoba, despite having a functional electronic registry capable of issuing reminders and capturing immunizations by a range of providers, suggests registries represent but one part of many components needed to reach high vaccination rates. As just under one third of two-year olds in some provinces may be missing one or more vaccines to be considered up-to-date, and non-immunizers or objectors total about 2 to 4.5% of target populations in the studied provinces, children in the former group present the largest window for improvement. These consist of people who unintentionally or purposefully delay vaccines, and those facing accessibility barriers or needing more information, rather than adamant non-vaccinators who abstain from all vaccines on religious or philosophical principle. Although apprehensive about safety and efficacy, vaccine-hesitant parents are potentially more amenable to behavioural change because they tend to seek information from their child's provider about vaccines (Opel et al. 2011). With the objectors likely unyielding in their positions, policy developments should focus on actively changing the behaviour and attitudes of parents with children in the hesitant, delayed, or undecided categories.

Chapter 9.

Objectives, Criteria, and Measures for Analysis of Policy Options

9.1. Criteria and Objectives for Analysis

The following section provides an evaluative framework to measure and compare policy options for implementation in Canadian provinces. Broad objectives guide the criteria for analysis: attaining a more consistent and strategic approach to childhood immunization programs within provinces and across Canada; improving population health through evidence-based interventions; working within an environment of constrained healthcare resources; and developing a culture of widespread support for vaccination. To assess the advantages and disadvantages of the policy options, the five criteria applied are effectiveness, equity and fairness, stakeholder acceptability, cost, and implementation complexity, with specific measures for each.

Effectiveness

Effectiveness examines how well the policy improves childhood immunization coverage levels relative to baseline rates. Timely, widespread, and complete vaccination are essential factors for reaching herd immunity and preventing disease. Recognizing also that the success of immunization programs relies on sustained public support, another dimension of effectiveness is improving widespread receptiveness to immunization in a climate of growing hesitancy. This aspect evaluates whether the policy option promotes cultural acceptance of routine childhood immunization through civic responsibility, promotion of community health interdependence, and a preventative, rather than reactive approach to public health. Based on the importance of effectiveness criteria in achieving public health outcomes, evaluation is based on two primary

outcomes: 1) uptake improvements over baseline coverage levels; and 2) the impact on attitudes and beliefs towards immunization acceptance.

Equity and Fairness

Demonstrated through the research presented, a range of factors may influence the equity of public health and immunization policies. Examples include geographical location and proximity to healthcare providers, such as the rural-urban continuum; socioeconomic status, including household income level and structure; and ethnicity or culture, such as Aboriginal identity and religious beliefs. This criterion assesses whether access to vaccination is improved or compromised through the proposed intervention. If a particular population is targeted, an empirical rationale should justify the benefit to that group, based on the tenet that policy should not worsen the conditions of those already facing barriers to healthcare. Finally, routine childhood immunization is a public good requiring informed decision-making and individual rights. The policy option should balance an individual's agency over their personal health decisions with broader public health goals.

Stakeholder Acceptability

Acceptability refers to the degree involved groups oppose changes required of the policy. Three groups of stakeholders are considered: government bodies responsible for public health administration, such as the Public Health Agency of Canada, provincial ministries, and regional public health bodies; healthcare providers, including physicians and public health nurses responsible for endorsing and operationalizing immunization policy; and parents of vaccine-eligible children, namely those under the age of 18 years. Data sources used to measure this criterion include the perspectives of interviewees as well as findings from public health reports. Stakeholder acceptability is an important concern because adherence to an immunization program requires public trust in the program's administration and messaging, supplied by government bodies and healthcare workers. Conversely, with certain groups expressly opposed to immunization, policies at risk of antagonizing these particularly vocal minorities may therefore be less favourable if they compromise wider vaccine uptake or overall support for the program.

Cost

The cost of the policy option gauges the extent to which additional resources are required to make changes. Because health funding is primarily a provincial expenditure (with some spending accrued through federal transfers), costs are projected provincially, and may be scaled on a per capita basis. For example, the costs of mobile immunization clinics would be greater in a more populous province such as Ontario, than in Manitoba. As a consequence, costs vary by jurisdiction, and this criterion should carefully consider any undue costs imposed on particular provinces. Estimated through comparable models used in other jurisdictions, these cost measures represent the best available estimate. Policies costing less than \$1 million are considered low cost and receive a high ranking (3); policies costing \$1 million to \$2 million are moderate (2); costs exceeding \$2 million are high (1).

Implementation Complexity

Lastly, implementation complexity evaluates the amount of coordination required and the degree of administrative change necessary for successful execution of the chosen policy route. Important factors include the need for federal and/or provincial legislation; the level of cooperation required across jurisdictions and between stakeholders; the extent of necessary changes to data collection and monitoring; and anticipated human resource adaptations, whether through training requirements or upgrades to current programs. Based on the goal of achieving short-term functionality, this criterion screens policy options for their compatibility with existing immunization registries and programs. Understanding the administrative burden of a policy option is critical to estimate where limitations may weaken or lessen long-run improvements, undermining complex changes and finite resources.

9.2. Measures

Presented below are descriptive measures to analyze how well a policy option fulfills the desired societal and governmental objectives. These follow from research outcomes and considerations from other jurisdictions, and gauge the ability of a policy to fulfill the desired criteria.

Table 9.1. Criteria and Measures for Evaluation of Policy Options

| Criteria | Definition | Description and Considerations | Ranking and Measure |
|----------------------------------|---|---|--|
| Effectiveness | Immunization Coverage | <ul style="list-style-type: none"> • Change in the proportion of children up to date for recommended immunizations • How well does the policy contribute to high coverage levels sustained over the long-term? | <p>High (3): >7% increase in immunization coverage</p> <p>Medium (2): 3%-7% increase in immunization coverage</p> <p>Low (1): <3% increase in immunization coverage</p> |
| | Increased Public Acceptance of Immunization | <ul style="list-style-type: none"> • How well does the policy increase acceptance of routine childhood immunization? | <p>High (3): substantial increase in vaccine demand and acceptance</p> <p>Medium (2): moderate effect on public acceptance and demand</p> <p>Low (1): no change in public acceptance and demand</p> |
| Equity | Socioeconomic Equity | <ul style="list-style-type: none"> • If the policy excessively targets certain ethnic, cultural, regional, or socioeconomic groups, is there an empirical rationale? | <p>High (3): widens or improves access to immunization</p> <p>Medium (2): no change to accessibility</p> |
| | Regional Equity | <ul style="list-style-type: none"> • Does the policy improve widespread access to immunization? | <ul style="list-style-type: none"> • Low (1): reduces or excludes access to immunization |
| Stakeholder Acceptability | Healthcare Providers | <ul style="list-style-type: none"> • Will the policy receive immediate support towards uptake from healthcare providers? | <p>High (3): acceptability among all three groups</p> <p>Medium (2): acceptability among two of three groups</p> <p>Low (1): acceptability among one or zero groups</p> |
| | Government | <ul style="list-style-type: none"> • Does the policy align with existing provincial immunization mandates? | |
| | Public | <ul style="list-style-type: none"> • Do a majority of parents support the policy option? | |
| Cost | Financial Impact of the Policy | <ul style="list-style-type: none"> • Cost to provincial government for each additional child targeted under the policy • Affordability relative to the status quo | <p>High (3): costs <\$1 million</p> <p>Medium (2): costs \$1million - \$2 million</p> <p>Low (1): costs >\$2 million</p> |
| Implementation Complexity | Administrative Implementation Burden | <ul style="list-style-type: none"> • Number of legislative changes required for implementation • Extent of changes to human resource capacity and database management • Degree of coordination required across stakeholders and jurisdictions • Short term functionality and compatibility with existing databases and registries | <p>High (3): no or few administrative changes required, minimal complexity</p> <p>Medium (2): some administrative changes required</p> <p>Low: (1): extensive administrative complexity and several changes required</p> |

Weighting and Ranking Considerations

The primary long-term goal is meeting and sustaining national vaccination coverage targets across provinces. For this reason, effectiveness is based on two measures and therefore doubly weighted. This means an option might strongly fulfill other criteria (equity and fairness, stakeholder acceptability, cost effectiveness, and implementation complexity), but if it does not improve vaccination coverage rates and public receptiveness, it fails to fulfill a central and essential objective for health outcomes.

Chapter 10.

Policy Options

The policy options presented below are derived from the research outcomes of literature reviews, international cross-jurisdictional analysis, feedback from stakeholder interviews, and provincial case study findings. Each option is evaluated within the established framework as an individual policy, and comparatively against the other alternatives. Following the analysis, a set of recommendations guides decision-makers with implementation considerations. From an initial set of alternatives, three were excluded from analysis: compulsory universal vaccination, public education campaigns, and parental tax rebate incentives tied to immunization status. Further explanation for exclusion is in Appendix F.

The Imperative of Electronic Immunization Registries

Highlighted through international best practices and shortcomings in provincial case studies, electronic immunization registries represent a fundamental component of highly functioning immunization programs. The Public Health Agency of Canada, along with the Canadian Public Health Association, provincial panel reviews, and other leading pediatricians and immunologists, previously identified the importance of such databases (PHAC 2004; Eggertson 2011; Government of Ontario 2014; Laroche and Diniz 2012; Giddings 2014). A \$100 million commitment by the federal government in 2004 represented a preliminary move towards the creation of national electronic health “infostructure”, with BC at the helm of provincial development (Webster 2013). Although provinces since made some headway on establishing registries – Ontario began piloting immunization modules in 2013-14 – progress remains slowed in many jurisdictions. Given wide recognition of the need for electronic registries by both federal and provincial bodies, the development of these databases is not analyzed as a policy option, but

recognized as an essential foundation. This study assesses several policies capable of improving immunization coverage in the interim.

10.1. Extended Recall & Reminder Programs

Provincial immunization schedules have become more complex due to timing and dosages. Many parents believe their children are up-to-date, when in fact far fewer are (PHAC 2015). Recall and reminder programs rely on provider-based interventions to improve vaccination uptake by giving parents notice of their child's upcoming or overdue immunizations. These programs are used sporadically across Canada, but not comprehensively across health authorities or provinces. This option proposes extending the use of reminders with both tested and more experimental methods, such as text messaging where potentially useful. With sufficient capability and diversion of human resources, such a system would deliver recalls and reminder notices by a variety of methods, including letter, telephone call by an administrator or automated-dialler, email, or some combination of the above to notify parents of children with near-due or overdue vaccinations. Recalls and reminders can function irrespective of provider setting, although require tailored implementation dependent on whether vaccines are provided through private (physician-delivered) or public (public health nurse-delivered) programs. To encourage participation, a one-time billable fee would be paid to physicians or their practices for each 18-24 month old patient whose parent or guardian is contacted for the purpose of scheduling an immunization appointment.

10.2. School Entry Requirements

In contrast to the requirements enforced in Ontario and New Brunswick, which allow schools to exclude children not up-to-date for vaccinations, other provinces have no means of reproach when parents choose not to immunize their children, beyond a physician's influence. School entry requirements may therefore motivate free riders or fence sitters who depend on and subsequently compromise herd immunity to justify their abstention. School-based requirements can also impel action among parents who do not oppose vaccines, but have not yet had their children immunized. Rather than

compulsory immunization, the mandated action is an informed and documented decision about receiving or not receiving vaccines, signed by a healthcare provider.

Findings from Toronto Public Health demonstrate fair warning to parents is necessary for equitable implementation of this option, to allow ample time to acquire any missing doses (Toronto Public Health 2012). Likewise, providing immunization clinics when notices are issued (such as in the summer months prior to school entry) is important for families with accessibility barriers. Entry requirements apply equally to all children attending school or a daycare facility, with parents having to justify non-compliance, whether due to prior immunity, contraindications, or philosophical, ethical, or religious objections. Consequences for failing to complete required immunizations or present a validated exemption can include school suspensions, fines, or exclusion of unvaccinated students during outbreaks. Parents exempting their children must be willing to sacrifice the time and economic costs – such as travel or notarization – required to opt out.

10.3. Provider Incentives

Interviews and scholarly research findings indicate healthcare providers may lack adequate incentives or remuneration to provide vaccines and associated education to clients (Omura et al. 2014). The aims of provider incentives, such as pay-for-performance bonuses for primary care providers whose practices have high rates of immunization coverage, are encouraging physicians to provide more vaccines, report immunizations, and foster population health promotion. Under this policy, provincial health ministries establish population outcome payments remunerating physicians or medical practices that successfully increase the proportion of children qualifying as up-to-date for age to a specified target level. Thresholds set at three levels, 85, 90, and 95% compliance levels, induce participation and promote improvements. Payments would be contingent on reporting vaccinations to the appropriate body, and scalable by the size of a doctor's cohort. Using Ontario as a benchmark, example yearly payments are set at \$440, \$1100, and \$2200 for the aforementioned outcomes (Government of Ontario 2012). Additionally, a completion payment for 2-year olds who receive all required vaccines on time would be billable by physicians at \$20 per patient. These rates

are set for demonstrative analysis purposes, and would be subject to implementation decisions by provinces based on respective physician compensation methods. Incentives are not applicable in provinces where the vast majority of vaccines are delivered by public health, and are therefore evaluated based on their application to physicians only.

10.4. Outreach Services and Mobile Immunization Clinics

Evidence shows better public engagement and interaction, by leveraging relationships with community members in remote areas for instance, is associated with higher regional vaccination coverage rates (Ransom et al. 2012). All of the provinces studied have experimented with various interventions to make childhood vaccines more accessible to families, although problems persist for northern or remote communities of provinces, large families, and some under-resourced urban communities where many parents struggle to access or navigate healthcare services, and delay immunizations as a result (Hilderman et al. 2011; Alberta Health 2007; Tarrant and Gregory 2002). Mobile immunization clinics, combined with community outreach activities, provide enhanced access to immunization services by targeting services to individuals less likely to be immunized due to proximity to clinics, transportation costs, or socioeconomic factors such as family structure. Community residents receive advance notice of outreach clinic dates in their area and the types of services available. This policy would see the establishment of dedicated immunization outreach coordinator positions in local health authorities with poor completion rates. This individual acts as a liaison between parents and providers, establishing referrals and community visits to connect individuals, especially new mothers, with immunization services including information, scheduling, notices, and vaccines themselves.

Chapter 11.

Evaluation of Policy Options

11.1. Extended Recall & Reminder Programs

Effectiveness

Research repeatedly demonstrates the effectiveness of recalls and reminders to improve immunization uptake. Across fifteen studies assessing the outcomes of preschool-aged children whose parents received some form of recall or reminder about routine childhood immunizations (including postcards, letters, phone calls, and automated-dialler calls), those who received reminders were 1.47 times more likely (pooled odds ratio, 95% confidence interval: 1.28-1.68) to have been immunized or up-to-date with immunizations compared with control subjects (Jacobson Vann and Szilagyi 2009). In a randomized study of parents of children with overdue immunizations in Saskatchewan, phone call reminders increased MMR coverage from 67% to 74% over one year across all income groupings, compared to a 3% improvement in the control region (Lemstra et al. 2011).

Recalls and reminders motivate individuals to take action, thereby contributing to improved coverage rates, but can also serve complementary policy goals of knowledge transfer and education. As one interviewee explained,

The system allows us to see that this person, every time they get a recall, they book an appointment, but they never come to them. [...] So we can phone them up and say, 'in our system it shows you booked five appointments but you never come. What's the issue?' Do they not have a ride, do they forget, or are they really not intending to come? (Stakeholder #6, January 23, 2015).

Phone call reminders can create an opportunity for conversation, allowing providers to then address other barriers, concerns, or misinformation preventing people from immunizing, as well as collect information on persistent challenges in their practice or health region. Studies examining recall and reminder programs as part of a multicomponent immunization strategy also involving education aimed at providers and clients, found median success rates of 16% improvement over the baseline coverage, compared with 8% as a single component (Briss et al. 2000). One caveat to achieving the outcome is the probability of having a direct conversation with a parent, rather than leaving a voicemail message or sending a reminder letter. Recalls and reminders thus rank high for uptake improvement (3) and moderate for acceptance increase (2).

Equity and Fairness

The utility of recall and reminders depends on the communication method used, bearing implications for equity. Households without landline telephones, for example, are less likely to receive reminders, with similar implications for those who do not use email services or have a regular address. Additionally, individuals without a record in a public health office or a regular family doctor would not receive notices. Although recalls and reminders can overcome geographical remoteness and target isolated communities, there remains a risk of overlooking the needs of families with the lowest health interface levels who may be vaccine willing but unable to access services. Relative to the overall population of a province, equity and fairness are moderate as access to immunization is generally unaffected by this option (2).

Stakeholder Acceptability

Governments appear supportive of recall and reminder programs, based on their use in some Canadian jurisdictions, and the empirical evidence for their impact (Ontario MOHLTC 2014, Alberta Health 2007, BC Ministry of Healthy Living and Sport 2010). Providing support and reminders to parents, many of whom may struggle to keep track of their child's immunizations, would be well-received. Among providers, acceptability of this option would likely be tempered, with added responsibility falling to primary physicians and their practices, or a greater workload for public health nurses now required to expand their scope. Research shows physician resistance to recall and reminder interventions stems from resource, workflow, data quality, and system-based

issues, and in particular, a desire for a single trusted source of up-to-date data (Pereira et al. 2012). Acceptability among stakeholders is moderate (2).

Cost

Depending on whether the jurisdiction uses public health nurses or physicians as vaccine providers, the costs could fall to either public health or private practices, although costs to government are of primary consideration. Assuming a \$7 fee paid to private medical practices only for initiating a patient reminder, and an optimistic uptake rate of 100%, relative provincial cost estimates are summarized below:

Table 11.1. Cost Estimates of Recall and Reminder Fees Payable to Physicians

| Province | Birth Cohort, 2013 | % Immunized by Physicians | Physician-Served Population | Total Costs (\$7/child) |
|-----------|--------------------|---------------------------|-----------------------------|-------------------------|
| AB | 56,582 | 0% | N/A | N/A |
| BC | 43,738 | 71% | 31,054 | \$217,378 |
| MB | 16,237 | 46% | 7,469 | \$52,283 |
| ON | 142,448 | 90% | 128,203 | \$897,421 |

Note: Birth estimates based on Statistics Canada, CANSIM, table 051-0004, Catalogue no. 91-215-X. Figures do not account for domestic and foreign migration.

While these costs are relatively low, the balance of children not contacted by physicians would have to be reached through public health, requiring added resources.

Interviewees acknowledged recalls and reminders place a sizable burden on public health staffing resources, although variable by the type of communication used. Measures perceived as more effective, such as personal phone calls, tend to be more labour intensive and time consuming. Components of the costs include staff education and training; staff time required to perform recalls and reminders; associated mailing, printing, or telephone costs; and time spent correcting contact information. Where electronic registries do not exist, processes are more time intensive (Pereira et al. 2012). Therefore, presumed inefficiencies of recalls and reminders would require substantial additions of clerical or nursing staff in regional public health offices. Accounting for proposed fees to physicians, and the added staffing resources required, costs rank as moderate (2).

Implementaton Complexity

Improvements through the use of recalls and reminders depend on accurate and comprehensive immunization registries to provide details of immunization history and status, as well as contact information. Evidenced by the case studies, fragmented provincial registries and varying capacity across health regions make this policy a very complex and potentially inefficient undertaking. While monitoring of patient immunization records is advancing as healthcare providers transition to electronic documentation, adoption would be fragmented over a long time horizon due to differing capacities of medical practices. Interview respondents urged caution, particularly for use in areas where consistent implementation would be difficult. Where electronic registries are functional and public health plays a greater role in vaccine provision, such as in Manitoba and Saskatchewan, implementation issues may be more manageable. Overall, the capacity required for effective and widespread use of recalls and reminders rests on a robust electronic registry that few provinces currently have, making implementation complexity intractable in the short term and ranked high (1).

| Evaluation Summary: Extended Recall & Reminder Programs | | | | |
|--|----------------------------|----------------------------------|-------------|----------------------------------|
| Effectiveness | Equity and Fairness | Stakeholder Acceptability | Cost | Implementation Complexity |
| 3 + 2 | 2 | 2 | 2 | 1 |

11.2. School Entry Requirements

Effectiveness

Legislation governing school immunization requirements serves two purposes: encouraging vaccine uptake, and assisting local medical officers of health to collect data on coverage in these age groups so they can manage public health risks and outbreaks. In the year following the introduction of the *Immunization of School Pupils Act* in Ontario, the overall coverage in the school population increased from 87% to 92% (Carlson and Lewis 1985). A report reviewing early changes to Australia's immunization programs found introducing school entry requirements in some states had one of the strongest impacts on coverage rates (Australian Government 2000a). Of 208 GPs surveyed, 84%

felt school entry requirements were effective in raising immunization rates in their practices (Australian Government 2000b).

As one interviewee described Ontario’s penalties under the *Immunization of School Pupils Act*, “the effect of the suspension process is somewhat of a heavy-handed reminder recall” (Stakeholder #8, February 3, 2015). The result of immunization notices and suspension orders on Toronto coverage rates is demonstrated in Table 11.2 below:

Table 11.2. Percentage of Elementary School Students Complete for Age: Mandatory Vaccines, 2010-2011 School Year, Toronto

| | Start of School Year (before notices) | After First Notice Sent Out | After Second Notice Sent Out | After Suspension Order Sent Out | Final Coverage Rate |
|----------------------|---------------------------------------|-----------------------------|------------------------------|---------------------------------|---------------------|
| Coverage Rate | 75.2% | 81.9% | 89.0% | 95.0% | 97.3% |

Source: Toronto Public Health 2012.

The composition of this increase seen in Toronto in 2010-11 is primarily attributable to updated records, although thousands of students also received overdue vaccinations (Toronto Public Health 2012). Nonetheless, this represents a 22% improvement over the baseline coverage rate.

Overall, evidence for the effectiveness of school entry requirements is strong. One shortcoming is that this policy does not come into effect until children enter daycare or kindergarten. Whether this encourages parents to delay vaccination until this time is unknown based on Ontario’s data, which does not track children prior to school age. Creating firm deadlines through school enrolment requirements might instead prompt parents to have their children immunized. Provincial responsiveness to exemption rates is integral to achieving success through this policy, requiring stringent enforcement across regions. Considerations include the rigour of the application process, the exemption review mechanism, and any appeals processes or penalties. Under the proposed policy option, the process refers parents seeking exemptions to health care providers for review and risk counselling. This policy’s ability to improve uptake is high (3), and promotes high acceptance by establishing a universal system mandating widespread participation as a civic responsibility (3).

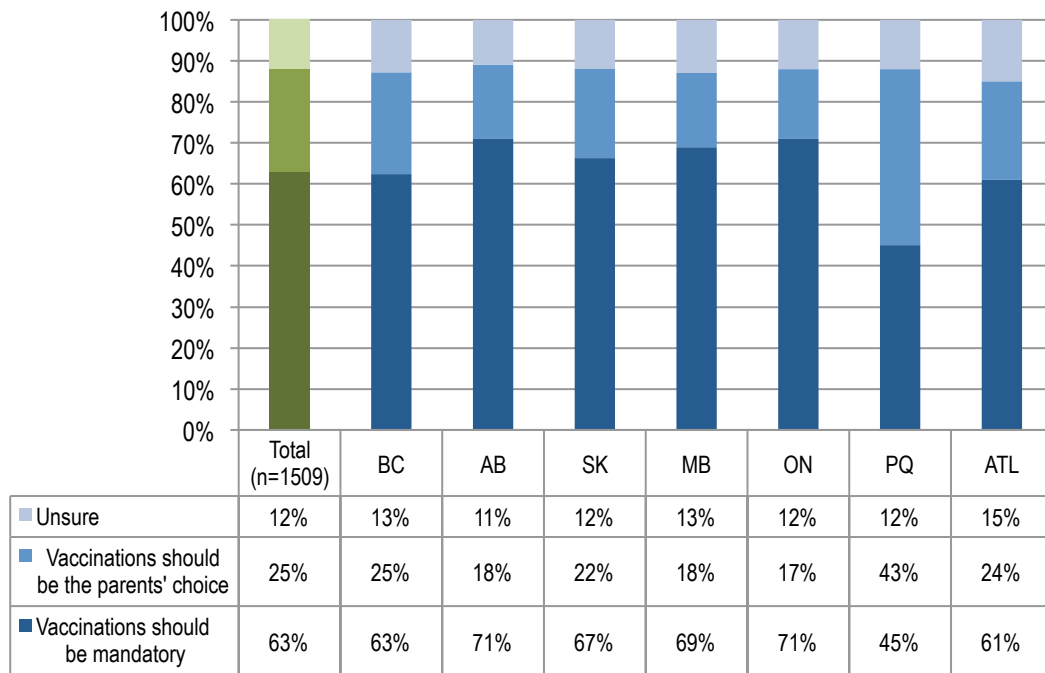
Equity and Fairness

School entry requirements apply equally to all children enrolled in school. The one group not captured by this process is homeschooled children, a group estimated as 80,000 in number across Canada in 2001 (Basham 2001). Research demonstrates that when parents received adequate notice of overdue immunizations, children from lower-income households were no more or less likely to be suspended than their higher income peers. Overall, 72.5% of suspension notices issued in Toronto in 2010-11 were averted once parents updated their children's records (Toronto Public Health 2012). Assuming a sufficient window of time is allocated to acquire any necessary vaccines, this policy should not impose a disproportionate burden on families. However, because the policy does not directly improve access to immunization, school entry requirements rank moderate for equity and fairness (2).

Stakeholder Acceptability

A recent public opinion poll shows the majority of Canadians support mandatory vaccinations as a requirement of daycare or school entry, presented in Figure 11.1:

Figure 11.1. Support for School-Based Vaccination Requirements by Canadian Provinces, 2015



Note: Survey respondents were asked, “There has been some debate about whether or not vaccinations should be mandatory, at least for a child to attend daycare or school with other kids or whether it should be the parents’ choice?”.

Source: Angus Reid Institute 2012.

It is also noteworthy that the poll found the least support for mandatory vaccinations among parents with children under the age of 18 (56%). Lastly, three quarters of Canadians surveyed (74%) agreed that people against childhood vaccinations are irresponsible (Angus Reid Institute 2012).

One interviewee admitted Ontario’s existing system creates tensions between some public health units and schools over the use of suspensions. Under the ISPA, Medical Officers of Health have the authority to mandate student suspensions, which school principals then issue. Unfortunately, time constraints of this project and low response from interviewees limited full exploration of this issue, but it serves as an important warning for enforcement design and penalties. Such a process can portray public health officials in a poor light, and inflicts the greatest consequences on children, who are kept out of school on account of their parents’ decisions.

At the provincial government level, comments from policymakers suggest widespread consideration of this option:

I think [school reporting] is on everybody's agenda across the country, particularly as we are trying to control measles outbreaks. We've had a few outbreaks over the last ten years, and now new measles cases are occurring because our rates are below the threshold at which we have herd immunity. Some type of policy for school immunization is something being discussed at every jurisdiction (Stakeholder #9, Feb. 11, 2015).

Because reception may be mixed among government and uncertainty or resistance exist in a minority of the public, school entry requirements moderately fulfill stakeholder acceptability (2).

Cost

Expenditures arising from school entry requirements accrue primarily through human resource capacity required for annual review of records and enforcement. At a minimum this would require increased and dedicated public health personnel to monitor records and contact children behind on their immunizations, and likely also necessitate coordinator positions to ensure cross-regional consistency. Public health offices would be responsible for contacting school boards to acquire enrolment lists. While in some provinces like BC, public health-delivered immunization clinics are routinely offered prior to or at the time of school entry, other provinces like Manitoba do not provide this service. Devoting additional resources to catch-up clinics at such times is essential for equitable access, and contributes to costs of the policy. Costs rank moderate relative to alternative considerations and provincial budgetary changes, likely falling within the order of \$1-2 million dollars annually, depending on provincial population size (2).

Implementation Complexity

Because health and education fall under provincial jurisdiction, the foremost challenge of this option is achieving uptake through provincial legislation. Legislation like Ontario's *Immunization of School Pupil's Act* and the *Public Health Act* in New Brunswick grant public health the authority to collect immunization information and impose consequences through schools if not provided. To ensure success, this policy requires strong provincial leadership to develop and expedite legislative changes.

School entry requirements necessitate effective reporting channels to ensure schools and public health departments receive timely and accurate records, with electronic reporting ideal, but not essential. In Ontario, parents must report vaccinations to their local public health unit, using channels such as telephone hotlines and websites. In most provinces, online portals exist where parents can report immunizations. In contrast, New Brunswick requires their immunization providers to report vaccines within one week of delivery, pursuant to stipulations of the *Public Health Act* (Government of New Brunswick 2012). Assigning reporting responsibility to providers also fulfills an important goal of reducing gaps in coverage data for children not yet at age of school entry, a major issue facing Ontario. In provinces like Alberta and Manitoba, where relatively robust and effective registries exist, current infrastructure provides public health with the means to verify the status of student populations. In sum, implementation complexity is high (1).

| Evaluation Summary: School Entry Requirements | | | | |
|---|---------------------|---------------------------|------|---------------------------|
| Effectiveness | Equity and Fairness | Stakeholder Acceptability | Cost | Implementation Complexity |
| 3 + 3 | 2 | 2 | 2 | 1 |

11.3. Provider Incentives

Effectiveness

Chien et al. (2010) found pay-for-performance incentives improve coverage levels for childhood immunizations, with an additional 11% increase over the studied comparison groups, although the results may be inflated due to improved reporting rather than actual provision of vaccines. Assessing the impact of an array of pay-for-performance incentives offered to Ontario physicians, however, Li et al. (2013) found no statistically significant effect on immunization coverage in children 24 months old. While the study in Ontario reflected low voluntary participation among physicians, enrolment among practices in Australia is estimated at 90% (Australian Government 2000a).

In a recent study of physicians in the US, 64% of 534 surveyed agreed to spread out the vaccination schedule when requested (Kempe et al. 2015). Those surveyed felt

doing so would build trust with families, and expressed concern that families might leave their practice if they did not comply. Whether incentives can overcome these tendencies remains unclear, with incentives still experimental in application to Canadian provinces. Based on uncertainty over effectiveness and participation among practices, the impact on vaccine uptake is ranked low (1) and acceptance shift low (1).

Equity and Fairness

Incentives could theoretically be targeted to health regions where public health delivery dominates, although this model creates perverse funding differentials between health districts, making it highly inequitable and therefore dismissed. Incentives aimed at physician providers should not create any equity gaps between groups based on socioeconomic status or region of residence. Studies suggest pay-for-performance incentive schemes can improve equity among and between groups (Van Herck et al. 2010). Children who live in areas with poor immunization coverage may benefit from improved counselling and attentiveness to vaccination if their physician seeks the incentive. This does not compromise care for other children, as the outcome payment is based on achieving a high proportion of coverage within a practice. Because provider incentives depend on widespread participation of physicians to improve vaccine accessibility, equity ranks moderate (2).

Stakeholder Acceptability

Pay-for-performance schemes have seen discriminatory use in other healthcare sectors in Canada. Some provinces, like Ontario and Alberta, have considered or initiated provider incentives for immunization programs. In a series of focus groups with BC doctors, participants suggested differentiating fees for the various aspects of vaccine delivery, including counselling or reviewing immunization status, as one method of sustaining vaccine delivery (Omura et al. 2014). Though not a direct application of fee changes, provider incentives may better compensate efforts dedicated to vaccination counselling and administration. Payments represent additional funds above regular remuneration, and ultimately impose no penalty on non-participants or physicians who fail to reach targets. Public reception is neutral, as most individuals would not be aware of the changes made. The acceptance of provider incentives to collective stakeholders ranks high (3).

Cost

This policy uses funds particularly efficiently because costs accrue directly with immunization coverage increases, whereas other options likely devote more resources to persuasion or operational tasks that may not directly increase vaccinations. However, adoption of provider incentives implies the province would assume the eventually high budgetary costs of the program accrued with successful coverage improvements. Annual costs under the combined outcomes and completion payments in Australia, rose to a stable \$A40 million following the introduction of quarterly payments (Hull et al. 2009). Spread over Canadian provinces with a total population approximately fifty percent larger, even annual payments would exceed several million dollars with medium to high uptake and participation. While introductory costs of this policy are moderate, prospective sums amassing with the program's success would likely escalate. Overall, costs are high (1).

Implementation Complexity

Due to the various physician payment models used across Canadian provinces, ranging from fee-for-service to blended models and salary pay structures, wide implementation of provider incentives requires some changes to healthcare administration. Further changes involve clerical training on new remuneration criteria, and likely some adjustments to how information is collected and verified on completed immunizations. For the most part, these do not imply long-term delays, and they require no legislative changes. For the reasons indicated, implementation complexity is moderate (2).

| Evaluation Summary: Provider Incentives | | | | |
|--|----------------------------|----------------------------------|-------------|----------------------------------|
| Effectiveness | Equity and Fairness | Stakeholder Acceptability | Cost | Implementation Complexity |
| 1 + 1 | 2 | 3 | 1 | 2 |

11.4. Outreach Services and Mobile Immunization Clinics

Effectiveness

According to a World Health Organization review of strategies to address hesitancy and for the outcome of vaccine uptake, interventions with the largest positive effect were those that directly targeted unvaccinated or undervaccinated populations; aimed to increase knowledge and awareness surrounding immunization; improved convenience and access; and targeted specific populations such as the local community (WHO 2014). These characteristics align with the stated policy intentions. Although mobile clinics can better connect individuals to immunization services, particularly for populations experiencing routine health accessibility challenges, the capacity and reach of these clinics is constrained to a population subset, without quantifiable evidence for overall outcomes. Outreach receives a moderate scoring for both categories of effectiveness (2 + 2).

Equity and Fairness

Mobile clinics and outreach services offer the ability to bring immunization services to people, rather than expecting people to travel to public health offices or doctors for immunizations. This includes populations not integrated in the public school or preschool system, such as homeschooled children for whom school-based catch-up immunization programs are less accessible. Clinics and public outreach initiatives improve equity for more isolated and remote populations, including northern areas and Aboriginal communities, or urban communities with empirically lower coverage. This option thereby improves vertical equity between groups with differing abilities to access services and extends access. Equity ranks high (3).

Stakeholder Acceptability

As noted in Chapter 6, mobile health clinics are underway in some areas of Manitoba, with prior use in Alberta, and may see sporadic use within some regional health authorities, such as for seasonal influenza vaccinations and dentistry services. The use of mobile and outreach health delivery by some Canadian jurisdictions for various services suggests this policy would satisfy government acceptability. In areas where transportation barriers are high and healthcare inconvenient, the public would

presumably support this option. Although not empirically evaluated, response to the Saskatoon Health Bus appears positive based on informal response among the public and medical communities (Lunau 2011; Accreditation Canada 2013). Acceptability among stakeholders is high (3).

Cost

As captured by a World Health Organization review on mobile outreach, “the mobile strategy is a good illustration of the tension between equity to access and effective utilization of scarce resources like health workforce” (de Roodenbeke et al. 2011). Travel time restricts cost effectiveness in the most remote destinations, representing a far pricier approach than provision in traditional settings. Based on a mobile dental clinic used in an Ontario Health unit, adding health service buses carry fixed costs of up to \$500,000 each (Peterborough County-City Health Unit 2012), scalable for smaller van units carrying less equipment and providing vaccinations only. Yearly operating costs of a health bus used in Saskatoon total approximately \$487,000 (Lunau 2011). Adding dedicated outreach coordinators in priority locales would raise regional health authority expenditures for each position added. Estimating yearly figures of \$50,000 to \$70,000 per full-time-equivalent (FTE), these do not represent substantial outlays relative to existing health budgets. Relative to other options analyzed and the magnitude of budgetary changes, this option is moderately expensive to deploy two mobile clinics within a province (2).

Implementaton Complexity

Mobile immunization delivery likely presents the fewest issues of implementation complexity. Most of the training required involves logistics and scheduling, with attention devoted to effective outreach also. The procedures and competencies performed by the healthcare providers, likely public nurses or nurse practitioners, would not differ substantially from their present responsibilities. Primary oversight would fall to regional health authorities, rather than the provincial ministry or public health department. A specific issue of implementation in mobile healthcare is establishing longstanding provider-patient relationships and correctly identifying populations for interventions. These conditions would require follow-up visits, combined with skilled and

knowledgeable personnel to leverage connections to community leaders. Acknowledging these components, implementation complexity for mobile clinics and outreach is low (3).

| Evaluation Summary: Outreach Services and Mobile Clinics | | | | |
|--|---------------------|---------------------------|------|---------------------------|
| Effectiveness | Equity and Fairness | Stakeholder Acceptability | Cost | Implementation Complexity |
| 2 + 2 | 3 | 3 | 2 | 3 |

11.5. Summary of Policy Evaluation

The matrix below summarizes for decision-makers and health administrators key trade-offs between the policy options assessed, and is used as a comparative tool to demonstrate the relative shortcomings and benefits of options. Green represents a high scoring (3), yellow a medium (2), and red a low scoring (1).

Table 11.3. Overview of Policy Analysis Findings

| | Recalls and Reminders | School Requirements | Provider Incentives | Outreach & Mobile Clinics |
|---|-----------------------|---------------------|---------------------|---------------------------|
| Effectiveness: Vaccine Uptake | 3 | 3 | 1 | 2 |
| Acceptance Shift | 2 | 3 | 1 | 2 |
| Equity | 2 | 2 | 2 | 3 |
| Acceptability | 2 | 2 | 3 | 3 |
| Cost | 2 | 2 | 1 | 2 |
| Implementation Complexity | 1 | 1 | 2 | 3 |
| Total | 12 | 13 | 10 | 15 |

From the preceding analysis, the following section offers recommendations and describes potential implementation considerations that may affect jurisdictions differently.

Chapter 12.

Recommendations and Implementation

12.1. Provincial Recommendations

Regional data shows evidence of waning or plateaued vaccination rates, and before optimal registries are established, policy changes are warranted in the interim to maintain protection against disease. Full functionality of registries may not occur for several years to come, gaps in records across birth cohorts indicate vaccine histories are undocumented for many children, and it remains unclear whether new registries will properly capture data from preceding birth cohorts. To capture the 20 to 30% of children who remain under-immunized, the analysis reveals significant trade-offs between policy effectiveness and outlays or administrative complexities. Even with better data, isolating efforts and resources for recalls and reminders, or encouraging physicians to persuade their patients to immunize, may remain ineffective and inefficient in changing the behaviour of parents who fail to adequately immunize their children.

12.1.1. Recommendation #1: Target outreach and mobile clinics to areas with low coverage

Community outreach is a proactive method of reaching under-immunized communities and improving health equity. Immediate efforts should introduce mobile outreach clinics to communities with the lowest access to immunization services and clinics and known under-immunization. By developing effective relationships with local leaders, outreach clinics can also create new lines of influence and vaccine demand among communities. Provincial assessment of required capital should begin immediately, with procurement of buses or vans and distribution of personnel following in the short term.

12.1.2. Recommendation #2: Initiate legislation for school entry reporting requirements

Legislation enforcing school entry reporting represents the most comprehensive alternative to increase and monitor coverage across all children. Establishing school-based immunization requirements creates a new site for the collection of health data, the mandate to enforce decision-making among parents, and the authority to enact penalties for non-compliance. This recommendation reinforces vaccination as an essential action for the personal and societal protection of public health by creating a standard of disease control and prevention across the country. Used in tandem with school reporting requirements, outreach and mobile clinics can directly support this recommendation by targeting undervaccinated communities and regions prior to the time of school entry. Finally, this allows school boards to act in ensuring the health and safety of their populations to prevent and control outbreaks in settings prime for contagion.

This recommendation is not without its implementation challenges. Strong federal and provincial leadership are necessary to catalyze legislative change. Provinces should look carefully to the many models employed by US states, which vary in their procedures. Policy design is a lever for adjusting how strictly to enforce processes among parents of under or non-immunized children. For example, New Brunswick allows parents 120 days to bring their child's immunizations up-to-date. A phased-in approach may be tactical during transition and introduction in provinces at risk of greater public dissent.

12.2. Supporting Recommendations

Improve provincial immunization registries

Provincial health jurisdiction significantly curtails the likelihood of a national registry in Canada. Interview findings revealed scepticism that the benefits of a national registry would outweigh the considerable administrative challenges and costs. Literature on the topic references the numerous administrative barriers, including differing provincial privacy legislation, the absence of overall governance structures, and the need for interprovincial access agreements (Kwong et al. 2010). Provinces should

instead recommit to and act on the original recommendations made at the 1996 Canadian Immunization Conference, namely that “every province and territory [...] have a comprehensive electronic immunization registry capable of participating in a national immunization records network” (PHAC 1998). Fundamental to effective program delivery, standardized provincial immunization registries should:

- provide information on the immunization status of all children, from birth onwards;
- identify priority areas deemed high risk because of widespread under or non-immunization;
- monitor coverage and vaccine effectiveness at national, provincial, and regional/local levels; and
- deliver the capacity to provide recalls and reminders to families, making wide use of a variety of methods, including phone calls and text-messaging.

Having registry interoperability for the entire country is important for monitoring disease susceptibility in the case of outbreaks, and necessary to evaluate and compare program effectiveness.

In the coming years, ensuring adequate functionality means provinces must amend respective privacy legislation to allow a range of healthcare workers, from public health nurses to acute care workers and physicians, to acquire and update immunization histories electronically. Otherwise, incomplete records and missed opportunities for immunization will persist due to limited access to information. Maintaining public support for this collection of information implies that individuals should also have access to their immunization histories, and that sufficient protections exist to preserve confidentiality of information. This recommendation falls to the long-term based on provincial plans, but electronic registries across the country ought to be established and operative within three to five years.

Streamline public messaging and create an authoritative information source on immunization

Canadian parents remain misinformed by myths about vaccine safety, effectiveness, and value. Mixed messages can come from providers, online information sources, the public, and media. With resources heavily devoted to vaccine purchasing

and delivery, many jurisdictions lack the capacity and capability to effectively counter negative messaging and strategically promote the value of immunization. To promote greater public confidence, accessible and consistent information should be disseminated nationally to vaccine providers, and made available to the public also. The federal government, concurrently with preceding provincial recommendations, should deliver this initiative. Before embarking on widespread education or promotion campaigns, further study is needed to determine what methods best influence attitudes, knowledge, and behaviour.

12.3. Areas for Further Research

Due to the constraints of the project, in-depth research on all provinces was not feasible. Despite making best practice recommendations to Canadian provincial jurisdictions, this study does not tailor itself to the unique conditions in northern territories, nor does it address the paucity of efforts in reaching on-reserve Aboriginal children. Healthcare delivery and immunization program considerations in these communities may differ significantly from those in the provinces studied, and are an important topic for future exploration. Second, the success of coverage improvements will create new challenges nation-wide. Directly examining Canada's vaccine procurement capacity and methods will be essential to match supply with increased uptake.

12.4. Conclusion

Across the US, Europe, and even in Canada, rates of diseases previously thought to be in decline, like measles and pertussis, have increased since initial successes of vaccine introduction. With recent outbreaks renewing public awareness of the threat of vaccine preventable diseases, and the risks imposed by international travel, now is an opportune time for Canadian provinces to make substantial changes reflecting their commitment to childhood immunization. Efforts to achieve and maintain high levels of vaccine coverage in the population require implementation and coordination of an array of public policy, health system and community-based interventions. No singular

intervention will achieve sufficiently high immunization levels over the long run. Provincial strategies should institute widespread participation in vaccination programs as both the convenient and default option through mobile outreach clinics and school entry requirements.

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Appendix A.

Cases of Vaccine Preventable Diseases in Canada, Before and After Immunization Programs

| <i>Vaccine-Preventable Disease</i> | <i>Cases in peak year before routine immunization¹</i> | <i>Peak cases in Canada, 2002-2012²</i> | <i>Fewest cases in Canada, 2002-2012³</i> |
|------------------------------------|---|--|--|
| Diphtheria | 9,010 | 4 | 0 |
| Haemophilus influenza b (Hib) | 671 | 50 | 17 |
| Measles | 61,370 | 752 | 8 |
| Mumps | 43,671 | 1,119 | 28 |
| Pertussis | 19,878 | 4,540 | 695 |
| Polio | 5,384 | 0 | 0 |
| Rubella | 37,917 | 319 | 2 |
| Tetanus | 25 | 6 | 1 |

Sources: ¹PHAC 2014a. ²PHAC 2014b. ³Ibid.

Appendix B.

National Advisory Committee on Immunization (NACI) Immunization Schedule

Publicly Funded Immunization Programs in Canada – Routine Schedule for Infants and Children including special programs and catch-up programs (as of September, 2014)

| Vaccine | Recommended Age(s) |
|--|--|
| DTaP-IPV-Hib Diphtheria, tetanus, acellular pertussis, inactivated poliomyelitis, haemophilus influenza type b | 2, 4, 6, 18 months |
| DTaP-IPV Diphtheria, tetanus, acellular pertussis, inactivated poliomyelitis | 4-6 years |
| DTaP or DTaP-IPV | 14-16 years |
| HB Hepatitis B | Infancy (3 doses) OR pre-teen/teen (2-3 doses) |
| MMR Measles, mumps, rubella | 12 months AND 18 months OR 4-6 years OR 2 doses MMR-Var |
| Var Varicella | 12-18 months AND 18 months OR 4-6 years OR 2 doses MMR-Var |
| MMR-Var Measles, mumps, rubella, varicella | 12 months AND 18 months OR 4-6 years |
| Men-C Meningococcal conjugate | Infancy (1-4 doses) AND pre-teen (1 dose) |
| Men-C-A-CYW-135 Quadrivalent meningococcal conjugate | Pre-teen (1 dose) |
| Pneu-C-13 Pneumococcal conjugate 13-valent | 2, 4, 6, 12-15 months |
| Inf Influenza | 6-59 months (1-2 doses) |
| HPV Human papilloma virus | 9-18 years (3 doses at 0, 2, 6 months) |
| Rot Rotavirus | 2, 4, 6, months |

Source: PHAC 2014c.

Appendix C.

Provincial Immunization Coverage Rates: Data Sources (Table 3.1)

Where records of multivalent vaccines (e.g. DTaP-Hib) are given individually by a province, the average of all rates corresponding to a vaccine are used.

National Targets:

Public Health Agency of Canada. 2014. Immunization Coverage in Canada (2002-2012): "Table 1: National Immunization Coverage Goals (2005) for Vaccines".
<http://www.phac-aspc.gc.ca/im/nics-enva/icc-cvc-eng.php>

Alberta:

Government of Alberta. 2014. Alberta Interactive Health Data: "Childhood Coverage Rates 2008 to 2013"; and "Childhood Coverage Rates – Varicella".
http://www.ahw.gov.ab.ca/IHDA_Retrieval/selectSubCategory.do

British Columbia:

BC Centre for Disease Control. 2014. "Percent of two-year olds with up-to-date immunizations British Columbia, 2009-2013".
http://www.bccdc.ca/NR/rdonlyres/B8FB94AC-A216-4AEF-B88A-5C3C539F2575/0/2_Year_Old_Imms_Coverage_20072011_Cohorts.pdf

Manitoba:

Government of Manitoba. 2014. "Manitoba Annual Immunization Surveillance Report – 2012 and 2013". *Manitoba Health, Healthy Living and Seniors. Public Health and Primary Health Care Division. Public Health Branch, Epidemiology and Surveillance.*
<http://www.gov.mb.ca/health/publichealth/surveillance/mims/docs/2012.pdf>

New Brunswick:

Government of New Brunswick. 2013. "Immunization Report – Public Health, September 2013: Daycare, school entry, and school program immunization enrolment rates, up to 2012." http://www2.gnb.ca/content/dam/gnb/Departments/h-s/pdf/en/CDC/HealthProfessionals/Immunization_Report_Regional_%20PH_2013.pdf

Newfoundland and Labrador:

Government of Newfoundland and Labrador. 2013. "Newfoundland and Labrador Immunization Coverage Report 2005-2012". *Department of Health and Community Services*.
<http://www.health.gov.nl.ca/health/publichealth/cdc/informationandsurveillance.html>

Nova Scotia:

Dummer, Trevor J.B., Yunsong Cui, Robert Strang, Louise Parker. 2012. "Immunization Completeness of Children Under Two Years of Age in Nova Scotia, Canada". *Canadian Journal of Public Health* 103(5): e363-e367.

Ontario:

Public Health Ontario. 2014. "Immunization coverage report for school pupils: 2012-13 school year".
http://www.publichealthontario.ca/en/eRepository/Immunization_coverage_report_2012-13.pdf

Prince Edward Island:

Prince Edward Island Department of Health and Wellness. 2012. "Promote, Prevent, Protect – PEI Chief Public Health Officer's Report and Health Trends 2012".
http://www.gov.pe.ca/photos/original/hw_cphoar2012.pdf

Saskatchewan:

Sun County Health Region. n.d. "SCHR Up-To-Date Immunization Coverage Rates".
http://www.suncountry.sk.ca/gsCMSDisplayPluginFile/show/id/209/menu_id/160/lang_type/en_US/page_type/people/page_id/31

Quebec:

Government of Quebec. 2013. "Enquête sur la couverture vaccinale des enfants de 1 an et 2 ans au Québec en 2012". *Institut National De Santé Publique du Québec*.
http://www.inspq.qc.ca/pdf/publications/1651_EnquCouvVaccinEnfants1Et2Ans2012.pdf

Appendix D.

Sample Informational Interview Schedule

| <i>Discussion Topic</i> | <i>Question</i> |
|-----------------------------|---|
| Vaccine hesitancy | <p>1) In your opinion/experience/research, what are some of the greatest factors preventing children in <i>PROVINCE</i> from becoming fully immunized on time? (Prompts: environment, location, socioeconomic status. (Does a community's socio-cultural or other characteristics affect coverage levels?))</p> <ul style="list-style-type: none"> • Can you comment on factors causing regional variation in coverage rates? How widely does coverage vary across the province? <p>2) Are you seeing an increase in the number of objections/refusals in <i>PROVINCE</i>?</p> |
| Provincial coverage | <p>3) What recent policies or programs has <i>PROVINCE</i> used to improve vaccination coverage and get children up to date for routine immunizations?</p> <ul style="list-style-type: none"> • Have these been effective? Why or why not? • Which providers (e.g. public health nurses, physicians) are responsible for vaccine delivery? How does this affect access? <p>4) Where should ongoing efforts be targeted to reach provincial immunization goals? (Prompts: reducing hesitancy, improving accessibility, provider type)</p> <ul style="list-style-type: none"> • What are the components of an optimal immunization program? What would the supporting policies look like? |
| Surveillance and registries | <p>5) How is childhood immunization information tracked and monitored in <i>PROVINCE</i>?</p> <ul style="list-style-type: none"> • How are immunizations reported? • In your opinion, does this system meet the needs of the province? • If no, what changes are needed? • How can this data be used to reach provincial coverage targets? |
| Policy options | <p>6) In your opinion, would/do recalls and reminders to families about a child's immunization status impact vaccination coverage rates?</p> <ul style="list-style-type: none"> • Why or why not? <p>7) Presently, two provinces in Canada have legislation requiring proof of immunization status before children enter or return to school. Would such policies be effective in <i>PROVINCE</i>?</p> <ul style="list-style-type: none"> • Why or why not? What would be the barriers to this policy? <p>8) In Australia, receiving certain maternal tax credits, like those used for childcare programs, requires proof of up-to-date immunization status. Are financial incentives a feasible option in Canadian provinces?</p> <ul style="list-style-type: none"> • Why or why not? What are the barriers to doing so? |
| National targets | <p>9) In your opinion, does Canada need a national immunization registry?</p> <ul style="list-style-type: none"> • What role should the federal government (PHAC) play in improving routine immunization coverage in Canada? |

Appendix E.

Interview Participants and Methodology

Interview participants were recruited via publicly available contact information located on the internet. Participants were contacted by email with a request to participate in the study, an overview of the study details, and documents detailing consent protocol. Additional contacts were retrieved through snowball sampling methods, using referrals from interview participants. Interviews were conducted over the telephone, and typically lasted 30-45 minutes in duration.

Outlined below are dates and roles of stakeholder interviews. As some interviewees requested to have comments attributed anonymously, specific positions are not provided for all individuals.

| Stakeholder # | Position/Province | Date Contacted |
|----------------------|--|-----------------------|
| 1 | Epidemiologist, Ontario | December 11, 2014 |
| 2 | Healthcare Expert, Alberta | December 15, 2014 |
| 3 | Public Health Nurse, Ontario | December 16, 2014 |
| 4 | Infectious Disease and Vaccine Epidemiologist, Ontario | January 15, 2015 |
| 5 | Medical Director, Immunization Programs and Vaccine Preventable Diseases Service, BC Centre for Disease Control | January 21, 2015 |
| 6 | Healthcare Expert, Alberta | January 23, 2015 |
| 7 | Healthcare Expert, Ontario | January 23, 2015 |
| 8 | Manager, Immunization & Vaccine Preventable Diseases, Communicable Disease Prevention and Control, Public Health Ontario | February 3, 2015 |
| 9 | Director, Immunization, Surveillance and Assessment Branch, Government of Alberta, Ministry of Health | February 11, 2015 |

Appendix F.

Excluded Policy Options

Immunization Education Campaigns

The appeal of education or information campaigns addressing misinformation about vaccines and immunization stems from the apparent simplicity of the approach, and attractively low costs relative to other strategies. Relevant issues limiting the effectiveness of this approach include sustainability over the long term, the ability to target intended recipients, and the effectiveness of factual information in changing perspectives and behaviour. While providing accurate information about risks and benefits is crucial, data and facts, even if strongly supportive of immunization, do not sufficiently persuade individuals motivated by emotion (Diekema 2012).

Indeed, some scholars are wary about increasing education that may further polarize anti-vaccination stances (Poland and Jacobson 2001; Kata 2009). As referenced in the background literature review, educational messages issued by the Center for Disease Control, designed to reduce vaccine misperceptions and increase vaccination rates for MMR found that none of the interventions increased parental intent to vaccinate a future child (Nyhan et al. 2014). Instead, the dramatic narratives and images of sick children, used to demonstrate the medical dangers of not vaccinating, actually increased individuals' concerns about vaccine side effects such as links to autism. At worst, widespread public education campaigns could be counteractive if they alienate or provoke immunization objectors; at best, expected improvements to coverage rates remain unclear.

Compulsory Universal Vaccination

Compulsory universal vaccination, used in Hungary, Slovenia, Croatia, and other countries, was not analyzed as a policy option. Even in countries with universal immunization requirements for healthcare workers or children entering school, exemption clauses for medical, ethical, or religious reasons are common practice. Compulsory immunization remains legally controversial, with opponents referencing rights outlined in section 7 of the *Canadian Charter of Rights and Freedoms* for protection against the intrusion on security of the person (Rodal et al. 2009). Though in the context of public health such infringements might be considered in accordance with the principles of fundamental justice, namely the spread of infectious disease, a lack of clarity on this issue makes the legality of mandatory immunization a potentially volatile issue.

Compulsory vaccination also significantly increases the burden on governments to ensure vaccine safety. The Public Health Agency of Canada has a surveillance system to monitor adverse events following immunization, but with the exception of Quebec, no provincial, territorial, or federal vaccine-injury compensation programs exist in Canada. Scholars argue government has an ethical and reciprocal responsibility to compensate the few individuals who may be injured as a consequence of a compulsory immunization program, as used in countries such as the US and UK (Keelan and Wilson 2011). Lastly,

it is not clear that compulsory vaccination is necessary to achieve high coverage levels. Countries like Sweden, Norway, and the United Kingdom use fully voluntary measures, with many other countries faring successfully through universal programs authorizing exemptions. The effect of mandatory immunization policies in the international landscape is an area warranting further research, especially with anti-vaccination sentiments and objections increasing in other countries worldwide.

Tax Rebate Incentives

Drawing on feedback from stakeholder interviews that stressed the administrative barriers to implementation, the option of using tax rebate incentives to incentivize widespread vaccination was rejected. Though effective in Australia and favoured for the application of behavioural economics to realize public health goals, interview respondents expressed concern over the immense burden this would create for healthcare agencies and the Canada Revenue Agency. Though the Universal Childcare Benefit could serve as the delivery mechanism of the program, complexity arising from jurisdictional issues and existing reporting structures make adoption expensive, and risks widespread delays or errors in payment. In the case of Australia, successful uptake leveraged a national, electronic registry that Canada does not presently have. Finally, the ability to target priority populations with this method is highly limited, offers less incentive to high-income families, and may pose an inequitable burden on lower-income households for whom childcare support rebates fill a greater financial need.