MANITOBA IMMUNIZATION STUDY

April 2011

University of Manitoba | Faculty of Medicine
Community Health Sciences

Manitoba Centre for Health Policy
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About the Manitoba Centre For Health Policy

The Manitoba Centre for Health Policy (MCHP) is located within the Department of Community Health Sciences, Faculty of Medicine, University of Manitoba. The mission of MCHP is to provide accurate and timely information to health care decision–makers, analysts and providers, so they can offer services which are effective and efficient in maintaining and improving the health of Manitobans. Our researchers rely upon the unique Population Health Research Data Repository (Repository) to describe and explain patterns of care and profiles of illness, and to explore other factors that influence health, including income, education, employment, and social status. This Repository is unique in terms of its comprehensiveness, degree of integration, and orientation around an anonymized population registry.

Members of MCHP consult extensively with government officials, health care administrators, and clinicians to develop a research agenda that is topical and relevant. This strength, along with its rigorous academic standards, enables MCHP to contribute to the health policy process. MCHP undertakes several major research projects, such as this one, every year under contract to Manitoba Health. In addition, our researchers secure external funding by competing for research grants. We are widely published and internationally recognized. Further, our researchers collaborate with a number of highly respected scientists from Canada, the United States, Europe, and Australia.

We thank the University of Manitoba, Faculty of Medicine, Health Research Ethics Board for their review of this project. MCHP complies with all legislative acts and regulations governing the protection and use of sensitive information. We implement strict policies and procedures to protect the privacy and security of anonymized data used to produce this report and we keep the provincial Health Information Privacy Committee informed of all work undertaken for Manitoba Health.

UNIVERSITY OF MANITOBA | Faculty of Medicine

Community Health Sciences

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We acknowledge the Faculty of Medicine Research Ethics Board for their review of this project. The Health Information Privacy Committee of Manitoba Health is kept informed of all MCHP deliverables. The Health Information Privacy Committee number for this project is 2008/2009–28. Strict policies and procedures were followed in producing this report to protect the privacy and security of the Repository data.

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Table of Contents

List of Figures

List of Tables

Executive Summary

In the last 50 years, immunization has saved more lives in Canada than any other health intervention (Public Health Agency of Canada, 2006). Dreaded infectious diseases like diphtheria and polio have essentially been eradicated due to successful childhood immunization programs (Public Health Agency of Canada, 2006); while the incidence of others like measles, mumps, rubella, and pertussis have been dramatically reduced. However, immunization programs in developed countries face many challenges in the 21st century. The ever expanding list of vaccine preventable diseases increases the cost and complexity associated with the delivery of the publicly funded immunization schedule. Furthermore, questionable media coverage of vaccine safety issues and dubious reports of vaccine conspiracies on the internet can galvanize the 'anti–vaccine' lobby (Kata, 2010). Recent surveys and studies suggest immunization rates are stable at best and falling at worst (Edmonton's Children & Youth Report, 2006; Institute of Health Economics, 2007).

This study used administrative data contained in the Population Health Research Data Repository housed at the Manitoba Centre for Health Policy (MCHP). Most of these data are derived from administrative claims data that are collected in order to administer the universal healthcare system within Manitoba. The Repository contains information of key interest to health planners. It includes the Manitoba Immunization Monitoring System (MIMS), person–level data such as birth and mortality, contacts with physicians and hospitals, pharmaceutical dispensing, use of home care services and nursing homes, and area–level data such as average household income by dissemination area from the Canadian Census.

Specific research questions that were asked include:

- What is the MIMS data (as it exists today) telling us about immunization coverage of target populations and outcomes? What health and health systems outcomes are Manitoba's immunization programs having?
- What is the potential power of the MIMS data, when aligned with other administrative data, to conduct very sensitive adverse outcome analysis for rare events, which might be used to conduct vaccine safety analysis/research?
- What are the implications of known data gaps in MIMS and which of those gaps might be most important to address from an outcomes, surveillance, and research perspective?

Overall, Manitoba's publicly funded immunization programs are producing consistent and stable immunization rates across most antigens and ages over time. This finding would seem to contradict the popular view that fewer Manitobans are choosing immunization for themselves and their children. However, notable exceptions exist and are worth highlighting. The execution of the primary series seems to be improving, as seen in this study's age two analyses. It shows increasing immunization rates despite a more complex immunization schedule. The notable declines in complete for age from birth immunization rates for most antigens at age seven suggest that more focus be given to improving uptake of the pre–school booster. In terms of influenza and pneumococcal vaccination programs, Manitoba's targeted high risk approach produces higher immunization rates for those at high risk; however, rates in some high risk groups, such as pregnant women, could clearly be higher.

There is significant variability in immunization rates between and within regions, which represents an opportunity for targeted programming using the RHA or RHA district/Winnipeg Community Areas boundaries as a valid population target.

Income quintile, maternal age at birth, continuity of care, and family size are consistently associated with immunization rates and could be used to define target groups for specific interventions.

In terms of the utility of MIMS, we believe that it is a robust and efficient platform for generating immunization coverage data; and when linked with other administrative databases (CancerCare, etc.), it produces valuable high risk group immunization coverage data. Underreporting in MIMS due to systemic and individual factors is likely occurring; and as such adult MIMS data needs to be validated similar to the work done with pediatric MIMS data (Roberts, Poffenroth, Roos, Bebchuk, & Carter, 1994). In this study, Manitoba children not continuously registered from birth with Manitoba Health increases both over time and with age. This is important as this group has significantly lower rates of immunization across all ages and antigens. Further study of this group is strongly recommended in order to validate the accuracy of MIMS.

Using MIMS linkage to other administrative databases for the purposes of assessing vaccine impact proved challenging and more work needs to be done in this area to fully realize it's potential. Despite these challenges our analyses demonstrated several interesting findings:

- Those 65 and older who received the influenza vaccination had lower all cause mortality and lower all cause hospitalizations than those who were not immunized
- A rapid decline in hospitalizations due to varicella was observed after the introduction of the varicella vaccination program
- No statistically significant association was seen between vaccinations and adverse events

Finally, linking MIMS with the large population based administrative database allowed for the relationship between vaccination and rare conditions to be studied; and it opens the door for the use of this approach in real time as a tool for early detection and/or assessment of safety signals.

Chapter 1: Introduction and Methods

Background and Objectives

In the last 50 years, **immunization**[1] has saved more lives in Canada than any other health intervention (Public Health Agency of Canada, 2006). Dreaded infectious diseases like **diphtheria** and **polio** have essentially been eradicated due to successful childhood immunization programs (Public Health Agency of Canada, 2006), while the incidence of others, including **measles, mumps, rubella** and **pertussis**, has been dramatically reduced. However, immunization programs in developed countries face many challenges in the 21st century. Advances in vaccinology have produced **vaccine** technologies capable of preventing invasive **pneumococcal disease**, invasive meningococcal disease, and **human papilloma virus** infection, but the ever expanding list of vaccine preventable diseases increases the cost and complexity associated with the delivery of the publicly funded **immunization schedule**. Furthermore, questionable media coverage of vaccine safety issues and dubious reports of vaccine conspiracies on the internet can galvanize the 'anti–vaccine' lobby (Kata, 2010). Recent surveys and studies suggest immunization rates are stable at best or falling at worst (Edmonton's Children & Youth Report, 2006; Institute of Health Economics, 2007). Canada's **National Advisory Committee on Immunization (NACI)** states quite clearly the importance of vaccination programs being carefully evaluated and that researchers and policy makers work collaboratively to identify programs that deliver the greatest benefit for the least cost (Public Health Agency of Canada, 2006).

Manitoba has had an immunization registry since 1988 when the **Manitoba Immunization Monitoring System (MIMS)** was launched. Initially it only contained immunization information for those born on or after January 1, 1980. By 1990, it recorded immunizations for all children aged 18 and under. MIMS was further expanded in 2000 and now records immunizations for all Manitobans. It is populated with the immunization status of every Manitoba resident with a valid **Manitoba Health Personal Health Identification Number (PHIN)** and includes data from all immunization providers. The historical path that has lead to the current immunization schedule is presented in Figures 1.1 and 1.2 (Michelle Long, personal communication, June 2010). The childhood immunizations recorded in MIMS were validated using a chart review and they were found to be highly accurate (Roberts, Poffenroth, Roos, Bebchuk, & Carter, 1994). A similar validation using adult MIMS data has not been performed to our knowledge.

MIMS can be programmed to generate reminder letters based on age of client and any specific missing **antigens** from a given individual's MIMS record. Manitoba currently issues pediatric MIMS reminder letters on a monthly basis using parents' or legal guardians' address, as cross–referenced with the **Manitoba Health Insurance Registry**, for all recommended **vaccinations**. Reminder letters are sent to parents whose children are missing any of the recommended immunizations as per the Recommended Routine Immunization Schedule for Infants and Children (Manitoba Health Communicable Disease Control, 2008):

- Children aged 15 months—a three month grace period from when the measles, mumps, and rubella (MMR) is recommended at 12 months
- Children aged 20 months—a two month grace period from receiving the 18 month **boosters** of diphtheria, **acellular pertussis**, **tetanus,** and polio (DaPTP); ***Haemophilus influenzae* type B** (Hib) vaccine; and **pneumococcal conjugate vaccine** (PCV–7)
- Children aged five–and–a–half years—approximately six months grace period from the recommendation of receiving the preschool boosters for DaPTP and MMR

1 Terms in bold type face are defined in the Glossary at the end of this report.

The five–and–a–half–year letters commenced in September 2004, the 20–month letters in February 2006, and the 15–month letters in December 2006. The **influenza** vaccine is not included in the reminder letters.

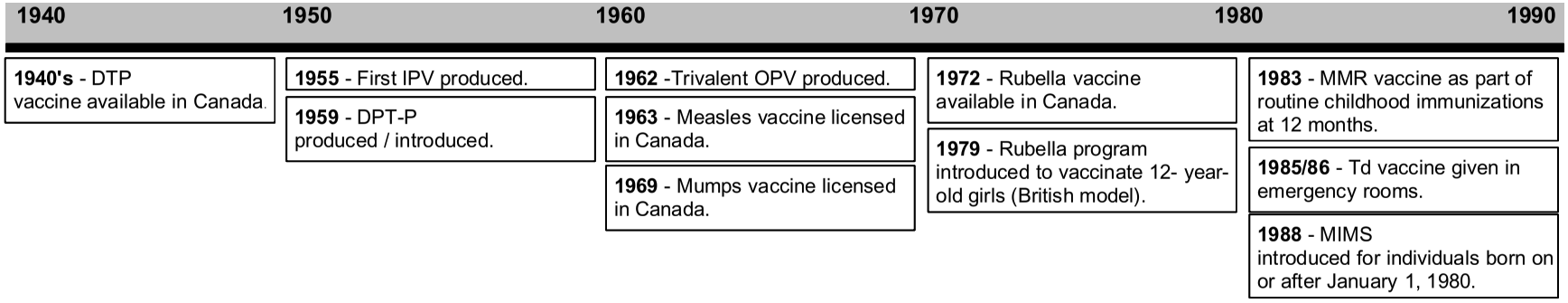
Reminder letters have been used with the adult **pneumococcal polysaccharide vaccine 23** (PPV–23) immunization program. Letters were sent in 2003, 2005, 2006, and 2008 to all Manitobans 65 and older. Due to significant improvement in PPV– 23 uptake after the 2003 reminder letters were sent, this targeted letter program was continued (Kathleen Messner, personal communication, June 2010).

This study was conducted at the **Manitoba Centre for Health Policy (MCHP)**, which is a research unit of the Department of Community Health Sciences in the University of Manitoba's Faculty of Medicine. MCHP develops and maintains the comprehensive **Population Health Research Data Repository (Repository)** on behalf of the Province of Manitoba. As MIMS is part of this Repository, research scientists at MCHP have the ability to link MIMS with other databases. As a result, Manitoba is in a unique position to understand and evaluate the immunization status of its population. The purpose of this project was to study the coverage and impact of Manitoba's childhood immunization program and its targeted influenza and **pneumonia** immunization programs. Specific research questions that were asked include:

- What is the MIMS data (as it exists today) telling us about immunization coverage of target populations and outcomes? What health and health systems outcomes are Manitoba's immunization programs having?
- What is the potential power of the MIMS data, when aligned with other **administrative dat**a to conduct very sensitive adverse outcome analysis for rare events, which might be used to conduct vaccine safely analysis/research?
- What are the implications of known data gaps in MIMS and which of those gaps might be most important to address from an outcomes, surveillance, and research perspective?

The report has three main sections. First the childhood immunizations are examined, including immunization coverage rates, trends in rates, factors associated with immunization coverage, and outcomes. In this report's second section, a similar approach is taken with Manitoba's targeted influenza and adult PPV–23 vaccination programs. In addition, several case–control studies looking at a number of outcomes, including mortality and hospitalization, were completed. Finally, the use of administrative data in vaccine safety is addressed. It is the hope of the research team that this report will enable vaccine providers, policy makers, researchers, and funders to meet the challenges that lay ahead in what has become a very fluid and dynamic core public health intervention.

Figure 1.1: History of Vaccine Use in Manitoba and Canada, 1940 - 1990



Legend:

DTP: Diphtheria,Tetanus and Pertussis Vaccine
DPT-P: Diphtheria,Pertussis,Tetanus and Polio Vaccine
IPV: Inactivated Polio Vaccine
MIMS: The Manitoba Immunization Monitoring System
MMR: Measles, Mumps, Rubella Vaccine
OPV: Oral Polio Vaccine
Td: Tetanus and Diphtheria Vaccine

(Michelle Long, personal communication, June 2010)

Figure 1.2: History of Vaccine Use in Manitoba and Canada, 1990-2010

1990

1992 - Inclusion of Hib vaccine as part of the routine childhood immunization.

1996 - Second dose of measles vaccine (using MMR) added to routine childhood immunization. School-based catch-up campaign for children born on or after January 1,1985 (using Measles-Rubella vaccine).

2000

1997 - Replacement of OPV with IPV and OPV with IPV and DTaP-IPV / DTaP-IPV-Hib introduced in Manitoba which included the introduction of aP.

1998 - Introduction of HBV school-based (grade four) immunization program for children born on or after January 1, 1989.

1999 - Introduction of publicly-funded influenza program for high-risk individuals and health care workers.

2000 - Introduction of a PPV program for high-risk individuals & MIMS to include all Manitobans.

2001 - PPV available for anyone turning 65 and older.

2003 - Three vaccine programs introduced for high-risk groups: V, Men-C, and PCV-7. Tdap replaced Td for the school-based (grade nine) program.

2004 - Four publicly-funded vaccine programs are offered to certain age groups of Manitoba children:
- influenza: 6-23 months of age
- PCV-7: 2, 4, 6, and 18 months of age
- V: 12 months, susceptible pre-schoolers, and grade four children
- Men-C: grade four students.

2010

2005 - People with conditions that reduce their ability to breathe or poses a risk of them choking are added to the MPEC to receive the influenza vaccine.

2007 - MP for high risk individuals 2-55 years of age. All pregnant women are added to the MPEC for the influenza vaccine.

2008 - HPV vaccine program in schools for grade six females only.

2009 - Men-C vaccine introduced for 12 month olds at the same time as the V and MMR vaccine; pandemic H1N1 campaign.

2010 - PCV-7 changed to PCV-13; MPEC for seasonal influenza expanded to include all Manitobans.

Legend:

aP: Acellular Pertussis Vaccine
DTaP: Diphtheria, Tetanus, acellular Pertussis Vaccine
Hib: *Haemophilus influenzae* type B Vaccine
HBV: Hepatitis B Vaccine
HPV: Human Papillomavirus Vaccine
IPV: Inactivated Polio Vaccine
Men-C: Meningococcal C Conjugate Vaccine
MIMS: The Manitoba Immunization Monitoring System
MMR: Measles, Mumps, and Rubella Vaccine
MP: Meningococcal Polysaccharide Vaccine,quadrivalent A,C,Y,W-135
MPEC: The Manitoba Provincial Eligibility Criteria
OPV: Oral Polio Vaccine
PCV: Pneumococcal Conjugate Vaccine
PPV-23: Pneumococcal Polysaccharide Vaccine
Td: Tetanus and Diphtheria Vaccine
Tdap: Tetanus, Diphtheria, and acellular Pertussis Vaccine
V: Varicella Zoster Vaccine (Chicken Pox)

(Michelle Long, personal communication, June 2010)

Geographical Boundaries

This report provides data for all 11 **Regional Health Authorities (RHAs)** in Manitoba, shown in Figure 1.3. Each non–Winnipeg RHA is divided into at least four districts (shown in Figures 1.4–1.6). Data for the Winnipeg RHA has been further broken down into the 12 Community Areas (CAs) (Figure 1.7)

For comparison purposes, the following aggregations of rural RHAs are also shown in the RHA–level graphs of the indicators:

- Rural South is composed of South Eastman, Central, Assiniboine, Interlake, North Eastman, and Parkland RHAs.
- North is composed of Churchill, NOR–MAN, and Burntwood RHAs.

The Manitoba averages for each time period are shown at the bottom of bar graphs; the vertical dashed lines correspond to these values.

We have also displayed the **complete for age from birth** results by area–level **income quintiles**. These income quintiles were developed separately for urban (Winnipeg and Brandon) and rural (all other) areas by assigning average household income from the 2006 **Statistics Canada Census** to **dissemination areas** and ranking these from highest to lowest. Dissemination areas were then divided into five groups or quintiles (one being poorest and five being wealthiest). Each contains approximately 20% of the total population. Each person living in the dissemination area is "attributed" the average household income of the dissemination area, so this is not an individual–level income but rather an area–level income measure. Income quintiles are often used as a proxy measure of **socio–economic status**.

Ordering of Areas in Graphs

In this report, RHAs, RHA districts, and Winnipeg CAs are shown in a particular order, which is consistent throughout the report and similar to other MCHP reports. This order is based on the overall health status of the population of each area as measured by the **premature mortality rate (PMR)** over the 10–year period from 1996 through 2005. Ten years of data were used because some RHA districts have small populations, so multiple years are required to provide reliable estimates. A death before the age of 75 is considered premature, so the PMR indicates the average annual rate at which an area's residents died before reaching age 75, per 1,000 area residents under 75.

In the RHA district–level graphs, the PMR order of the RHAs is maintained. The districts within each RHA are ordered according to PMR. Within each RHA, the district with the lowest PMR (the best overall health status) is listed first with the others listed in order of increasing PMR.

Figure 1.3: Regional Health Authorities (RHAs) of Manitoba

Figure 1.4: Districts of North RHAs

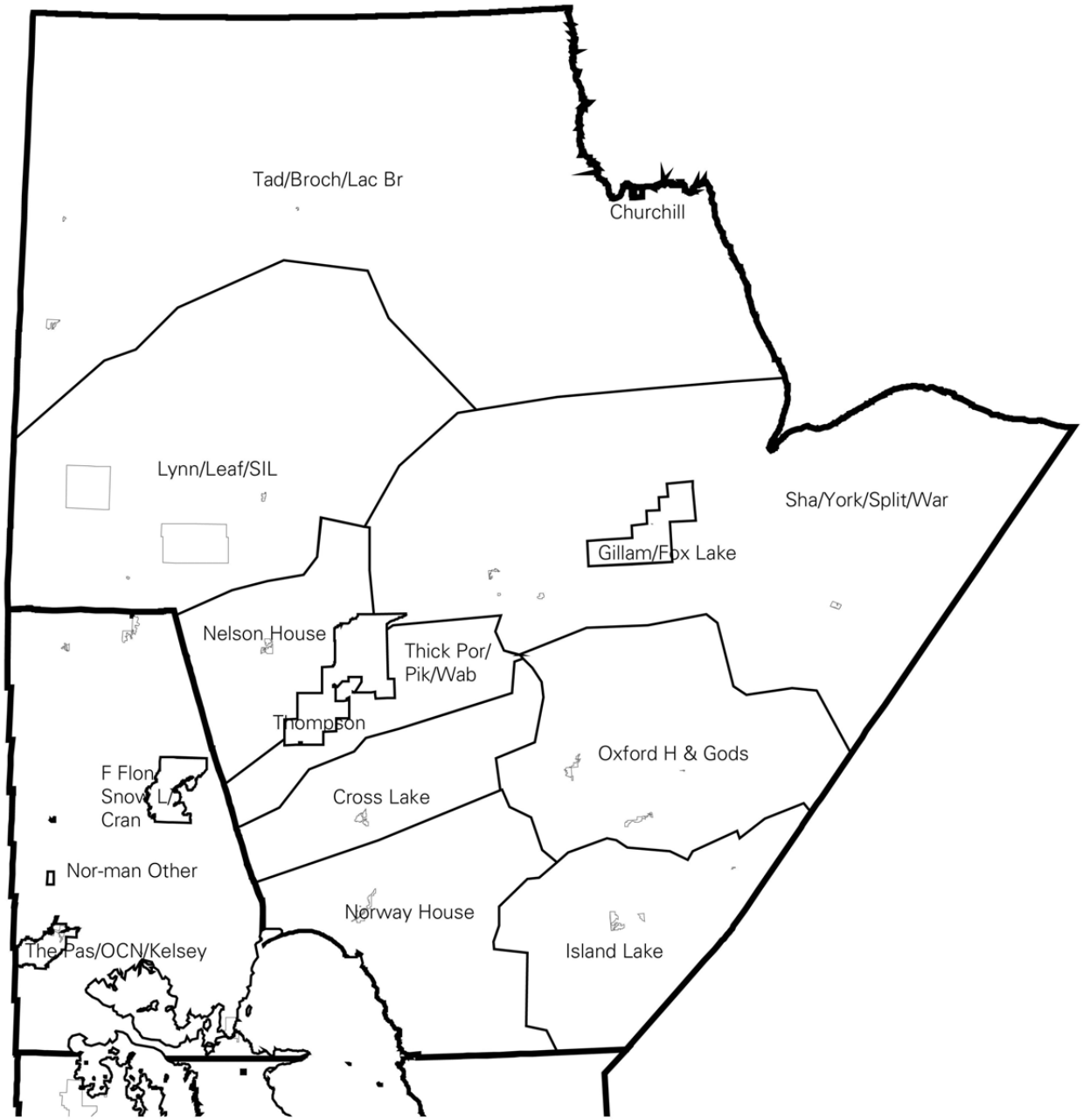


Figure 1.5: Districts of Rural South RHAs

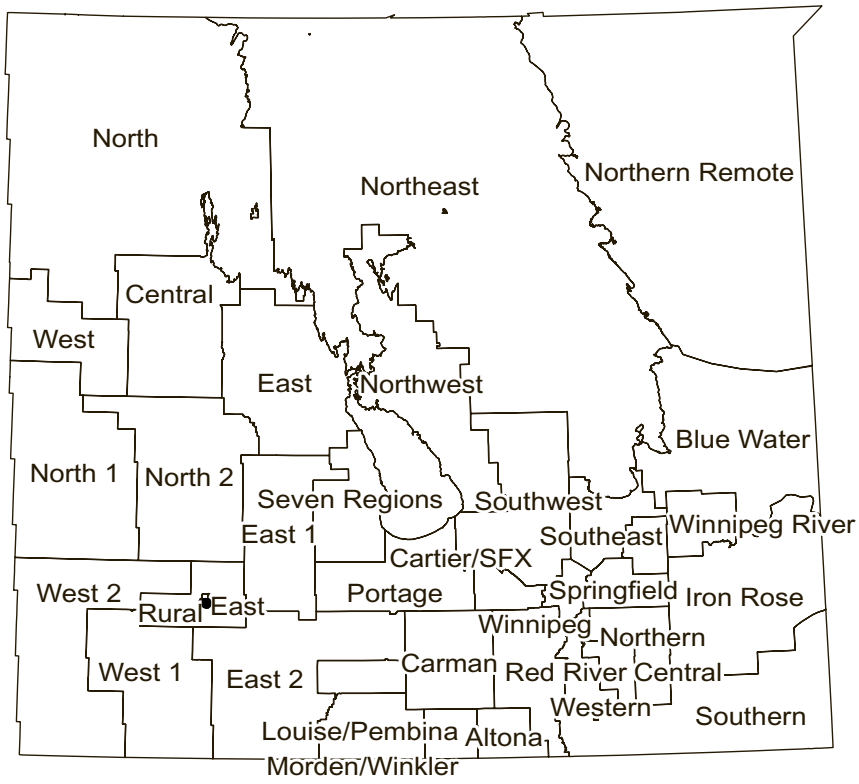


Figure 1.6: Brandon RHA

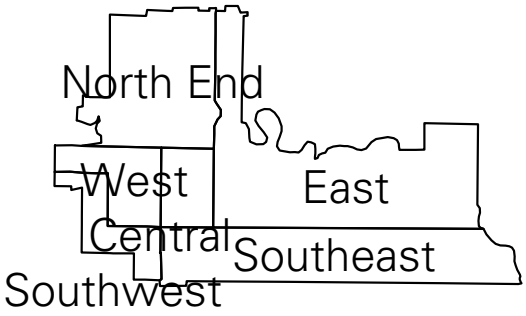
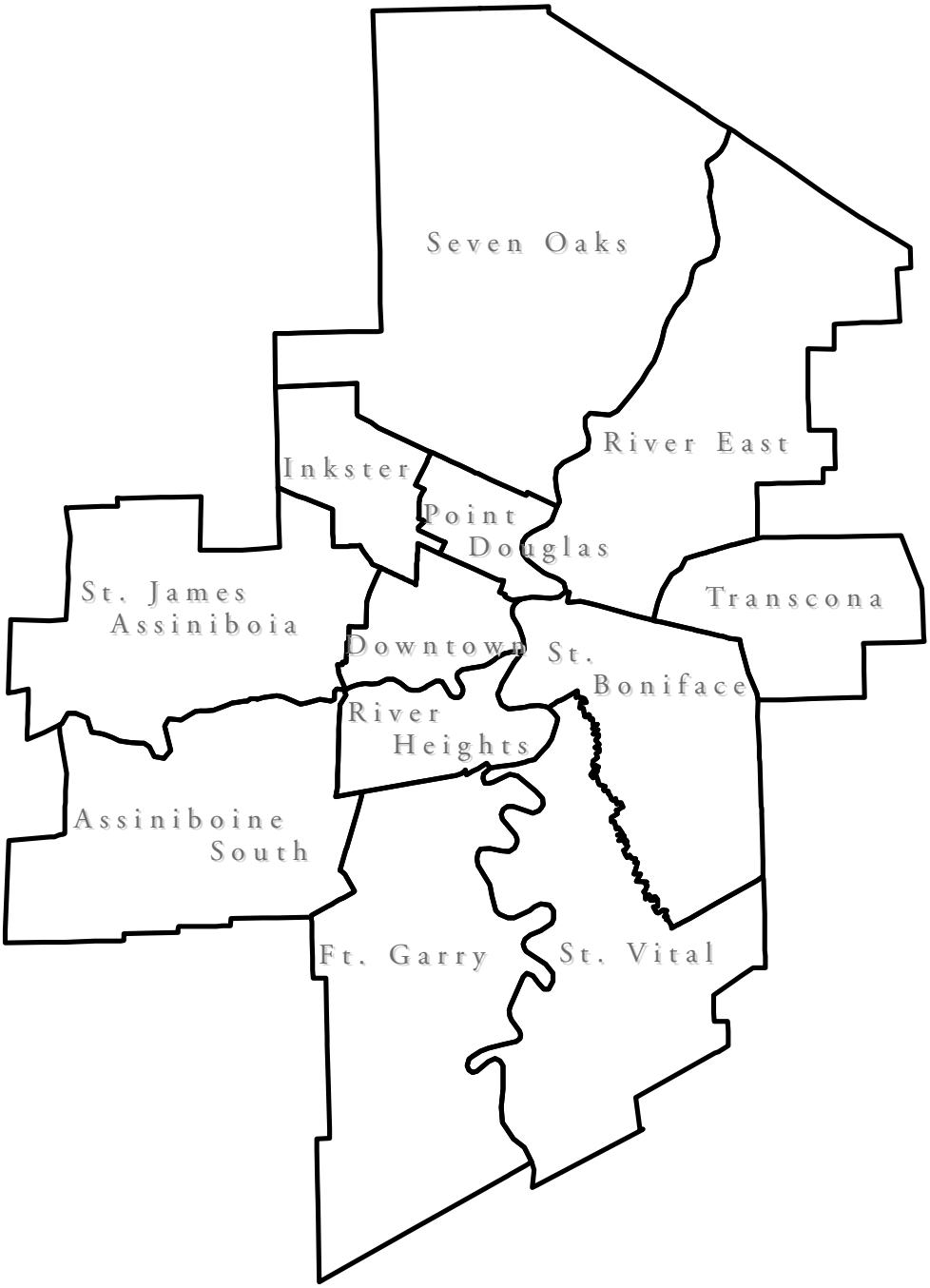


Figure 1.7: Winnipeg Community Areas (CAs)



Data Sources and Years of Data Used

This study used administrative data contained in the Repository housed at MCHP. Most of these data are derived from administrative claims data that are collected in order to administer the universal healthcare system within Manitoba. The Repository includes information of key interest to health planners; and it includes person–level data such as birth and mortality, contacts with physicians and hospitals, pharmaceutical dispensing, use of home care services and nursing homes, and area–level data such as average household income by dissemination area from the Canadian Census. All records in the Repository are de–identified. Prior to data transfer to MCHP, Manitoba Health processes the records to encrypt all personal identifiers and remove all names and addresses. Records from database files are linked through the use of a scrambled **personal health identification number (PHIN)**.

The following database files from the Repository were used for analyses in this report:

- Medical claims (records of visits to physicians outside of those occurring to a hospital in–patient)
- Physician Registry files (to identify the type of provider)
- Hospital claims (records of hospital discharges)
- Manitoba Health Insurance Registry data (records of the time a person is registered as a resident of Manitoba, as well as their age, sex, area of residence, siblings, and marital status)
- Vital statistics (records deaths, causes of death)
- Pharmaceutical claims (records of pharmaceutical prescriptions dispensed)
- Manitoba Immunization Monitoring System (MIMS) (records of immunizations)
- Public use census files (for neighbourhood–level socioeconomic information)
- Home care (records of the use of provincial home care services)
- **Personal care homes** (records of the use of nursing homes)

Additionally, **CancerCare Manitoba** provided a file of all invasive cancer patients diagnosed 1983 to 2008.

For purposes of this particular study, MCHP obtained ethical approval from the University of Manitoba's Faculty of Medicine Human Research Ethics Board and the Health Information Privacy Committee of the Manitoba government, to access the Repository.

When examining childhood, influenza, and pneumococcal immunization rates, we looked at eight fiscal years of data, from April 1, 2000 to March 31, 2008. Data for all eight years are presented only at the provincial level. For RHA, RHA district, Winnipeg CA, income, and sociodemographic analyses, two years of data are presented and compared—2002/03 and 2007/08. When modeling the **covariates**, we used the most recent year of data, 2007/08. The section involving outcomes uses a variety of years of data within the time frame of April 1, 2000 to March 31, 2008 as the most relevant year(s) of data were chosen for each analysis.

All data management, programming and analyses were performed using **Statistical Analysis Software** (SAS®) version 9.1.

Statistical Testing of Rates

Rates are **suppressed** (that is, not reported) where the counts upon which the rates are based represent five events or less (unless the rate is truly zero, in which case it can be reported). This is to avoid breeches of confidentiality and is similar to the way in which Statistics Canada reports data. Throughout the report, the letter "s" in brackets beside the year, RHA, RHA district, Winnipeg CA, income quintile, or sociodemographic factor on the axis of the graph or table indicates a suppressed rate.

Statistical testing indicates how much confidence to put in the results. If a difference is "statistically significant," then this difference is large enough that we are confident it is not just due to chance. The notation "p<.05" means that the probability of seeing a difference as large as this by chance alone is less than 5%.

Most of the graphs contain information about statistical comparisons. This gives an indication as to whether or not an area's rate is statistically higher or lower than the comparison group, or if the rate should be considered similar to the comparison group when no statistical difference is noted. When you see a large difference that is NOT statistically significant, it is telling you that this rate is considered similar to the comparison (usually the provincial average). This is usually due to the rate being based on small numbers (either a small number of events or a small underlying population). Because of its very small population, the Churchill RHA often has highly fluctuating rates.

With the exception of "s", each graph and table has notations provided in brackets beside the name of the year, RHA, RHA district, Winnipeg CA, income quintile, or sociodemographic factor. They indicate statistical significance. Below each graph is an explanation of the statistical notations.

- 'c' indicates the complete from birth rate for this fiscal year was statistically different from the complete from birth rate in 2007/08
- '¥' indicates the complete + partial from birth rate for this fiscal year was statistically different from the complete + partial from birth rate in 2007/08
- '1' indicates area's rate was statistically different from Manitoba average in first time period
- '2' indicates area's rate was statistically different from Manitoba average in second time period
- 't' indicates change over time was statistically significant for that area
- 'l' indicates a significant linear trend over time

For the childhood immunizations at the Manitoba level, the p value or probability due to chance alone associated with the linear trend test is listed at the bottom of the graph.

Information in the **logistic regression** models throughout the report may yield valuable insights into what patient, provider, or system characteristics are associated with being completely immunized. Note that a significant association between an outcome and a variable within a regression model does NOT necessarily mean causation. The association may provide valuable information or a hypothesis to planners for exploring specific programs or policies to test out the causal nature of the finding.

Chapter 2: Childhood Immunizations

Manitoba's universal childhood immunization program (as of June 30, 2010) provides protection against the following bacterial pathogens: diphtheria (D or d), tetanus (T), pertussis (with the acellular pertussis vaccine (aP)), *Haemophilus influenzae* type b (Hib), ***streptococcus pneumoniae*** (with the **polyvalent** conjugate vaccine (PCV–7)), and *Neisseria meningitidis* (with the meningococcal conjugate vaccine (Men–C)). As well, it provides protection against the following viral infections: measles, mumps, rubella (MMR); polio (IPV); varicella (V); **hepatitis B** (HBV); human papilloma virus (HPV); and influenza. The recommended number of doses required to be considered complete for age from birth for 2000/01–2007/08 is depicted in Table 2.1.

Manitoba uses a mixed delivery model for its childhood immunization program with physicians, nurse practitioners, and public health nurses administering vaccines in private and public health office settings. In addition, public health provides school based immunization programs for HBV, HPV, Men–C, **varicella,** tetanus, and pertussis (as TdaP).

Table 2.1: Manitoba Infant and Childhood Recommended Number of Doses Required to be Complete For Age from Birth, 2000/01–2007/08

Antigen	Age				
	1	2	7	11	17
Tetanus	3	4	5	5	6
Diphtheria	3	4	5	5	6
Pertussis	3	4	5	5	5
Polio	2	3	3(4)[a]	3(4)[a]	3(4)[a]
Measles	0	1	2	2	2
Mumps	0	1	1	1	1
Rubella	0	1	1	1	1
Hib	3	4	4	4	4
HBV	0	0	0	3	3
Varicella*	0	1	1	1	1
Men-C*	0	0	0	1	1
PCV-7 *	3	4	4	4	4

[a]Additional dose added in 2007

*Added to the Recommended Immunization Schedule October 2004

Source: Manitoba Centre for Health Policy, 2011

Methods

We looked at eight fiscal years of data, from April 1, 2000 to March 31, 2008. Data for all eight years are presented only at the provincial level and are compared to the most current year (2007/08) of data. For RHA, RHA district, Winnipeg CA, income quintile, and covariate analyses, two years of data are presented and compared—2002/03 and 2007/08. The denominator used to calculate the rates was the population as of December 31 of the year of interest. As a result, we may have totals that are above 100%.

HPV and the primary Men–C (age one) vaccinations are excluded from our analyses as they were not part of the Manitoba Recommended Immunization Schedule until 2008 and 2009, respectively.

The **tariff codes** used to identify the vaccinations are listed in Appendix 1. All children registered with Manitoba Health for insured benefits are included in these analyses. Previous studies at MCHP have generally included only those children who have been continuously covered from birth by

Manitoba Health. Children not continuously covered from birth would include children who were born in Manitoba, moved out for a period of time and then returned; or children who were not born in Manitoba and then moved to the province. Although it is the policy of many public health units to update the MIMS records for all such clients, those non–**continuously registered** individuals could have been immunized in their home country or province before obtaining a Manitoba Health number and would be unlikely to have their MIMS record updated unless accessing vaccination in public health clinic settings. Utilizing the approach of including all children registered with Manitoba Health allows for the consideration of the known immunization status of Manitoba's entire population—similar to the intent to treat analysis in a clinical trial—but could result in an underreporting of complete for age from birth immunization status.

Immunizations in Manitoba are traditionally administered at two months, four months, six months, 12 months, 18 months, four to six years of age, Grade Four, and Grade Eight or Nine (Table 2.1). Instead of looking at each of these ages separately, we chose four ages that represented milestones in immunizations: age two—the end of the **primary series**; age seven—to capture the preschool boosters, age 11—to capture the first of the school based programs, and age 17—to capture the overall immunization status of the children.

Immunization coverage rates by age reflect a child's status on his/her birthday. With the exception of the graphs showing the immunization trends over time, the data that are presented are for children who are complete for age from birth. This means that at the specified observation point (age two; for example), they have received all of the recommended doses for that given antigen according to the provincial immunization schedule. In some circumstances, for certain antigens it is possible to have received an adequate number of doses of an antigen to be effectively immune but yet still be considered incomplete for age at that observation point. We examined this in greater detail for two antigens, tetanus and PCV–7, by looking at the exact number of doses that children had received.

One of the goals of this project was to describe factors associated with complete for age from birth immunization status. In order to describe these children, two logistic regression models were run. Covariates were chosen after consulting the literature and determining which covariates we could measure using our data. The first model included the following covariates: continuously registered with Manitoba Health from birth (referred to as 'Coverage from Birth'), Income Quintile, Mother's Age at Birth, **Continuity of Care**, Provider Type, **Region of Residence**, Sex of the Child, and Number of Children in the Family. This model excluded children with no immunizations as children with no immunization could not be assigned a provider type, which made it necessary to exclude them. The second model included children with no immunizations, but provider type was not included as a covariate. Only the adjusted models are presented. The models were adjusted for all other factors included in the model.

Coverage from Birth: Describes children continuously registered in MIMS from birth. Coverage refers to healthcare coverage provided by Manitoba's universal healthcare program. Children not continuously covered from birth would include children who may have been born in Manitoba, moved out for a period of time and then returned or children who were not born in Manitoba and then moved to the province.

Income Quintile: For the logistic regression analyses, we did not separate the quintiles into rural and urban quintiles as we included a separate factor for region. These income quintiles were developed by assigning average household income from the 2006 Statistics Canada Census to dissemination areas and then ranking these from highest to lowest. Dissemination areas were then grouped into five groups

or quintiles (one being poorest and five being wealthiest), each containing approximately 20% of the total population. The average household income of the dissemination area is attributed to each person, so this is not an individual income but rather an area–level income measure. Income quintiles are often used as a proxy measure of socio–economic status.

Mother's Age at Birth: Mother's age refers to the age of the mother when the child was born. We created four age categories: 18 and younger, 19–24, 25–34, and 35 and older. There were some children for whom we could not calculate an age of their mother and rather than exclude them, we created a category called unknown.

Continuity of Care: Continuity of care is the extent to which individuals see a given healthcare provider (versus two or more other providers) over a specified period of time. Individuals with a regular family physician (or specialist) may have improved health outcomes as a result of one physician managing their healthcare needs over an extended period of time. A child was considered to have continuity of care if they had three or more visits over a two–year period and at least 50% of their ambulatory visits from the same physician. This physician could either be a **general practitioner/family physician** or a **pediatrician.** A separate category was created for those children who had less than three visits as we did not want to exclude them from the analysis and felt they were different from those children who did not have continuity of care.

Provider Type: MIMS records the provider where the immunization is administered. There are 10 such providers listed:

- First Nations/Tribal Council
- Primary Care
- Pharmacy
- Facility
- Public Funded Health Facility
- Occupational Health
- Physician
- Regional Health Unit
- Private Healthcare Provider, such as Victorian Order of Nursing
- Unknown

It was decided to aggregate this list to three groups:

- Physician
- Regional Health Unit (Regional Health Unit, First Nations/Tribal Council, Primary Care)
- Other/Unspecified (including Pharmacy, Facility, Public Funded Health Facility, Occupational Health, Private Healthcare Provider, and Unknown)

An additional fourth group included mixed providers. This grouping was used when not all doses of a particular antigen were administered by the same provider. Prior to 2002/03, the coding of First Nations/ Tribal Councils and Primary Care were included in the Regional Health Authority Grouping in MIMS. In order to compare the rates across the eight fiscal years, First Nations/ Tribal Councils and Primary Care were added to the Regional Health Authority Grouping for 2002/03 onwards.

Region of Residence: Region of residence was defined for the fiscal year of interest. Brandon RHA, the North (Churchill, NOR–MAN, and Burntwood RHAs), and Rural South (South Eastman, Central, Assiniboine, Interlake, North Eastman, and Parkland RHAs) were compared to Winnipeg RHA.

Sex of the Child: Sex of the child was included in all of the logistic regressions. In only one of the models was sex found to be statistically significant and, therefore, rates are not provided in the report.

Number of Children in the Family: The number of children in the family was calculated for the fiscal year of interest.

Immunization Coverage—Rates, Trends, and Factors Associated With Being Complete for Age from Birth

All Manitoba residents with active Manitoba Health registration (i.e., with a PHIN) are included in the MIMS database; as such, all immunizations delivered to registered Manitobans have the potential to be captured in MIMS. Manitoba residents born in Manitoba are assigned a PHIN at birth and as long as they reside within Manitoba are considered continuously registered or 'covered' from birth. Manitoba residents who have immigrated to the province and register with Manitoba Health after birth, or those who for some reason (e.g., emigration from Manitoba followed by immigration back to Manitoba) have their coverage by Manitoba Health interrupted, are considered not continuously registered from birth or 'not covered from birth'. Children not continuously registered with Manitoba Health from birth have lower rates of complete for age from birth immunization rates at all ages and across all antigens. Table 2.2 shows that the proportion of children not continuously registered changes both by year and by age under consideration. For example, in 2000/01 at age two, 6% of Manitoba's two–year–olds were not continuously registered, while 8% of Manitoba's two–year–olds were not continuously registered in 2007/08. Further, in 2007/08, 17% of seven–year–olds, 20% of 11–year–olds, and 24% of 17–year–olds were not continuously registered. Two trends appear: first, the proportion of non–continuously covered children increases with increasing age. Second, the number of non–continuously covered two–, seven–, and 11–year–olds appears to be increasing over time. Given the significantly lower rates of complete for age from birth immunization as captured by MIMS in those not continuously registered, this group is important to keep in mind when interpreting complete for age from birth immunization rates overall. Although all MIMS records can be updated to accurately reflect immunization status for members of this group, their lower immunization rates in MIMS could result from either actual lower rates, incomplete MIMS capture, or some combination of both.

The Primary Series—Overview

Manitoba's immunization schedule recommends immunization with DTaP–IPV–Hib at two, four, six, and 18 months. These five antigens are delivered with a single intramuscular injection. In addition, Manitoba recommends MMR and varicella (separate injections) at 12 months. Additionally, as of 2009, Men–C vaccine has been added to the 12 month vaccination schedule; but as described earlier, it was added after our data cut off point and as such will not be considered.

Table 2.3 defines the continuously registered and not continuously registered populations by year for age two.

Table 2.2: Children Registered with Manitoba Health for Insured Benefits by Year

Coverage	Age	2000/01		2001/02		2002/03		2003/04		2004/05		2005/06		2006/07		2007/08	
		n	(%)	n	(%)	n	(%)	n	(%)	n	(%)	n	(%)	n	(%)	n	(%)
Not Covered From Birth	2	934	6.4	952	6.5	887	6.3	1,009	7.1	1,006	7.2	963	6.8	957	6.9	1,100	7.6
Covered From Birth		13,695	93.6	13,621	93.5	13,244	93.7	13,263	92.9	13,058	92.8	13,219	93.2	12,967	93.1	13,466	92.4
Not Covered From Birth	7	2,421	14.5	2,194	13.4	2,249	14.0	2,328	14.9	2,316	15.4	2,298	15.4	2,491	16.4	2,473	16.7
Covered From Birth		14,269	85.5	14,232	86.6	13,802	86.0	13,247	85.1	12,704	84.6	12,670	84.6	12,683	83.6	12,333	83.3
Not Covered From Birth	11	3,100	18.0	3,081	18.0	3,160	18.4	3,070	18.4	3,242	19.0	3,064	18.2	3,122	19.0	3,264	20.4
Covered From Birth		14,103	82.0	13,991	82.0	13,998	81.6	13,657	81.6	13,798	81.0	13,747	81.8	13,296	81.0	12,760	79.6
Not Covered From Birth	17	3,769	23.1	3,882	23.4	3,763	22.6	3,860	23.0	3,752	22.5	3,888	22.9	3,905	22.3	4,153	23.5
Covered From Birth		12,571	76.9	12,676	76.6	12,898	77.4	12,913	77.0	12,922	77.5	13,077	77.1	13,622	77.7	13,488	76.5

Source: Manitoba Centre for Health Policy, 2011

Table 2.3: Children Registered with Manitoba Health for Insured Benefits by Year, Aged 2

Coverage	Age	2000/01		2001/02		2002/03		2003/04		2004/05		2005/06		2006/07		2007/08	
		n	(%)	n	(%)	n	(%)	n	(%)	n	(%)	n	(%)	n	(%)	n	(%)
Not Covered From Birth	2	934	6.4	952	6.5	887	6.3	1,009	7.1	1,006	7.2	963	6.8	957	6.9	1,100	7.6
Covered From Birth		13,695	93.6	13,621	93.5	13,244	93.7	13,263	92.9	13,058	92.8	13,219	93.2	12,967	93.1	13,466	92.4

Source: Manitoba Centre for Health Policy, 2011

The Primary Series—Tetanus Toxoid and Diphtheria

Tetanus is a significant cause of illness in developing countries, where universal vaccination is not available. *Clostridium tetani* is a ubiquitous bacterium found in the environment and wounds that are contaminated with soil or feces may lead to colonization with *C. tetani*, resulting in tetany or lockjaw. Since the inception of vaccination programs, tetanus has become rare in Canada. On average, four cases are reported annually in Canada, with a range of one to 10 cases. The majority of these cases occur in those older than 60 years of age (Public Health Agency of Canada, 2006). The two most recent cases of tetanus reported in Manitoba were in 1991 and 1993 (Manitoba Health Communicable Disease Control, 2001b).

Diphtheria is an acute communicable disease caused by the exotoxin producing *Corynebacterium diphtheria.* Symptoms are primarily of the upper respiratory system; however, dissemination of the exotoxin can lead to cardiac and neurological sequelae. The bacteria is known to colonize the nasopharynx of up to 5% of healthy persons, therefore eradication of this bacterium is unlikely (Public Health Agency of Canada, 2006).

Given the nature of the available vaccine, it is convenient to consider the immunization rates of these two antigens together. Currently, they are included in the polyvalent primary series with polio virus, pertussis, and Hib; but these will be discussed separately as vaccine formulations have changed over the course of the study period.

Immunization rates for tetanus (and diphtheria) at two years of age over an eight–year period are presented in Figure 2.1. In 2007/08, 95% of children in Manitoba had received one or more tetanus immunizations, with 74% receiving the completed four dose series and 22% receiving between one and three doses. This analysis indicates that 6% of children had no record of any tetanus immunizations (the sum is greater than 100% as the denominator used to calculate the rates is based on the population as of December 31). The trend over time is stable with statistically significant higher rates of complete from birth immunization in 2007/08 compared to 2003/04, 2004/05, and 2005/06. Figure 2.2 provides insight into the immunization status of partially immunized children. Although four doses are recommended, it is reassuring that the majority of children who were partially immunized received three of the four doses.

When looking at the RHA rates, individual rates of tetanus immunization at age two for two different time periods, 2002/2003 and 2007/2008, we see some differences in the rates (Figure 2.3). In 2007/08, Assiniboine and Parkland RHA rates were significantly higher than the Manitoba average, while South Eastman, Brandon, Winnipeg, Interlake, North Eastman, Churchill, and NOR–MAN were not significantly different from the provincial average. Both Central and Burntwood regions were below the Manitoba average in this analysis. Although rates in most regions increased in 2007/08 compared to 2002/03, these increases were not statistically significant.

Further dividing the rural RHAs into district levels could be particularly instructive for those responsible for immunization program delivery. Figure 2.4 demonstrates large differences in immunization rates in many districts within a given health region. Using the Interlake RHA (IL) as an example, we see that rates for tetanus in the Southwest region (84% in 2007/08) are higher than the provincial average, while those in the Northeast region (61% in 2007/08) are lower.

Manitoba's largest region by population is Winnipeg and analysis of its 12 CAs shows similar differences, with Transcona at 82% in 2007/08 and Point Douglas at 61% in 2007/08 (Figure 2.5).

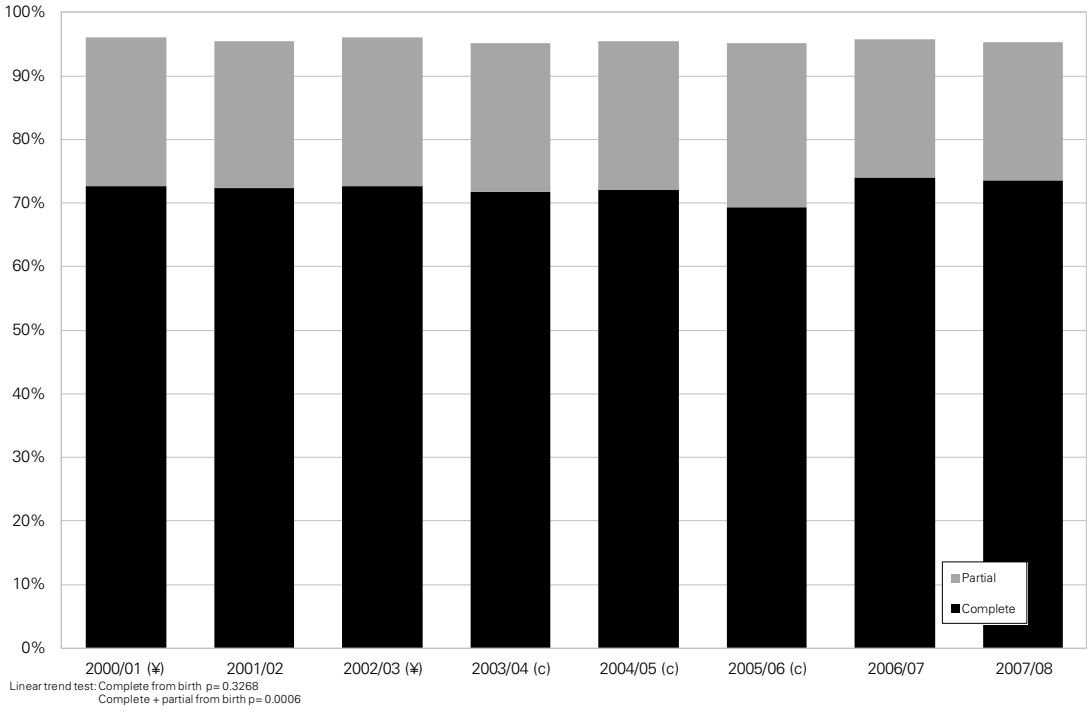
The relationship between socioeconomic status and immunization status in both rural and urban settings is illustrated in Figure 2.6. This figure shows that children in the lowest two income quintiles are less likely to have received all four recommended doses of tetanus antigen than those in Manitoba's highest income quintile.

In order to better understand the factors that are associated with receiving four doses of tetanus antigen, logistic regression models were developed (**odds ratios** presented in Table 2.4). The complete from birth crude tetanus immunization rates by sociodemographic factors for 2002/03 and 2007/08 can be found at the end of this section in Table 2.11.

Children who were not continuously registered with Manitoba Health from birth were significantly less likely to have four doses of tetanus than those who were continuously registered. For example, in 2007/08, only 34% of those children who were not continuously registered had received all recommended doses according to their MIMS record compared to 77% of those who were continuously registered from birth. It is important to note that determining immunization coverage rates using MIMS likely results in an underreporting of rates in the "not continuously registered" group as updating MIMS with vaccine doses delivered in another jurisdiction requires manual input and is done to varying degrees depending on location and provider type. The impact on rates overall is obviously dependent on the proportion of the total population that this represents. Maternal age at birth plays a role in complete from birth immunization rates as mothers 18 and younger and those 19–24 were less likely to have their child receive all four tetanus doses by age two. This finding is not surprising and has been noted elsewhere in the literature (Wiecha & Gann, 1994; Luman, McCauley, Shefer, & Chu, 2003). While male and female children were equally likely to be fully immunized against tetanus, children in families with four or more children were less likely to be completely immunized. Children from one–child families were more likely to be complete for age from birth than children from multi–children families. Given Manitoba's immunization mixed provider delivery model, the provider type variable is particularly interesting. Children who received vaccinations from a mix of providers had a higher likelihood of receiving all doses. This may be due to higher levels of contact with the health system; those who had multiple points of contact subsequently had higher rates of vaccine immunization. Continuity of care was significantly associated with complete from birth immunization as children who did not have it were less likely to receive a complete series.

Figure 2.1: Manitoba Tetanus Immunization Rates, Aged 2

Percent of children who are complete/partial from birth for the tetanus vaccination, 2000/01–2007/08

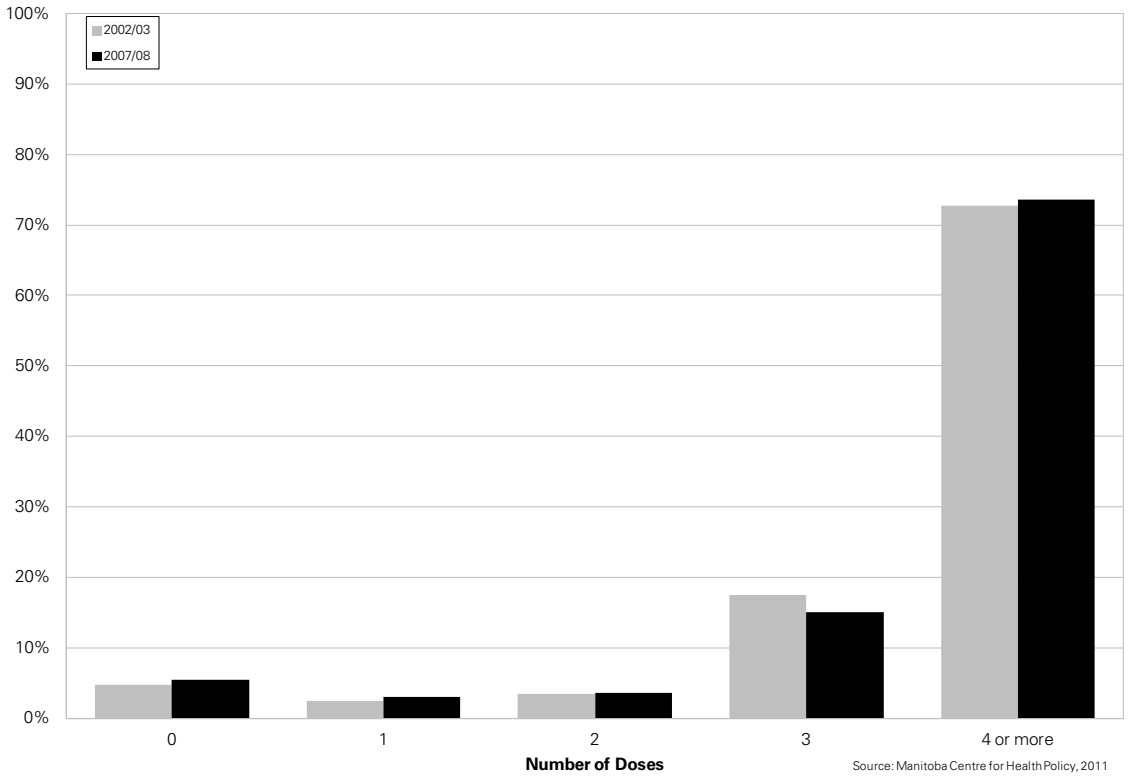


Linear trend test: Complete from birth p= 0.3268
Complete + partial from birth p= 0.0006

'c' indicates the complete from birth rate for this fiscal year was statistically different from the complete from birth rate in 2007/08
'¥' indicates the complete + partial from birth rate for this fiscal year was statistically different from the complete + partial from birth rate in 2007/08

Source: Manitoba Centre for Health Policy, 2011

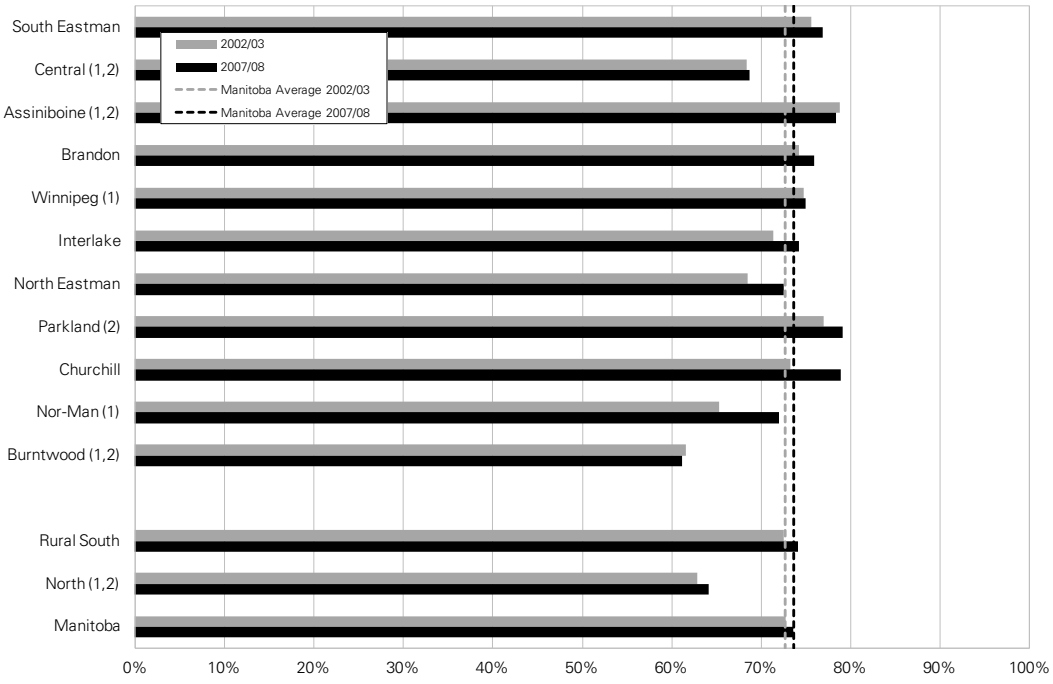
Figure 2.2: Tetanus Immunization Rates by the Number of Doses Received, Aged 2, 2007/08



Source: Manitoba Centre for Health Policy, 2011

Figure 2.3: RHA Tetanus Immunization Rates, Aged 2

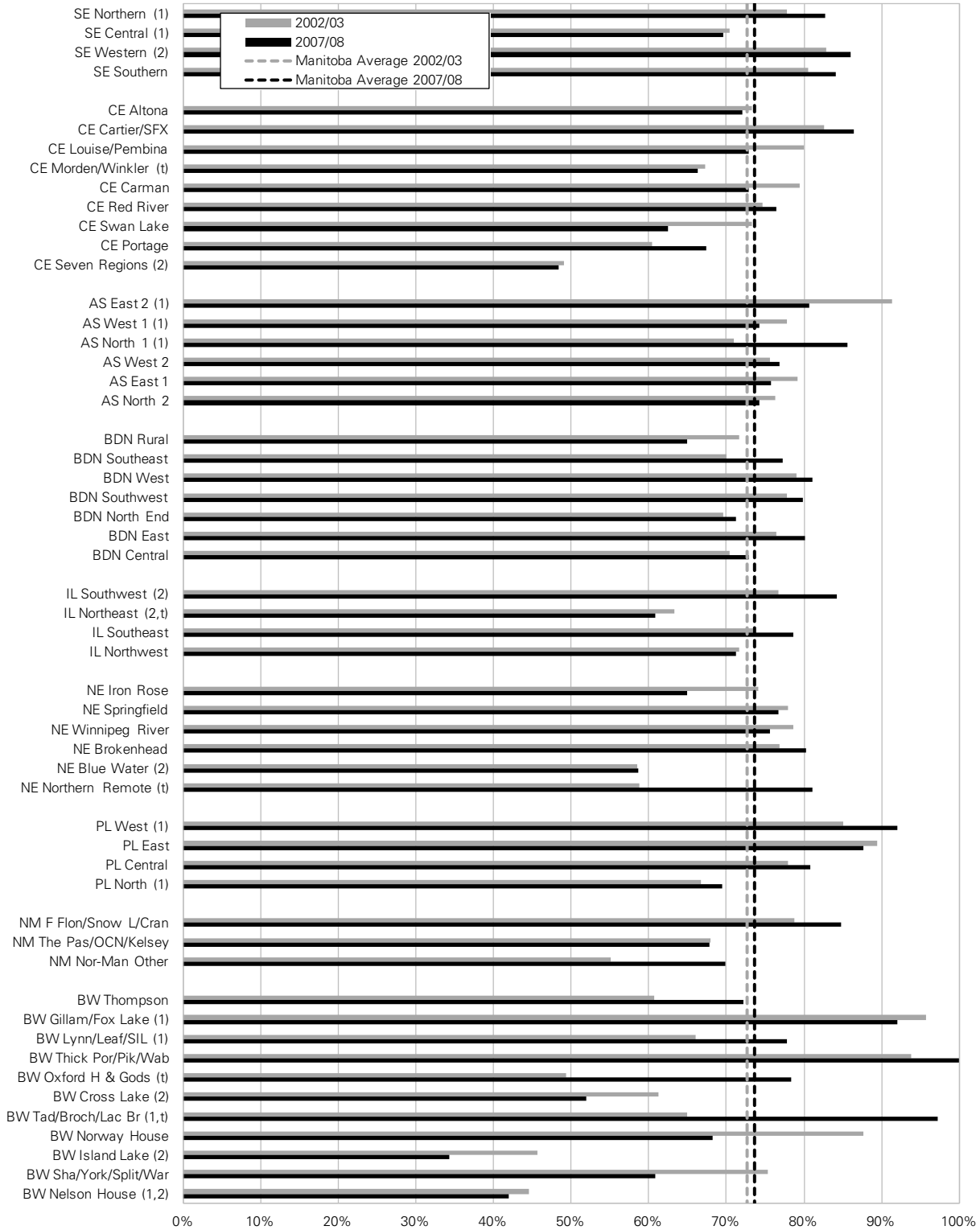
Percent of children who are complete from birth for the tetanus vaccination, 2002/03 and 2007/08



'1' indicates area's rate was statistically different from Manitoba average in first time period
'2' indicates area's rate was statistically different from Manitoba average in second time period
't' indicates change over time was statistically significant for that area
's' indicates data suppressed due to small numbers

Source: Manitoba Centre for Health Policy, 2011

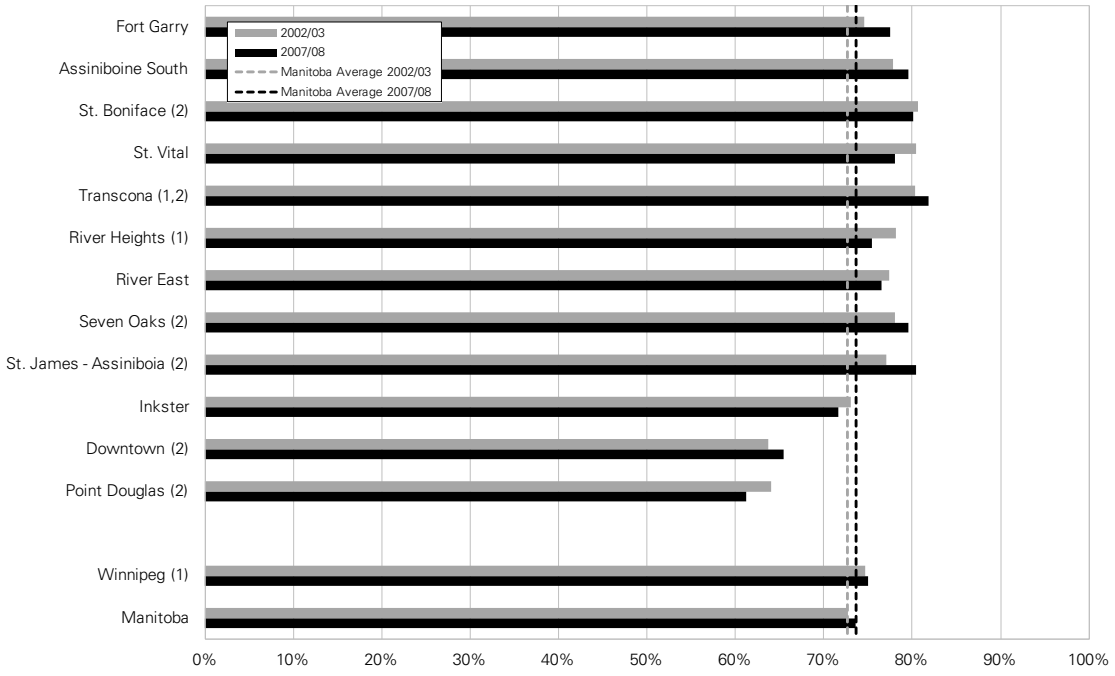
Figure 2.4: RHA District Tetanus Immunization Rates, Aged 2
Percent of children who are complete from birth for the tetanus vaccination, 2002/03 and 2007/08



Source: Manitoba Centre for Health Policy, 2011

Figure 2.5: Winnipeg CA Tetanus Immunization Rates, Aged 2

Percent of children who are complete from birth for the tetanus vaccination, 2002/03 and 2007/08

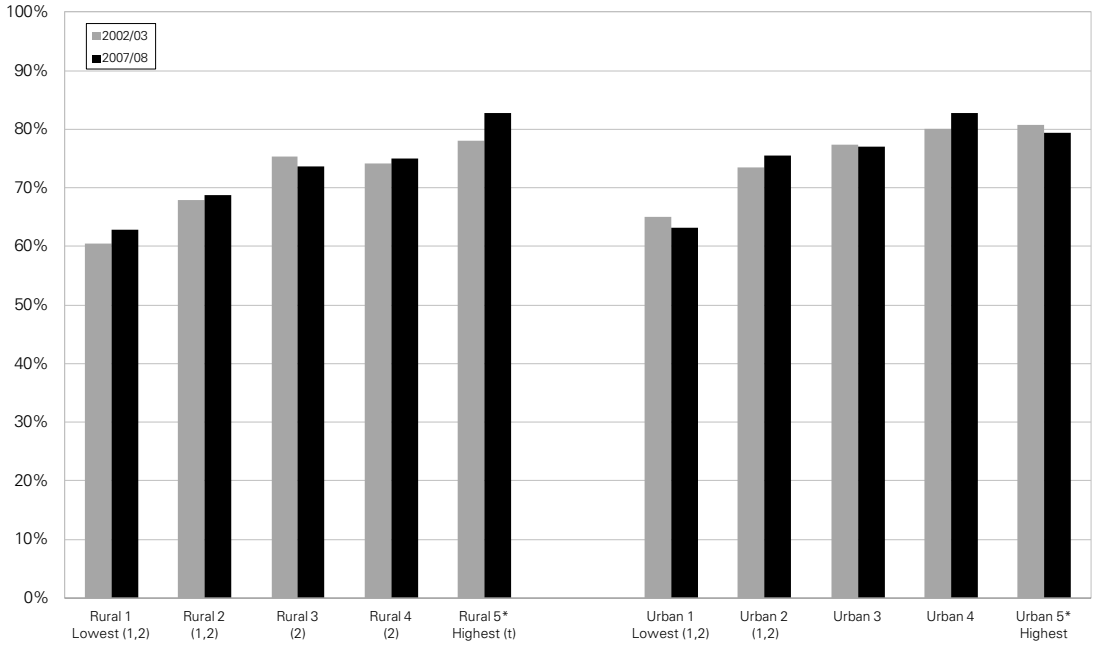


'1' indicates area's rate was statistically different from Manitoba average in first time period
'2' indicates area's rate was statistically different from Manitoba average in second time period
't' indicates change over time was statistically significant for that area
's' indicates data suppressed due to small numbers

Source: Manitoba Centre for Health Policy, 2011

Figure 2.6: Tetanus Immunization Rates by Income Quintile, Aged 2

Percent of children who are complete from birth for the tetanus vaccination, 2002/03 and 2007/08



'1' indicates quintile's rate was statistically different from reference group in first time period
'2' indicates quintile's rate was statistically different from reference group in second time period
't' indicates change over time was statistically significant for that quintile
's' indicates data suppressed due to small numbers
'*' indicates the reference group. Rural 5 is the reference group for rural quintiles; Urban 5 is the reference group for urban quintiles

Source: Manitoba Centre for Health Policy, 2011

Table 2.4: Factors Associated with Being Complete from Birth for the Tetanus Immunization, Aged 2
Adjusted Odds Ratio (95% Confidence Interval), 2007/08

Factor	Category	Adjusted Odds Ratio (95% CI)	
		Model 1	Model 2
Coverage from Birth	Covered from Birth	***Reference***	***Reference***
	Not Covered from Birth	0.18 (0.15,0.21)	0.14 (0.12,0.16)
Income Quintile	Quintile 1 (lowest)	0.49 (0.42,0.57)	0.57 (0.50,0.66)
	Quintile 2	0.67 (0.58,0.78)	0.76 (0.66,0.88)
	Quintile 3	0.76 (0.65,0.89)	0.84 (0.73,0.97)
	Quintile 4	0.85 (0.73,1.01)	0.95 (0.81,1.10)
	Quintile 5 (highest)	***Reference***	***Reference***
Mother's Age at Birth	Unknown	0.83 (0.44,1.56)	0.76 (0.44,1.34)
	18 and younger	0.58 (0.49,0.70)	0.66 (0.55,0.79)
	19-24	0.67 (0.61,0.75)	0.72 (0.65,0.79)
	25-34	***Reference***	***Reference***
	35 and older	1.08 (0.92,1.23)	1.08 (0.95,1.22)
Continuity of Care	No Continuity of Care	0.63 (0.57,0.69)	0.64 (0.58,0.70)
	Less than 3 Physician Visits*	0.51 (0.44,0.60)	0.35 (0.31,0.40)
	Continuity of Care	***Reference***	***Reference***
Provider Type	Mixed Providers	1.53 (1.34,1.75)	
	Regional Health Unit	1.20 (1.04,1.38)	
	Other/Unspecified	0.85 (0.63,1.15)	
	Physician	***Reference***	
Region of Residence	Brandon	1.11 (0.89,1.38)	1.27 (1.03,1.56)
	North	0.80 (0.67,0.95)	1.13 (0.98,1.30)
	Rural South	1.16 (1.03,1.30)	1.26 (1.15,1.39)
	Winnipeg	***Reference***	***Reference***
Sex of Child	Male	0.97 (0.89,1.05)	0.96 (0.88,1.04)
	Female	***Reference***	***Reference***
Number of Children in the Family	1 Child	1.34 (1.20,1.48)	1.35 (1.22,1.49)
	2-3 Children	***Reference***	***Reference***
	4 or more Children	0.43 (0.38,0.48)	0.43 (0.38,0.47)

Model 1–children with no immunizations are excluded from the adjusted model
Model 2–children with no immunizations are included in the adjusted model; provider type not included as a covariate

'*' for children with less than 3 physician visits, we were unable to define continuity of care

Source: Manitoba Centre for Health Policy, 2011

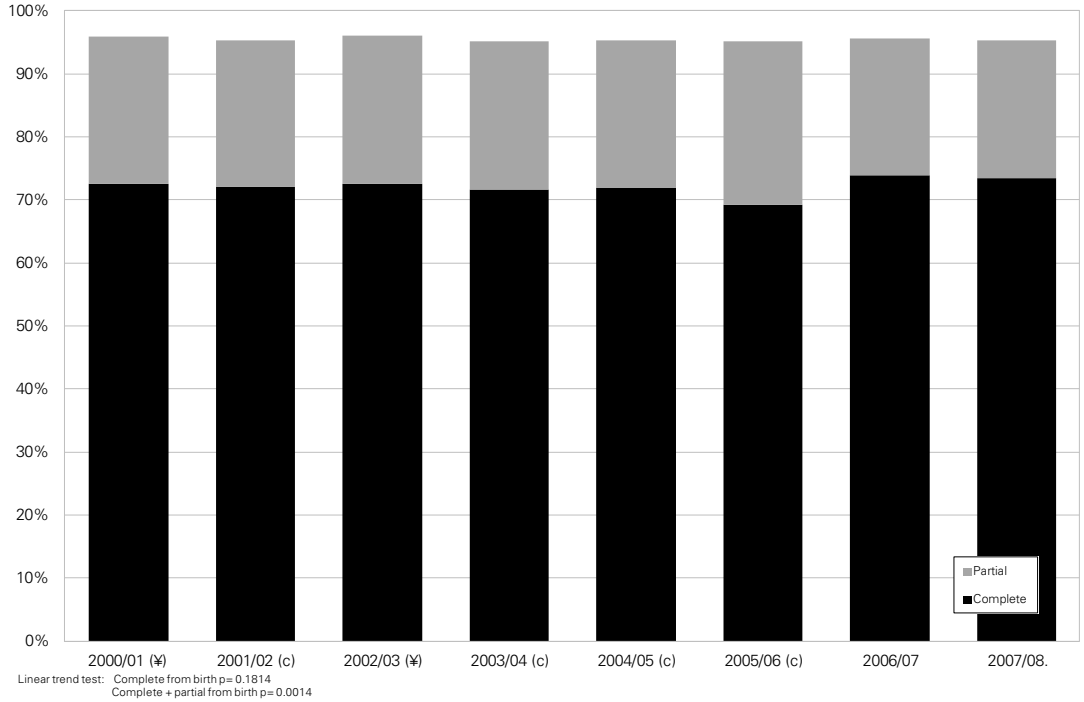
The Primary Series— Pertussis

Pertussis or "whooping cough" is a highly communicable upper respiratory infection caused by *Bordetella pertussis*. Severity is greatest amongst young infants, but it can affect all ages. Despite vaccinations, outbreaks still occur; and waning **immunity** among adolescents and adults has been suggested as the cause of continued spread of this disease. True incidence is difficult to ascertain due to incomplete reporting, however, 20–30 cases have been reported annually in 2008–2009 (Manitoba Health Communicable Disease Control, 2010).

Although **morbidity** and mortality due to pertussis have dropped dramatically since the first pertussis vaccines were introduced in Canada in the 1940's, pertussis remains an important childhood infectious disease. Childhood immunization in Manitoba dates back more than 60 years and Manitoba introduced the first combined DPT–P in 1959. Acellular pertussis vaccine was introduced to the primary series in 1997; and a school based booster was added to the Grade Nine tetanus diphtheria (TdaP) program in 2003. Some regional health authorities opted to move the tetanus, diphtheria and acellular pertussis (TdaP) program to Grade Eight. For the purposes of this analysis, children aged two were considered to be complete for age from birth after having received four doses of pertussis vaccine.

Figure 2.7 illustrates that in 2007/08, 95% of children in Manitoba aged two had received at least one dose of pertussis vaccine, with 74% having received four doses. Over the eight–year observation period, the rate is generally stable. Manitoba pertussis and tetanus antigens are given together in the DTaP–IPV–Hib (at two, four, six, and 18 months) vaccine. Since both require four doses to be complete for age from birth, it is not surprising that the pertussis analysis at age two is very similar to the tetanus analysis at age two (Figures 2.8–2.11; Tables 2.5, 2.12).

Figure 2.7: Manitoba Pertussis Immunization Rates, Aged 2
Percent of children who are complete/partial from birth for the pertussis vaccination, 2000/01–2007/08



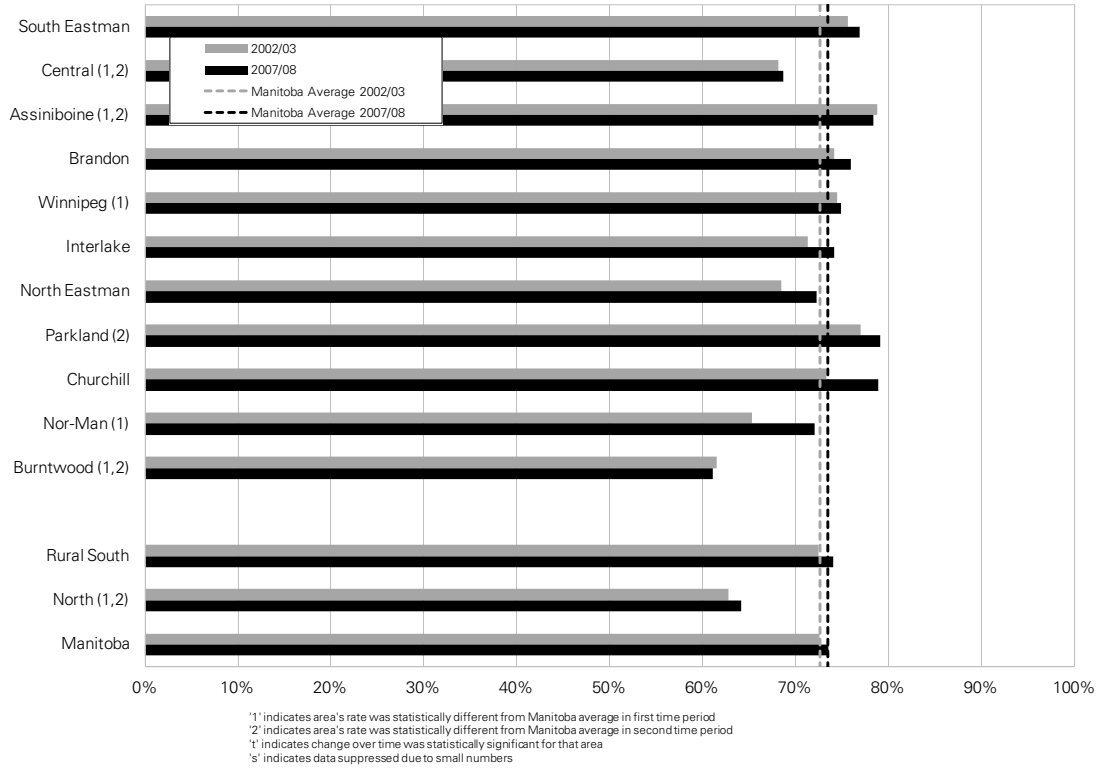
Linear trend test: Complete from birth p= 0.1814
Complete + partial from birth p= 0.0014

'c' indicates the complete from birth for this fiscal year was statistically different from the complete from birth rate in 2007/08
'¥' indicates the complete + partial from birth rate was statistically different in this fiscal year from the complete + partial from birth rate in 2007/08

Source: Manitoba Centre for Health Policy, 2011

Figure 2.8: RHA Pertussis Immunization Rates, Aged 2

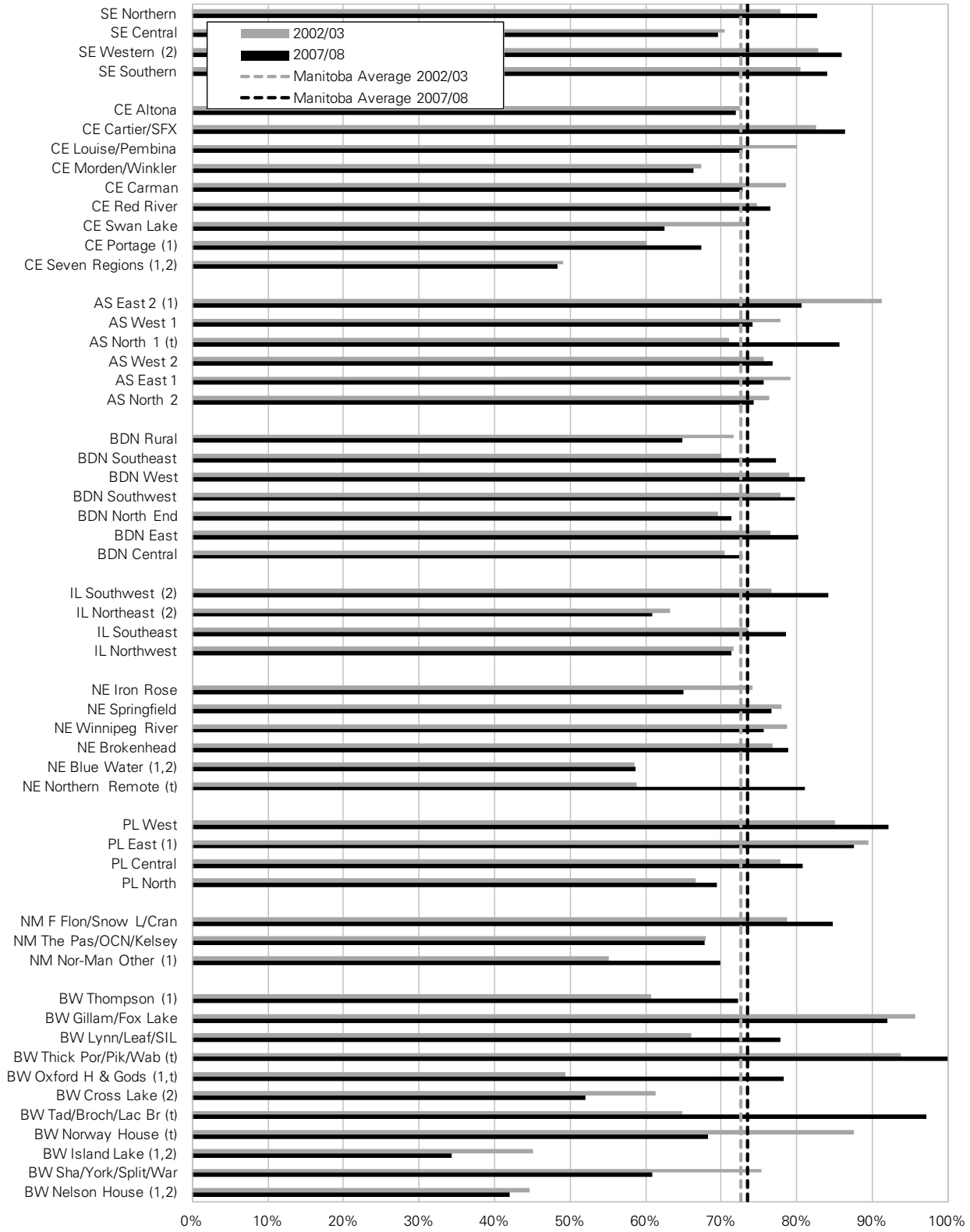
Percent of children who are complete from birth for the pertussis vaccination, 2002/03 and 2007/08



'1' indicates area's rate was statistically different from Manitoba average in first time period
'2' indicates area's rate was statistically different from Manitoba average in second time period
't' indicates change over time was statistically significant for that area
's' indicates data suppressed due to small numbers

Source: Manitoba Centre for Health Policy, 2011

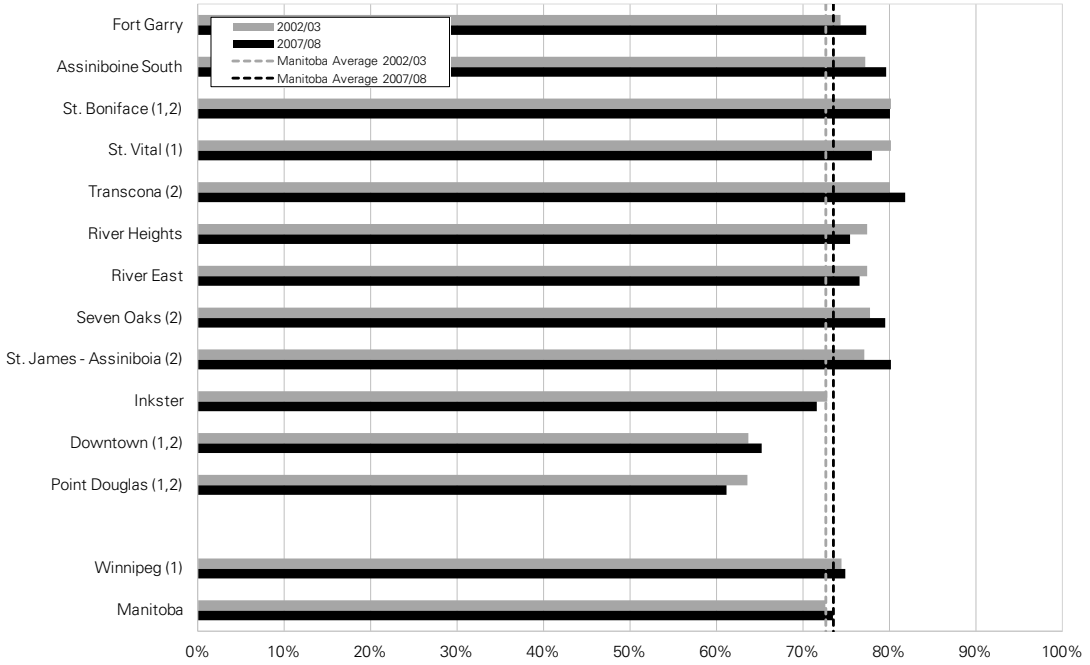
Figure 2.9: RHA District Pertussis Immunization Rates, Aged 2
Percent of children who are complete from birth for the pertussis vaccination, 2002/03 and 2007/08



Source: Manitoba Centre for Health Policy, 2011

Figure 2.10: Winnipeg CA Pertussis Immunization Rates, Aged 2

Percent of children who are complete from birth for the pertussis vaccination, 2002/03 and 2007/08

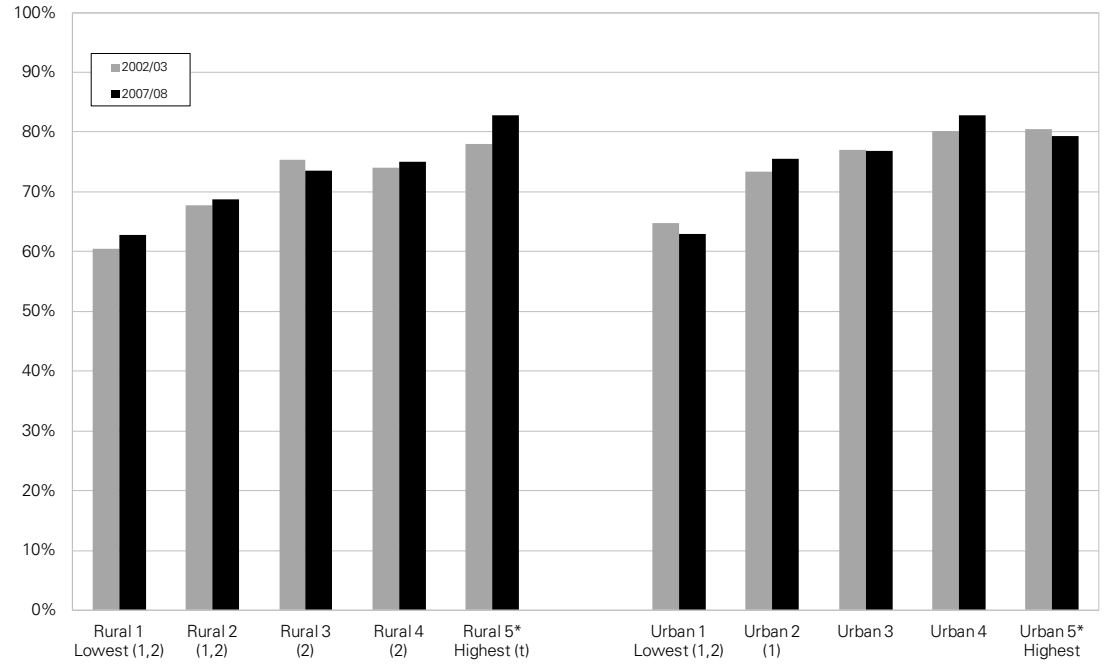


'1' indicates area's rate was statistically different from Manitoba average in first time period
'2' indicates area's rate was statistically different from Manitoba average in second time period
't' indicates change over time was statistically significant for that area
's' indicates data suppressed due to small numbers

Source: Manitoba Centre for Health Policy, 2011

Figure 2.11: Pertussis Immunization Rates by Income Quintile, Aged 2

Percent of children who are complete from birth for the pertussis vaccination, 2002/03 and 2007/08



'1' indicates quintile's rate was statistically different from reference group in first time period
'2' indicates quintile's rate was statistically different from reference group in second time period
't' indicates change over time was statistically significant for that quintile
's' indicates data suppressed due to small numbers
'*' indicates the reference group. Rural 5 is the reference group for rural quintiles; Urban 5 is the reference group for urban quintiles

Source: Manitoba Centre for Health Policy, 2011

Table 2.5: Factors Associated with Being Complete from Birth for the Pertussis Immunization, Aged 2
Adjusted Odds Ratio (95% Confidence Interval), 2007/08

Factor	Category	Adjusted Odds Ratio (95% CI)	
		Model 1	Model 2
Coverage from Birth	Covered from Birth	***Reference***	***Reference***
	Not Covered from Birth	0.18 (0.15,0.21)	0.14 (0.12,0.16)
Income Quintile	Quintile 1 (lowest)	0.49 (0.42,0.57)	0.57 (0.50,0.66)
	Quintile 2	0.67 (0.58,0.79)	0.76 (0.66,0.88)
	Quintile 3	0.75 (0.65,0.88)	0.84 (0.72,0.97)
	Quintile 4	0.86 (0.73,1.01)	0.95 (0.82,1.10)
	Quintile 5 (highest)	***Reference***	***Reference***
Mother's Age at Birth	Unknown	0.83 (0.44,1.58)	0.77 (0.44,1.35)
	18 and younger	0.59 (0.49,0.71)	0.66 (0.55,0.79)
	19-24	0.68 (0.61,0.75)	0.72 (0.65,0.79)
	25-34	***Reference***	***Reference***
	35 and older	1.08 (0.95,1.23)	1.08 (0.95,1.22)
Continuity of Care	No Continuity of Care	0.62 (0.57,0.69)	0.64 (0.58,0.70)
	Less than 3 Physician Visits*	0.51 (0.44,0.60)	0.35 (0.31,0.40)
	Continuity of Care	***Reference***	***Reference***
Provider Type	Mixed Providers	1.53 (1.34,1.75)	
	Regional Health Unit	1.20 (1.04,1.39)	
	Other/Unspecified	0.86 (0.64,1.16)	
	Physician	***Reference***	
Region of Residence	Brandon	1.11 (0.89,1.39)	1.28 (1.04,1.57)
	North	0.80 (0.67,0.95)	1.14 (0.99,1.31)
	Rural South	1.16 (1.03,1.31)	1.27 (1.16,1.39)
	Winnipeg	***Reference***	***Reference***
Sex of Child	Male	0.97 (0.89,1.05)	0.96 (0.88,1.04)
	Female	***Reference***	***Reference***
Number of Children in the Family	1 Child	1.33 (1.20,1.48)	1.34 (1.22,1.48)
	2-3 Children	***Reference***	***Reference***
	4 or more Children	0.43 (0.38,0.48)	0.43 (0.38,0.48)

Model 1–children with no immunizations are excluded from the adjusted model

Model 2–children with no immunizations are included in the adjusted model; provider type not included as a covariate

'*' for children with less than 3 physician visits, we were unable to define continuity of care

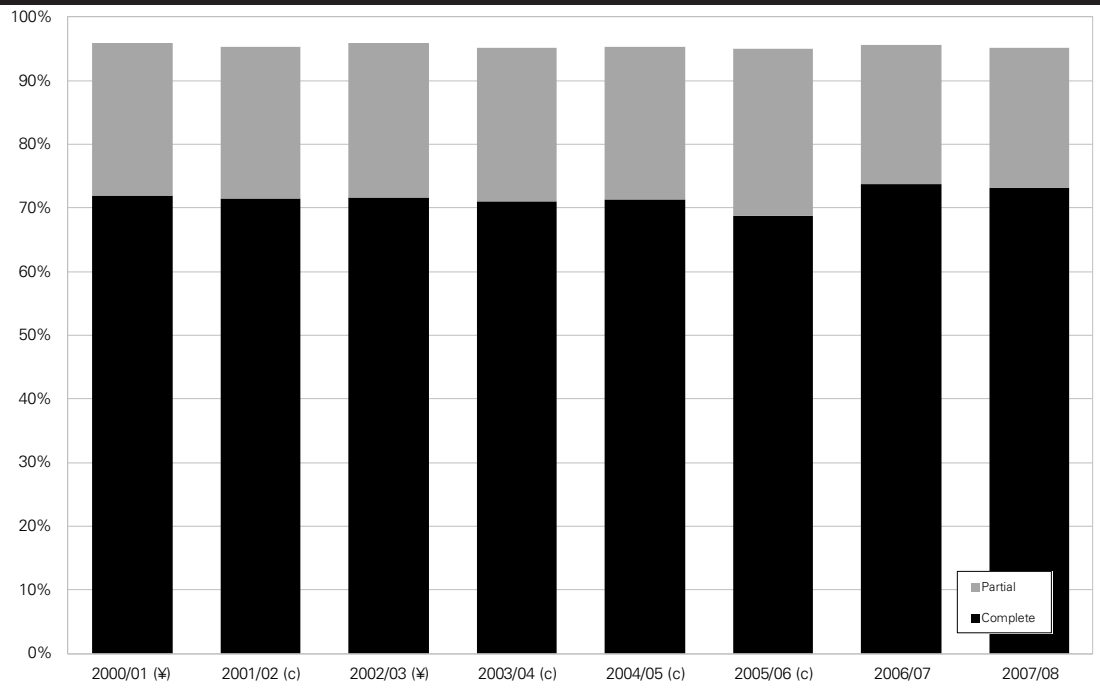
Source: Manitoba Centre for Health Policy, 2011

The Primary Series –*Haemophilus influenzae* type b (Hib)

Haemophilus influenzae type b (Hib) is a ubiquitous bacterium that does not survive in the environment and is known to colonize humans as the only reservoir. This encapsulated organism is highly pathogenic and can cause severe disease in those under six years of age (Manitoba Health Communicable Disease Control, 2007). Since introduction of the vaccine, fewer than five cases are diagnosed annually in Manitoba. Prior to the introduction of universal immunization for Hib in Canada, invasive disease due to Hib was the most common cause of bacterial **meningitis** in young children and an important cause of other invasive diseases such as **epiglottitis** and **bacteremia** (Public Health Agency of Canada, 2006). Universal Hib immunization was introduced in Manitoba in 1992 and was included in the penta valent (DTaP–IPV–Hib) vaccine which is given at two, four, six months and, starting in 1997 when the acellular pertussis vaccine became available, at 18 months.

Figure 2.12 illustrates that 95% of two–year–olds have been partially immunized with Hib antigen, but 73% have received all four recommended doses. As we have demonstrated with tetanus toxoid and pertussis antigen, immunization rates at age two are stable with statistically significant increases over the last two years (2006/07–2007/08). Provincial, RHA, RHA district, and Winnipeg CA immunization rates are very similar to those seen with tetanus and pertussis, which is expected given that all antigens are generally delivered together (Figures 2.13–2.16). Similarly, factors associated with higher complete from birth immunization rates for tetanus and pertussis—continuous coverage, higher family income, continuity of care, older maternal age at birth, and smaller number of children in the family—were also associated with higher levels of complete from birth Hib immunization (Table 2.6). The complete from birth crude Hib immunization rates by sociodemographic factors can be found at the end of this section in Table 2.13.

Figure 2.12: Manitoba *Haemophilus influenzae* type B (Hib) Immunization Rates, Aged 2
Percent of children who are complete/partial from birth for the Hib vaccination, 2000/01–2007/08

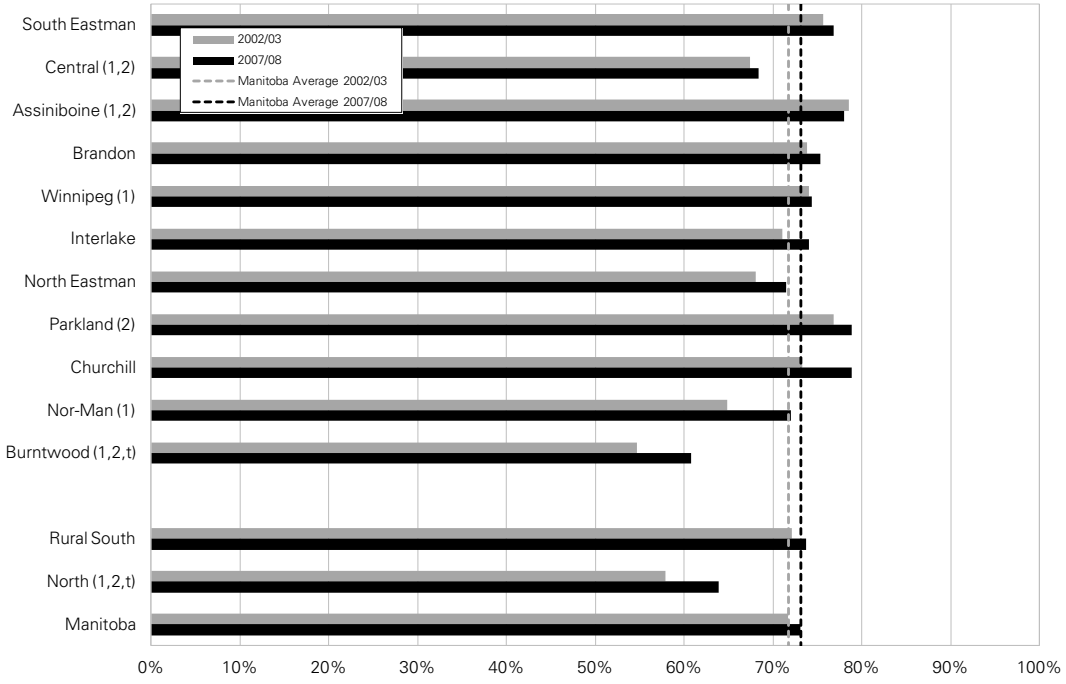


Linear trend test: Complete from birth p= 0.0358
Complete + partial from birth p= 0.0038

'c' indicates the complete from birth rate for this fiscal year, was statistically different from the complete from birth rate in 2007/08
'¥' indicates the complete + partial from birth rate for this fiscal year was statistically different from the complete + partial from birth rate in 2007/08

Source: Manitoba Centre for Health Policy, 2011

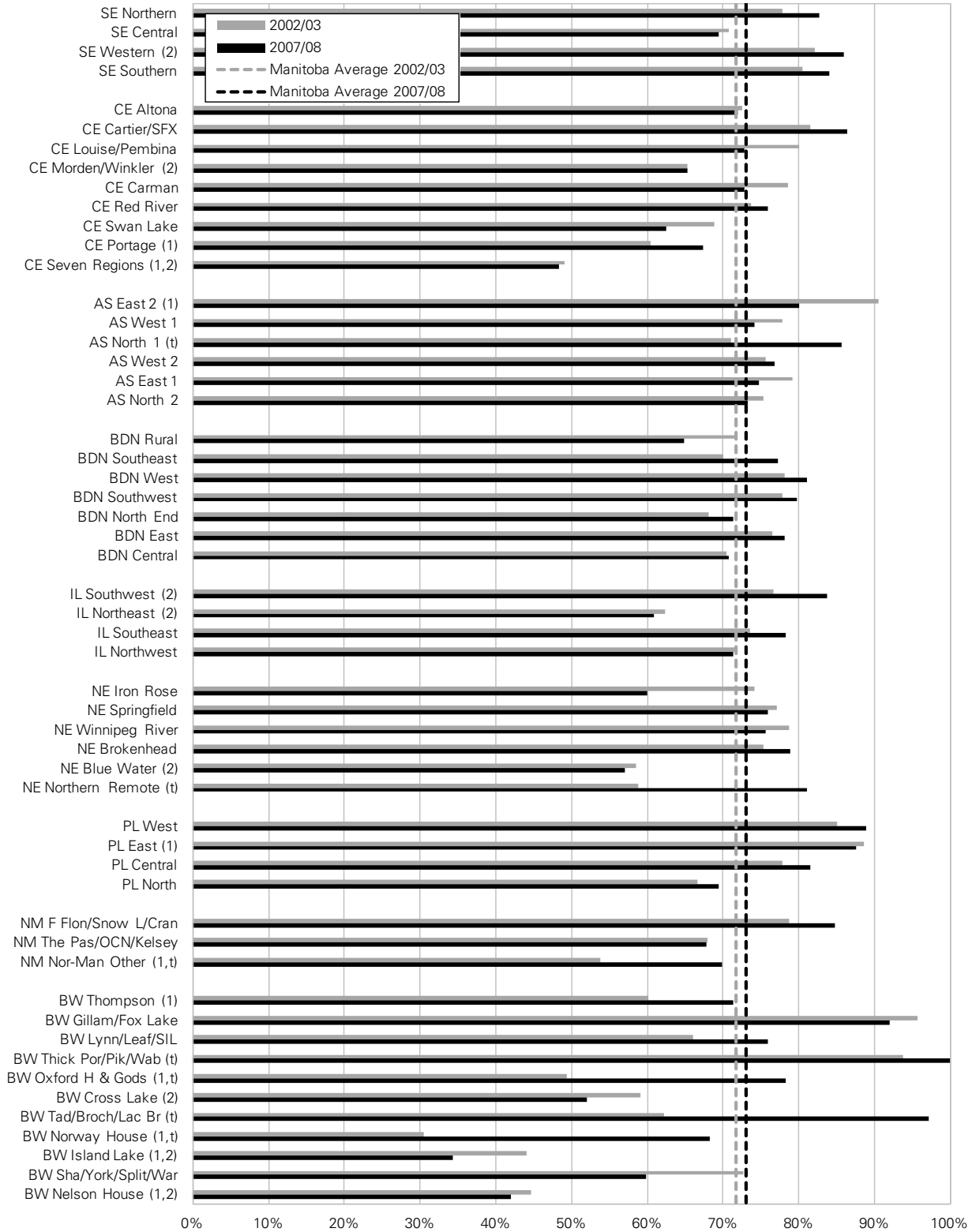
Figure 2.13: RHA *Haemophilus influenzae* type B (Hib) Immunization Rates, Aged 2
Percent of children who are complete from birth for the Hib vaccination, 2002/03 and 2007/08



'1' indicates area's rate was statistically different from Manitoba average in first time period
'2' indicates area's rate was statistically different from Manitoba average in second time period
't' indicates change over time was statistically significant for that area
's' indicates data suppressed due to small numbers

Source: Manitoba Centre for Health Policy, 2011

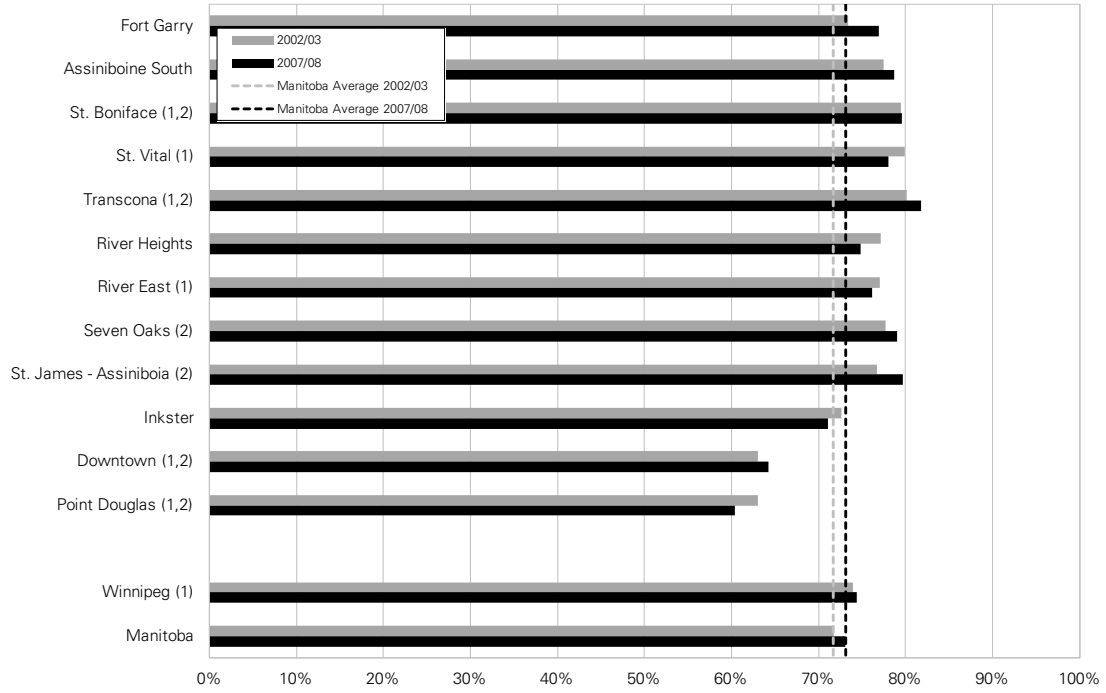
Figure 2.14: RHA District *Haemophilus influenzae* type B (Hib) Immunization Rates, Aged 2
Percent of children who are complete from birth for the Hib vaccination , 2002/03 and 2007/08



Source: Manitoba Centre for Health Policy, 2011

Figure 2.15: Winnipeg CA *Haemophilus influenzae* type B (Hib) Immunization Rates, Aged 2

Percent of children who are complete from birth for the Hib vaccination, 2002/03 and 2007/08

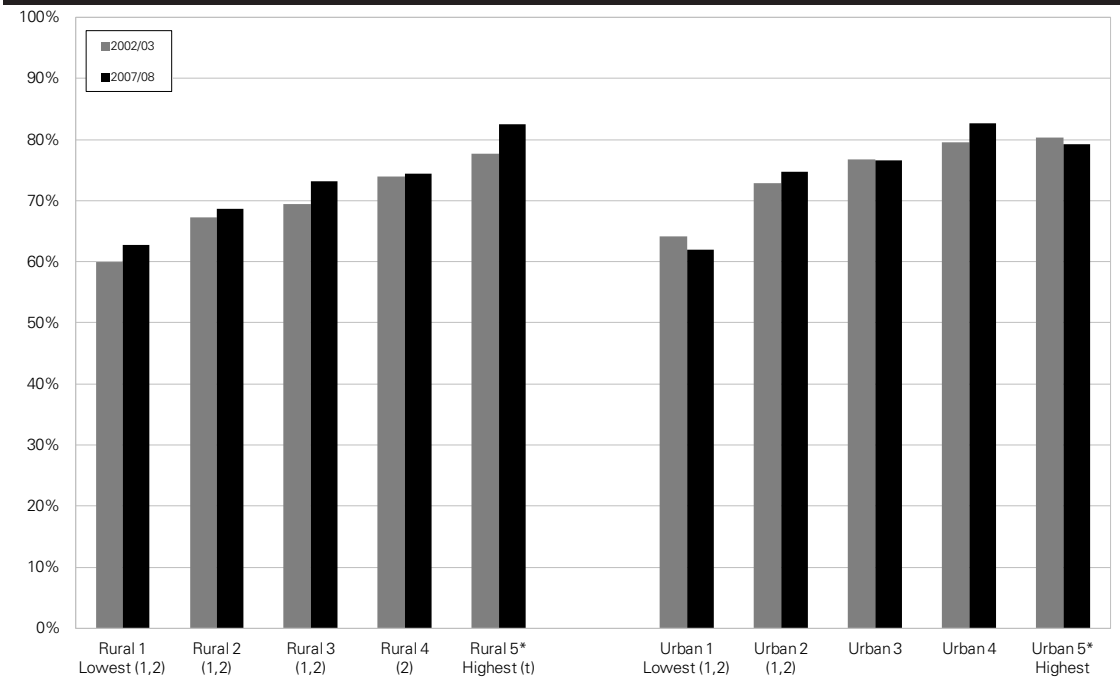


'1' indicates area's rate was statistically different from Manitoba average in first time period
'2' indicates area's rate was statistically different from Manitoba average in second time period
't' indicates change over time was statistically significant for that area
's' indicates data suppressed due to small numbers

Source: Manitoba Centre for Health Policy, 2011

Figure 2.16: *Haemophilus influenzae* type B (Hib) Immunization Rates by Income Quintile, Aged 2

Percent of children who are complete from birth for the Hib vaccination, 2002/03 and 2007/08



'1' indicates quintile's rate was statistically different from reference group in first time period
'2' indicates quintile's rate was statistically different from reference group in second time period
't' indicates change over time was statistically significant for that quintile
's' indicates data suppressed due to small numbers
'*' indicates the reference group. Rural 5 is the reference group for rural quintiles; Urban 5 is the reference group for urban quintiles

Source: Manitoba Centre for Health Policy, 2011

Table 2.6: Factors Associated with Being Complete from Birth for the *Haemophilus influenzae* type B (Hib) Immunization, Aged 2
Adjusted Odds Ratio (95% Confidence Interval), 2007/08

Factor	Category	Adjusted Odds Ratio (95% CI)	
		Model 1	Model 2
Coverage from Birth	Covered from Birth	***Reference***	***Reference***
	Not Covered from Birth	0.16 (0.13,0.18)	0.12 (0.10,0.14)
Income Quintile	Quintile 1 (lowest)	0.48 (0.41,0.56)	0.40 (0.35,0.45)
	Quintile 2	0.66 (0.57,0.77)	0.62 (0.55,0.71)
	Quintile 3	0.75 (0.64,0.88)	0.73 (0.64,0.83)
	Quintile 4	0.85 (0.72,1.00)	0.90 (0.78,1.03)
	Quintile 5 (highest)	***Reference***	***Reference***
Mother's Age at Birth	Unknown	1.01 (0.52,1.93)	0.39 (0.24,0.63)
	18 and younger	0.59 (0.49,0.71)	0.62 (0.53,0.73)
	19-24	0.68 (0.61,0.75)	0.71 (0.65,0.78)
	25-34	***Reference***	***Reference***
	35 and older	1.07 (0.94,1.22)	0.95 (0.85,1.07)
Continuity of Care	No Continuity of Care	0.64 (0.58,0.70)	0.55 (0.51,0.60)
	Less than 3 Physician Visits*	0.52 (0.45,0.61)	0.20 (0.18,0.22)
	Continuity of Care	***Reference***	***Reference***
Provider Type	Mixed Providers	1.46 (1.28,1.66)	
	Regional Health Unit	1.17 (1.01,1.34)	
	Other/Unspecified	0.90 (0.66,1.21)	
	Physician	***Reference***	
Region of Residence	Brandon	1.13 (0.90,1.40)	1.04 (0.86,1.25)
	North	0.82 (0.69,0.98)	0.61 (0.54,0.68)
	Rural South	1.19 (1.06,1.34)	0.96 (0.88,1.04)
	Winnipeg	***Reference***	***Reference***
Sex of Child	Male	0.96 (0.88,1.05)	0.99 (0.92,1.06)
	Female	***Reference***	***Reference***
Number of Children in the Family	1 Child	1.30 (1.18,1.45)	1.19 (1.09,1.30)
	2-3 Children	***Reference***	***Reference***
	4 or more Children	0.43 (0.38,0.48)	0.39 (0.35,0.43)

Model 1–children with no immunizations are excluded from the adjusted model
Model 2–children with no immunizations are included in the adjusted model; provider type not included as a covariate

'*' for children with less than 3 physician visits, we were unable to define continuity of care

Source: Manitoba Centre for Health Policy, 2011

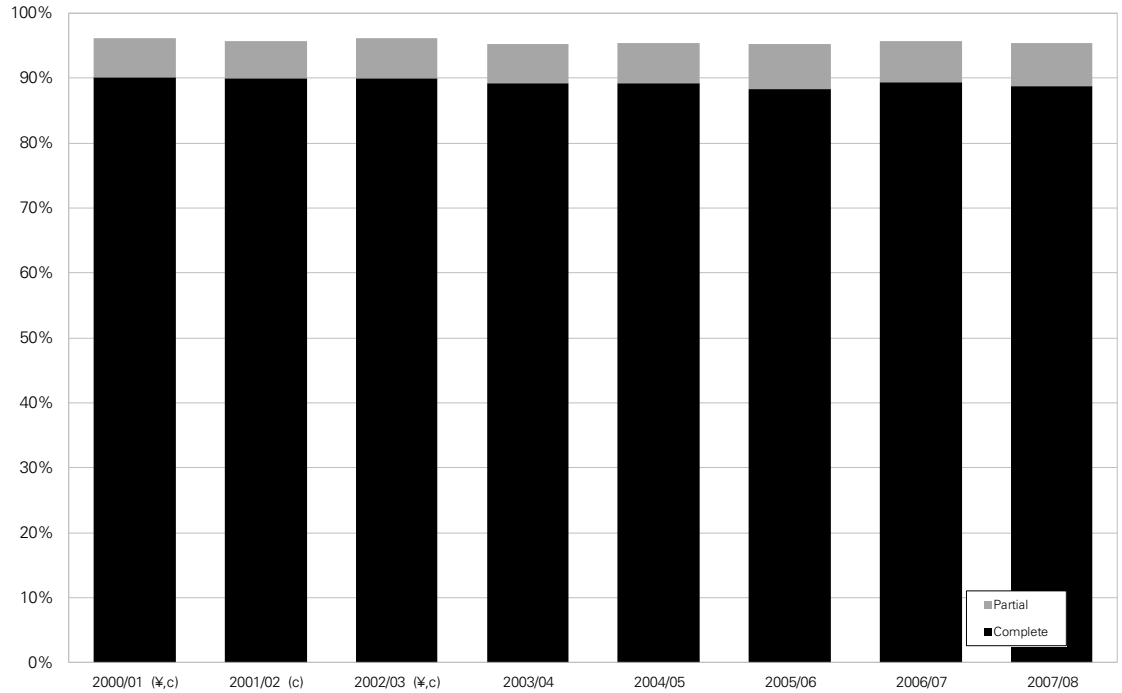
The Primary Series—Polio

Poliomyelitis (polio) is a highly infectious disease capable of causing irreversible paralysis. The stable polio virus is found in the environment and can survive for prolonged periods of time. It is spread by fecal–oral contamination from person to person (Public Health Agency of Canada, 2006; Manitoba Health Communicable Disease Control, 2001a). In 1993, a religious community in Canada was found to have poliovirus circulating in their unimmunized population; no other cases have been seen since (Manitoba Health Communicable Disease Control, 2001a). With the introduction of inactivated poliovirus vaccine (IPV–1955) and trivalent oral poliovirus vaccine (OPV–1962) this disease has been eradicated from Canada (Public Health Agency of Canada, 2006). Canada has been certified as polio–free since 1994.

In Manitoba, it is recommended that children receive three doses of IPV (which replaced OPV in 1997) delivered as DTaP–IPV–Hib by age two. In 2007/08, 95% of Manitoba children aged two had received at least one of three doses of IPV, with 89% having had the complete series (Figure 2.17). Although this rate has been stable over the last five years, it was slightly higher in 2000/01–2002/03 (90%) than the rate in 2007/08. Figures 2.18–2.21 show less variation between and within regions than is seen with other antigens. The results of the logistic regression can be seen in Table 2.7.

The complete from birth crude polio immunization rates by sociodemographic factors can be found at the end of this section in Table 2.14.

Figure 2.17: Manitoba Polio Immunization Rates, Aged 2
Percent of children who are complete/partial from birth for the polio vaccination, 2000/01–2007/08

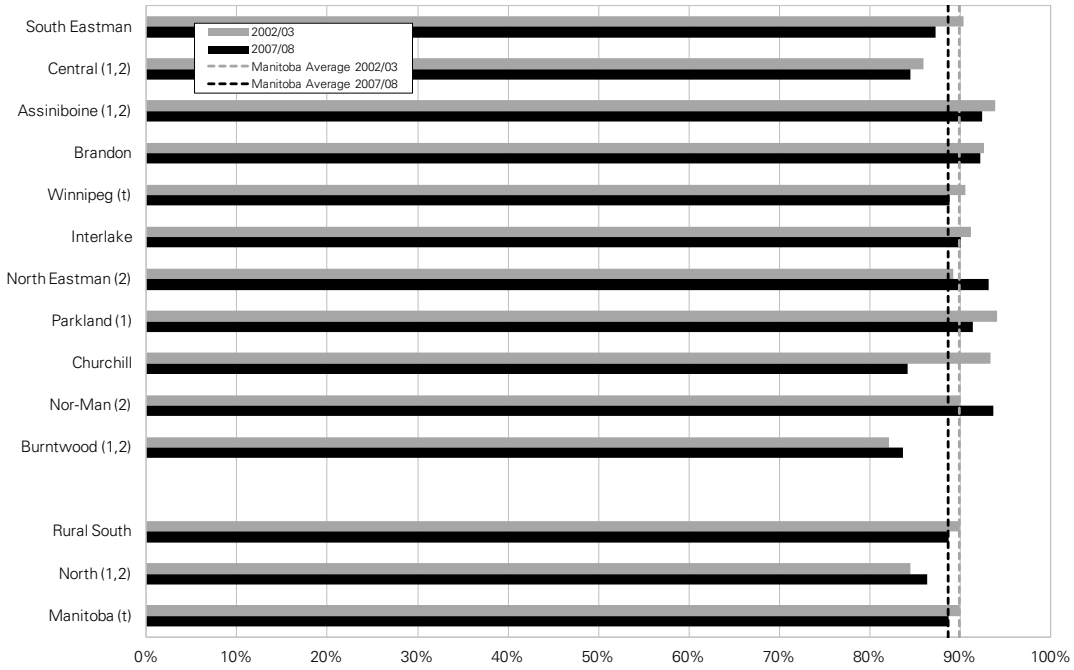


Linear trend test: Complete from birth p<0.0001
Complete + partial from birth p= 0.0006
'c' indicates the complete from birth rate was statistically different from the complete from birth rate in 2007/08
'¥' indicates the complete + partial from birth rate was statistically different from the complete + partial from birth rate in 2007/08

Source: Manitoba Centre for Health Policy, 2011

Figure 2.18: RHA Polio Immunization Rates, Aged 2

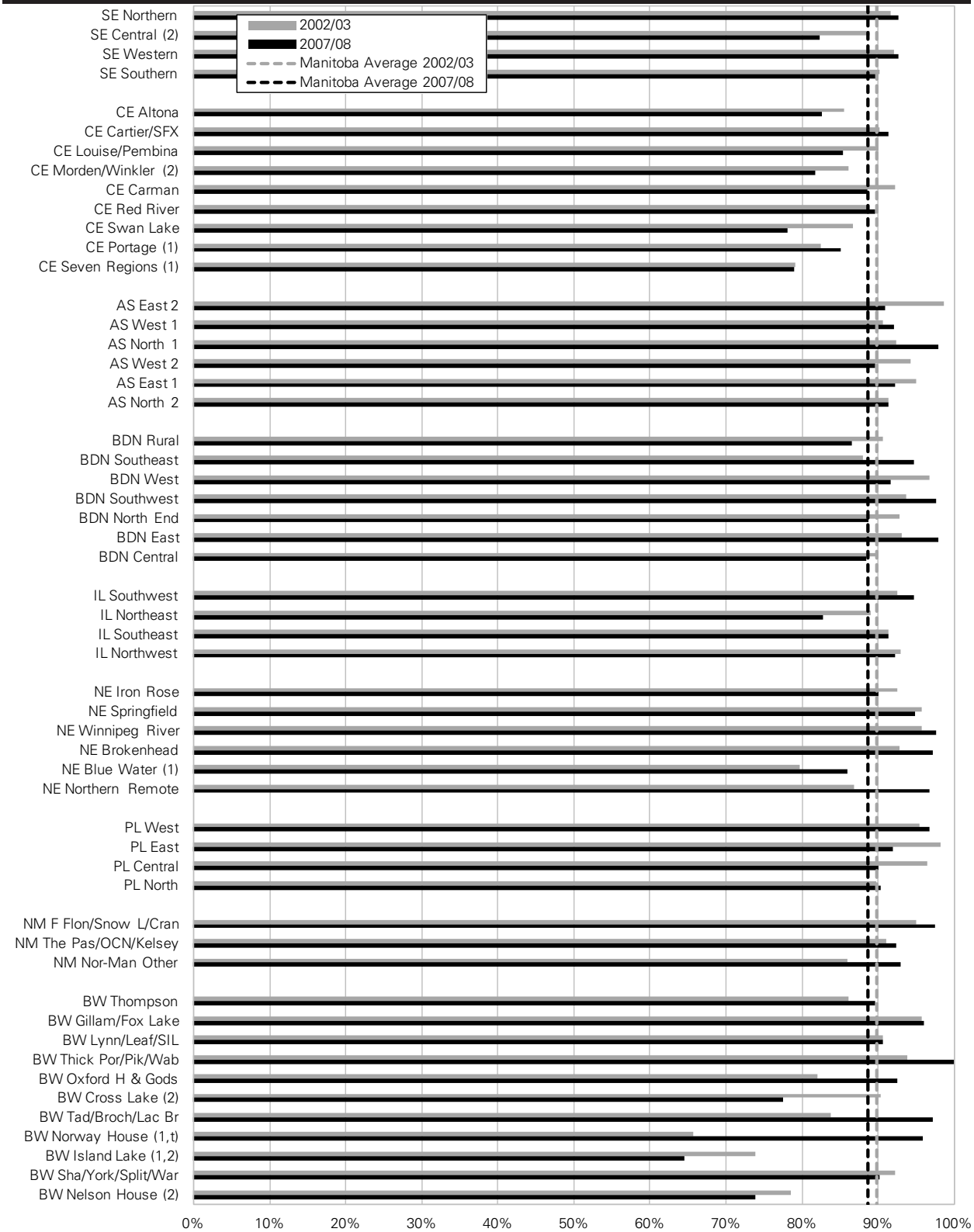
Percent of children who are complete from birth for the polio vaccination, 2002/03 and 2007/08



'1' indicates area's rate was statistically different from Manitoba average in first time period
'2' indicates area's rate was statistically different from Manitoba average in second time period
't' indicates change over time was statistically significant for that area
's' indicates data suppressed due to small numbers

Source: Manitoba Centre for Health Policy, 2011

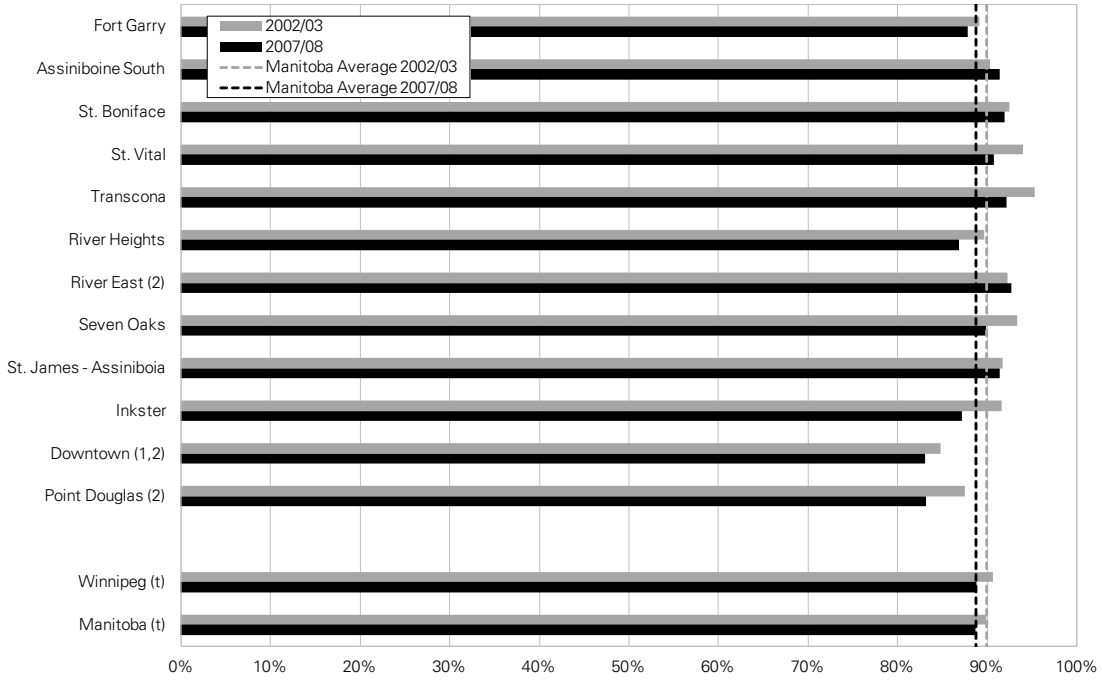
Figure 2.19: RHA District Polio Immunization Rates, Aged 2
Percent of children who are complete from birth for the polio vaccination, 2002/03 and 2007/08



Source: Manitoba Centre for Health Policy, 2011

Figure 2.20: Winnipeg CA Polio Immunization Rates, Aged 2

Percent of children who are complete from birth for the polio vaccination, 2002/03 and 2007/08

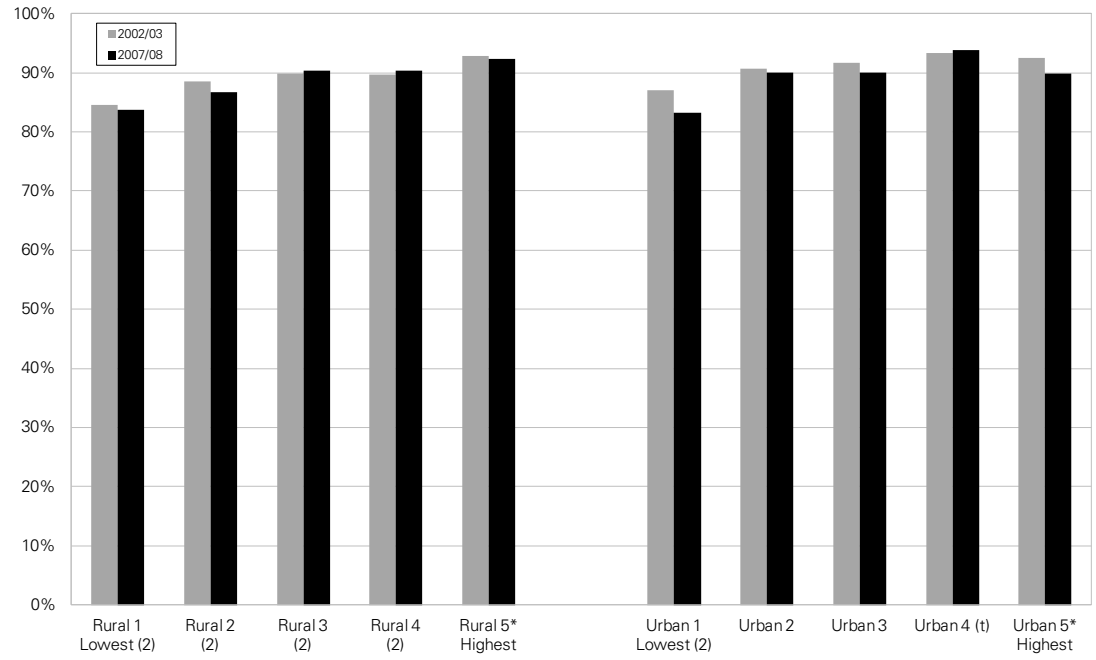


'1' indicates area's rate was statistically different from Manitoba average in first time period
'2' indicates area's rate was statistically different from Manitoba average in second time period
't' indicates change over time was statistically significant for that area
's' indicates data suppressed due to small numbers

Source: Manitoba Centre for Health Policy, 2011

Figure 2.21: Polio Immunization Rates by Income Quintile, Aged 2

Percent of children who are complete from birth for the polio vaccination, 2002/03 and 2007/08



'1' indicates quintile's rate was statistically different from reference group in first time period
'2' indicates quintile's rate was statistically different from reference group in second time period
't' indicates change over time was statistically significant for that quintile
's' indicates data suppressed due to small numbers
'*' indicates the reference group. Rural 5 is the reference group for rural quinitiles; Urban 5 is the reference group for urban quintiles

Source: Manitoba Centre for Health Policy, 2011

Table 2.7: Factors Associated with Being Complete from Birth for the Polio Immunization, Aged 2
Adjusted Odds Ratio (95% Confidence Interval), 2007/08

Factor	Category	Adjusted Odds Ratio (95% CI)	
		Model 1	Model 2
Coverage from Birth	Covered from Birth	***Reference***	***Reference***
	Not Covered from Birth	0.07 (0.06, 0.08)	0.08 (0.07, 0.09)
Income Quintile	Quintile 1 (lowest)	0.46 (0.36, 0.59)	0.66 (0.54, 0.80)
	Quintile 2	0.70 (0.54, 0.91)	0.92 (0.75, 1.13)
	Quintile 3	0.87 (0.66, 1.14)	1.04 (0.84, 1.28)
	Quintile 4	1.11 (0.82, 1.48)	1.28 (1.02, 1.60)
	Quintile 5 (highest)	***Reference***	***Reference***
Mother's Age at Birth	Unknown	1.87 (0.67, 5.24)	1.11 (0.58, 2.15)
	18 and younger	0.62 (0.46, 0.82)	0.88 (0.68, 1.14)
	19-24	0.70 (0.59, 0.83)	0.85 (0.74, 0.98)
	25-34	***Reference***	***Reference***
	35 and older	1.02 (0.83, 1.27)	1.02 (0.86, 1.21)
Continuity of Care	No Continuity of Care	0.56 (0.47, 0.66)	0.60 (0.53, 0.69)
	Less than 3 Physician Visits*	0.41 (0.33, 0.51)	0.21 (0.18, 0.25)
	Continuity of Care	***Reference***	***Reference***
Provider Type	Mixed Providers	2.99 (2.32, 3.86)	
	Regional Health Unit	1.27 (1.01, 1.61)	
	Other/Unspecified	0.81 (0.56, 1.18)	
	Physician	***Reference***	
Region of Residence	Brandon	1.64 (1.08, 2.50)	1.82 (1.31, 2.54)
	North	0.85 (0.64, 1.13)	1.65 (1.35, 2.01)
	Rural South	1.33 (1.09, 1.63)	1.40 (1.22, 1.60)
	Winnipeg	***Reference***	***Reference***
Sex of Child	Male	0.90 (0.78, 1.03)	0.90 (0.80, 1.01)
	Female	***Reference***	***Reference***
Number of Children in the Family	1 Child	1.25 (1.05, 1.49)	1.28 (1.11, 1.48)
	2-3 Children	***Reference***	***Reference***
	4 or more Children	0.40 (0.34, 0.48)	0.44 (0.38, 0.51)

Model 1–children with no immunizations are excluded from the adjusted model

Model 2–children with no immunizations are included in the adjusted model; provider type not included as a covariate

'*' for children with less than 3 physician visits, we were unable to define continuity of care

Source: Manitoba Centre for Health Policy, 2011

The Primary Series—Pneumococcal Conjugate (PCV–7)

Invasive pneumococcal disease (IPD) is a severe communicable bacterial infection that can affect individuals at all ages but is more prevalent in those with weakened immune systems and at the extremes of age (the very young and the very old). *Streptococcus pneumoniae* is a leading cause of meningitis, bacterial pneumonia, and acute otitis media. Since the introduction of the universal primary immunization program, annual cases of invasive pneumococcal disease, including bacteremia, pneumonia, and meningitis, have ranged from 80 to 125 cases (Manitoba Health Communicable Disease Control, 2010). There are multiple serotypes that are related to severe disease, and the seven most common serotypes are included in the PCV–7.

In October of 2004, Manitoba introduced its universal PCV–7 program recommending four doses be administered at two, four, six, and 18 months of age. In 2010, Manitoba phased out PCV–7 and moved to PCV–13 vaccine that protects against 13 pneumococcal serotypes. For the purposes of this analysis, four doses are required to be considered complete from birth for age two.

Figure 2.22 shows uptake before and after program inception. In 2007/08, 93% of children aged two had received at least one dose of PCV–7 and 70% of children had received all four doses. There is increasing evidence that three adequately timed doses of PCV–7 vaccine are sufficient to produce immunity (Rennels et al., 1998); in fact, British Columbia and Quebec both recommend three dose programs. Figure 2.23 illustrates that 85% of children would be considered immune.

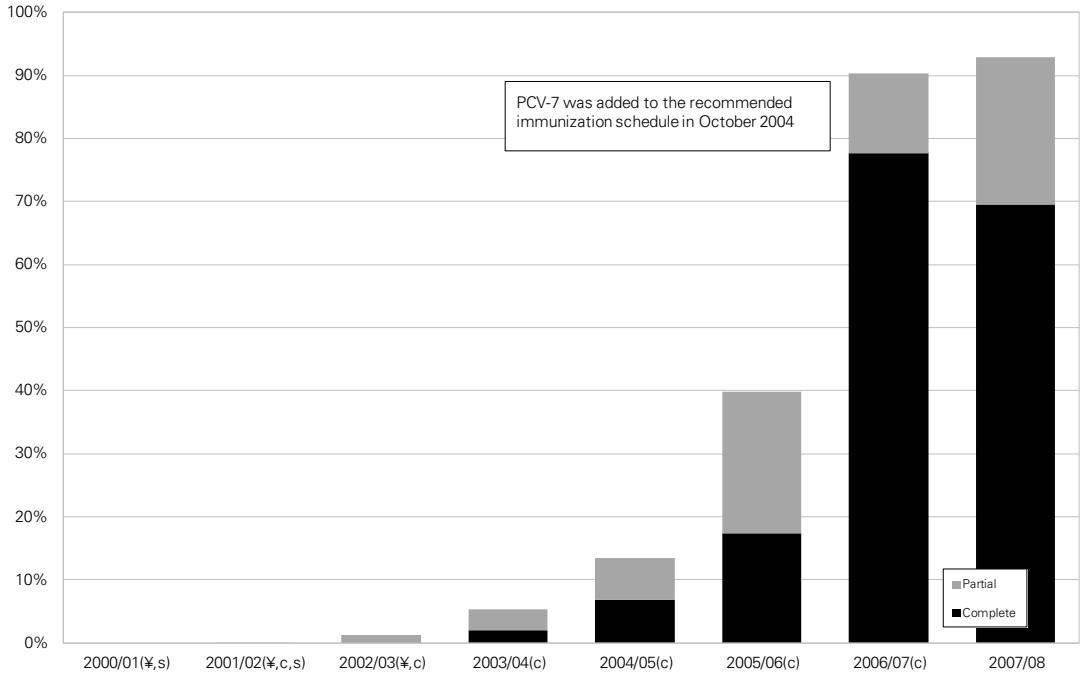
When looking at the rates by RHA in 2007/08, South Eastman and Parkland have rates exceeding the provincial average. Assiniboine, Brandon, Winnipeg, Interlake, North Eastman, Churchill, and NOR–MAN have PCV–7 rates similar to the provincial average; and Central and Burntwood have rates below average. As expected, all regions showed a significant increase in complete from birth immunization rates after the program was implemented (Figure 2.24).

At the RHA district level (Figure 2.25) rates are highly variable. For example, when looking at the Central RHA (CE), we see that rates range from 79% in the Cartier district to 46% in the Seven Regions district. Similar variation can be found in Winnipeg, where rates vary between 78% in Transcona and 57% in Point Douglas (Figure 2.26).

To gain insight into the factors associated with receiving four doses of PCV–7 vaccine by age two, two logistic regression models were constructed (Table 2.8). As illustrated in Figure 2.27, children in higher income quintiles were more likely to be fully immunized than children in lower income quintiles. Mother's age at birth was associated with immunization status as mothers 18 and younger and mothers 19–24 were less likely to have two–year–olds who had received all four PCV–7 doses. Sex of child made no difference to immunization status; however, children in families with four or more children were less likely to be fully immunized than children from families with two to three children. Children from families with one child had the highest rate of immunization. Continuity of care was associated with being complete from birth.

The complete from birth crude PCV–7 immunization rates by sociodemographic factors can be found at the end of this section in Table 2.15.

Figure 2.22: Manitoba Pneumococcal Conjugate (PCV-7) Immunization Rates, Aged 2
Percent of children who are complete/partial from birth for PCV-7, 2000/01–2007/08

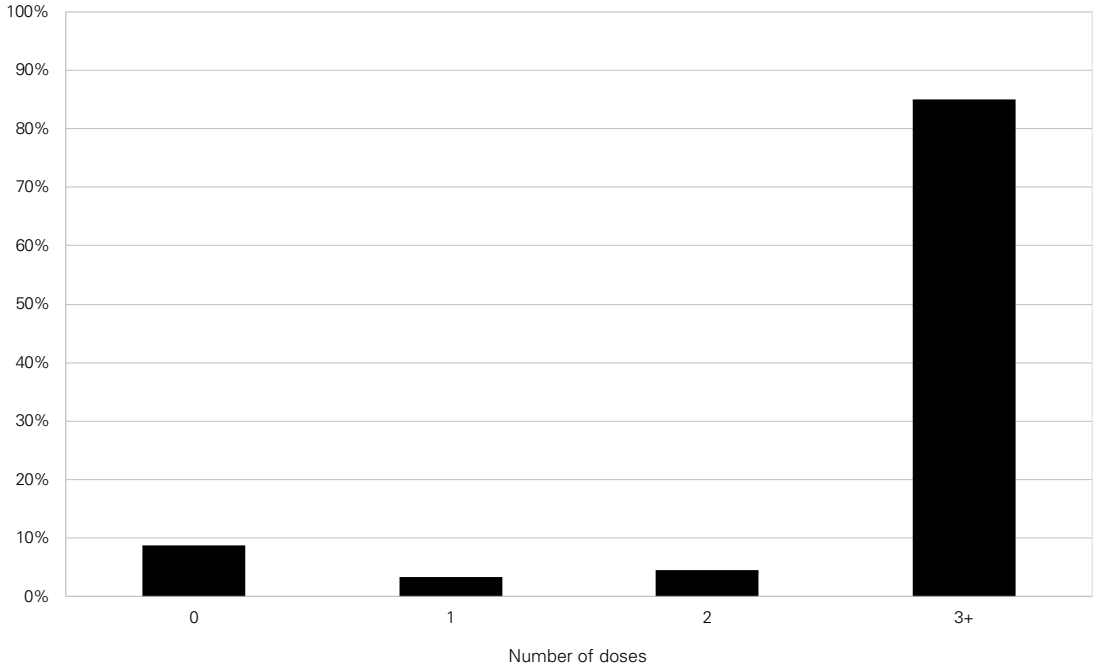


Linear trend test: Complete from birth p<0.0001
Complete + partial from birth p<0.0001

'c' indicates the complete from birth for this fiscal year was statistically different from the complete from birth rate in 2007/08
'¥' indicates the complete + partial from birth rate was statistically different in this fiscal year from the complete + partial from birth rate in 2007/08
's' indicates data suppressed due to small numbers

Source: Manitoba Centre for Health Policy, 2011

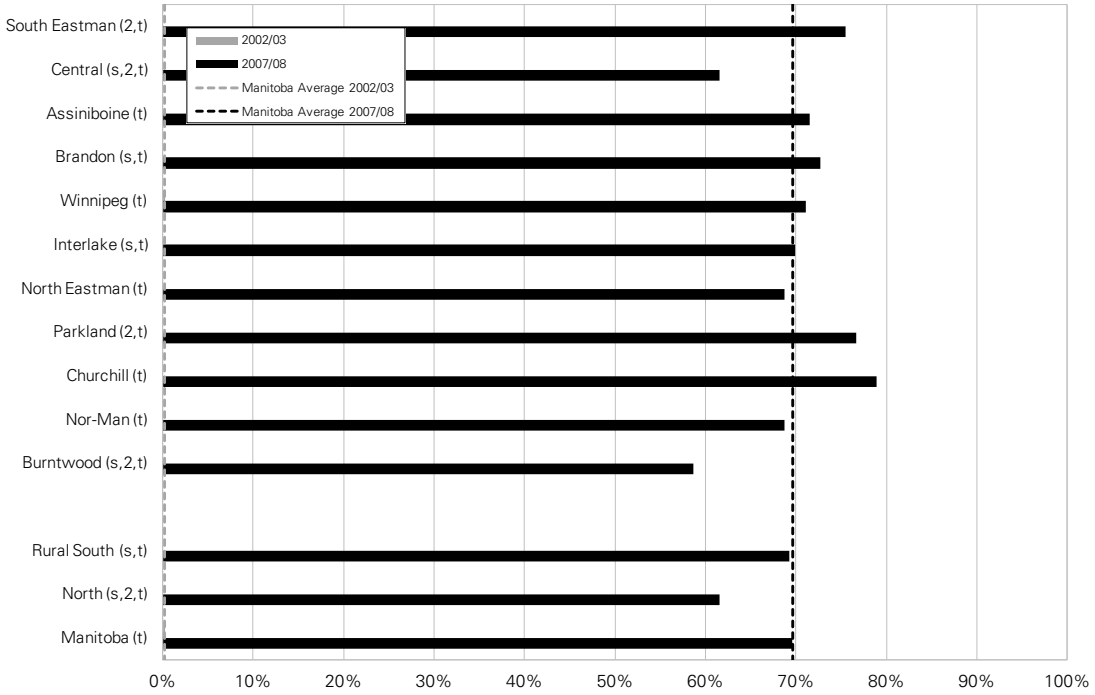
Figure 2.23: Pneumococcal Conjugate (PCV-7) Immunization Rates by the Number of Doses Received, Aged 2, 2007/08



Source: Manitoba Centre for Health Policy, 2011

Figure 2.24: RHA Pneumococcal Conjugate (PCV-7) Immunization Rates, Aged 2

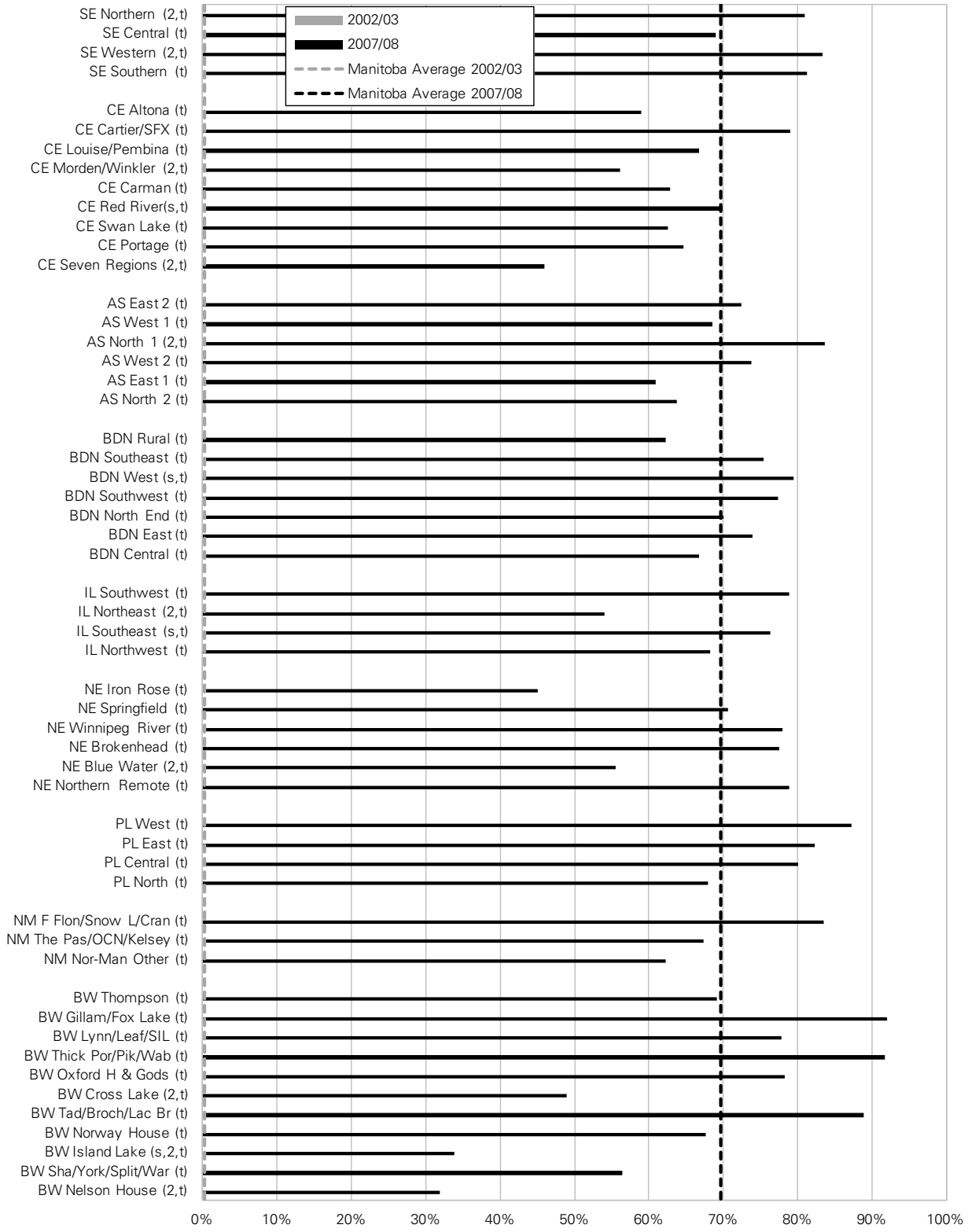
Percent of children who are complete from birth for PCV-7, 2002/03 and 2007/08



'1' indicates area's rate was statistically different from Manitoba average in first time period
'2' indicates area's rate was statistically different from Manitoba average in second time period
't' indicates change over time was statistically significant for that area
's' indicates data suppressed due to small numbers
PCV-7 was added to the recommended immunization schedule in October 2004

Source: Manitoba Centre for Health Policy, 2011

Figure 2.25: RHA District Pneumococcal Conjugate (PCV-7) Immunization Rates, Aged 2
Percent of children who are complete from birth for the PCV-7 vaccination, 2002/03 and 2007/08

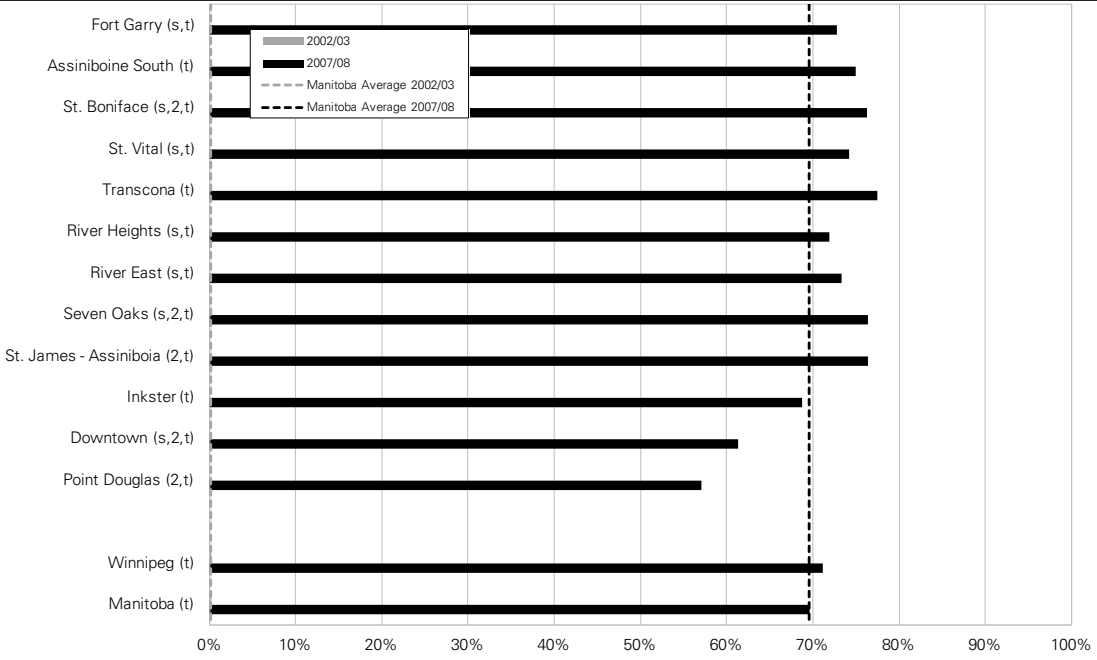


PCV-7 was added to the recommended immunization schedule in October 2004

Source: Manitoba Centre for Health Policy, 2011

Figure 2.26: Winnipeg CA Pneumococcal Conjugate (PCV-7) Immunization Rates, Aged 2

Percent of children who are complete from birth for the PCV-7 vaccination, 2002/03 and 2007/08

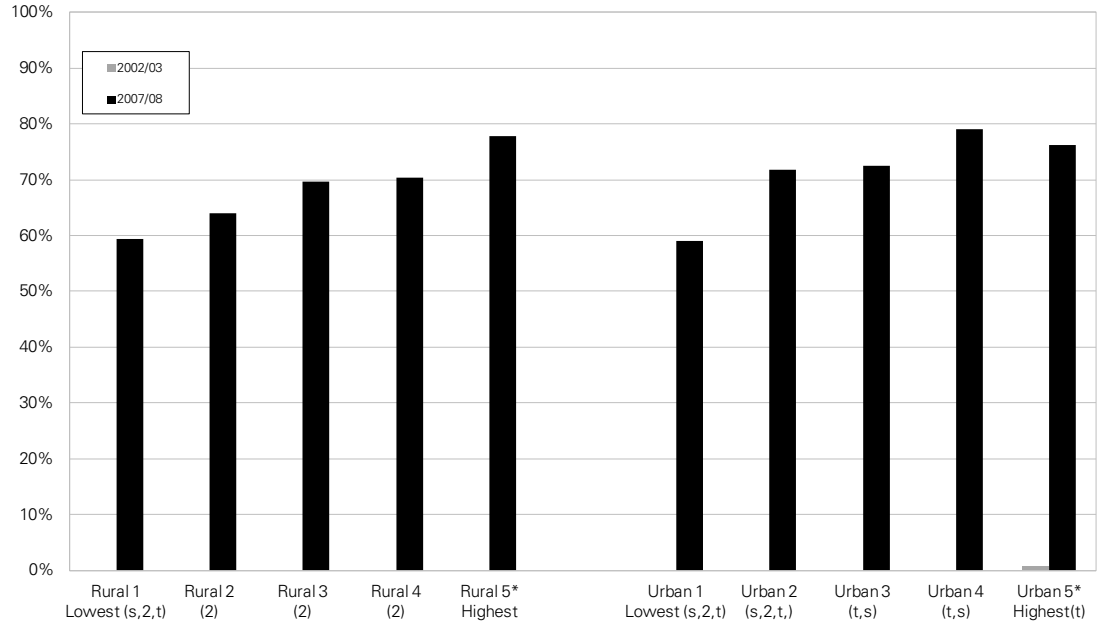


'1' indicates area's rate was statistically different from Manitoba average in first time period
'2' indicates area's rate was statistically different from Manitoba average in second time period
't' indicates change over time was statistically significant for that area
's' indicates data suppressed due to small numbers
PCV-7 was added to the recommended immunization schedule in October 2004

Source: Manitoba Centre for Health Policy, 2011

Figure 2.27: Pneumococcal Conjugate (PCV-7) Immunization Rates by Income Quintile, Aged 2

Percent of children who are complete from birth for PCV-7, 2002/03 and 2007/08



'1' indicates quintile's rate was statistically different from reference group in first time period
'2' indicates quintile's rate was statistically different from reference group in second time period
't' indicates change over time was statistically significant for that quintile
's' indicates data suppressed due to small numbers
'*' indicates the reference group. Rural 5 is the reference group for rural quintiles; Urban 5 is the reference group for urban quintiles
PCV-7 was added to the recommended immunization schedule in October 2004

Source: Manitoba Centre for Health Policy, 2011

Table 2.8: Factors Associated with Being Complete from Birth for the Pneumococcal Conjugate (PCV-7) Immunization, Aged 2
Adjusted Odds Ratio (95% Confidence Interval), 2007/08

Factor	Category	Adjusted Odds Ratio (95% CI)	
		Model 1	Model 2
Coverage from Birth	Covered from Birth	***Reference***	***Reference***
	Not Covered from Birth	0.12 (0.10, 0.14)	0.10 (0.08, 0.11)
Income Quintile	Quintile 1 (lowest)	0.54 (0.47, 0.63)	0.60 (0.52, 0.68)
	Quintile 2	0.71 (0.62, 0.82)	0.77 (0.67, 0.88)
	Quintile 3	0.79 (0.69, 0.92)	0.84 (0.73, 0.97)
	Quintile 4	0.88 (0.75, 1.02)	0.94 (0.81, 1.08)
	Quintile 5 (highest)	***Reference***	***Reference***
Mother's Age at Birth	Unknown	1.16 (0.60, 2.23)	1.05 (0.58, 1.89)
	18 and younger	0.62 (0.52, 0.74)	0.67 (0.56, 0.79)
	19-24	0.71 (0.65, 0.79)	0.75 (0.68, 0.82)
	25-34	***Reference***	***Reference***
	35 and older	1.05 (0.93, 1.19)	1.05 (0.93, 1.18)
Continuity of Care	No Continuity of Care	0.68 (0.62, 0.74)	0.67 (0.61, 0.73)
	Less than 3 Physician Visits*	0.50 (0.43, 0.57)	0.35 (0.31, 0.40)
	Continuity of Care	***Reference***	***Reference***
Provider Type	Mixed Providers	1.16 (1.02, 1.31)	
	Regional Health Unit	1.05 (0.92, 1.21)	
	Other/Unspecified	0.72 (0.54, 0.98)	
	Physician	***Reference***	
Region of Residence	Brandon	1.23 (1.00, 1.53)	1.32 (1.08, 1.62)
	North	0.96 (0.81, 1.14)	1.20 (1.05, 1.38)
	Rural South	1.17 (1.04, 1.30)	1.18 (1.08, 1.29)
	Winnipeg	***Reference***	***Reference***
Sex of Child	Male	0.98 (0.90, 1.06)	0.97 (0.90, 1.05)
	Female	***Reference***	***Reference***
Number of Children in the Family	1 Child	1.31 (1.19, 1.44)	1.33 (1.21, 1.46)
	2-3 Children	***Reference***	***Reference***
	4 or more Children	0.43 (0.38, 0.48)	0.42 (0.38, 0.47)

Model 1–children with no immunizations are excluded from the adjusted model

Model 2–children with no immunizations are included in the adjusted model; provider type not included as a covariate

'*' for children with less than 3 physician visits, we were unable to define continuity of care

PCV-7 was added to the recommended immunization schedule in October 2004

Source: Manitoba Centre for Health Policy, 2011

The Primary Series—Measles, Mumps and Rubella (MMR)

Measles is an RNA virus of the *Morbillivirus* family of *Paramyxoviridae* found only in humans, and no asymptomatic carrier state has ever been identified (Manitoba Health, 2010b). Measles is an acute viral disease presenting with some combination of fever, cough, coryza, conjunctivitis, rash, and Koplik spots. Measles infection may be complicated by otitis media, bronchopneumonia, croup, and diarrhea. Severe complications include acute **encephalitis** (about 1/1,000 cases), which often results in permanent brain damage and a case fatality rate of between one and three deaths per 1,000 cases (American Academy of Pediatrics, 2006). The last outbreak of measles occurred in Manitoba in 1986 with over 3,000 cases. Since then, only three cases have been identified in Manitoba: one case each in 2002, 2003, and 2004 (Manitoba Health, 2010).

The mumps virus is another member of the *Paramyxoviridae* family, genus *Rubulavirus*. Humans are the only known reservoir; there is no known carrier state, although illness may be subacute in nature. The acute illness caused by mumps may be nonspecific respiratory symptoms, but 40% of those infected develop acute parotitis. Complications of mumps infection include orchitis, thyroiditis, mastitis, glomerulonephritis, myocarditis, pancreatitis, and hearing impairment, as well as central nervous system manifestations of cerebellar ataxia, transverse myelitis, and ascending polyradiculitis. Mumps occurs infrequently in Manitoba with less than ten cases annually from 2006–2009. In 2009, an outbreak in a Manitoba correctional facility resulted in five cases (Manitoba Health Communicable Disease Control, 2005).

Rubella is an enveloped RNA virus that belongs to the *Rubivirus* genus of the *Togaviridae* family. Humans are the only reservoir. Infection with rubella virus is usually mild and characterized by a maculopapular rash, lymphadenopathy, and slight fever. It may be confused with other rash infections, such as measles, dengue, parvovirus, or enterovirus. In adults, infection may be accompanied by transient polyarthritis or polyarthralgia. Symptomatic or asymptomatic infection during pregnancy may lead to stillbirth, miscarriage, premature delivery, or fetal abnormalities as a result of congenital rubella syndrome (Manitoba Health Communicable Disease Control, 2005). In Manitoba, the last outbreak was in 1997 in adolescent males, who were unvaccinated due to selective vaccination programs targeted to females. Since then, one case of rubella was reported in 2007 and two cases in 2009. From 1991–2009, only three cases of congenital rubella were reported—two cases in 1993 and one in 1998 (Manitoba Health Communicable Disease Control, 2005).

Live vaccine for protection against measles was approved in Canada in 1963, and its introduction reduced measles cases from more than 300,000 cases annually to an average of 14 cases annually (2001–2005) (Public Health Agency of Canada, 2006). In 1983, the trivalent MMR vaccine was added to the primary vaccination series for one–year–olds. In the late 1980's to early 1990's, several large measles outbreaks occurred despite high levels of immunization; in 1996/97, every Canadian province moved to a two dose MMR schedule. In Manitoba, during our observation period, measles protection was provided by two doses of MMR vaccine recommended at 12 months and four– to six–years of age.

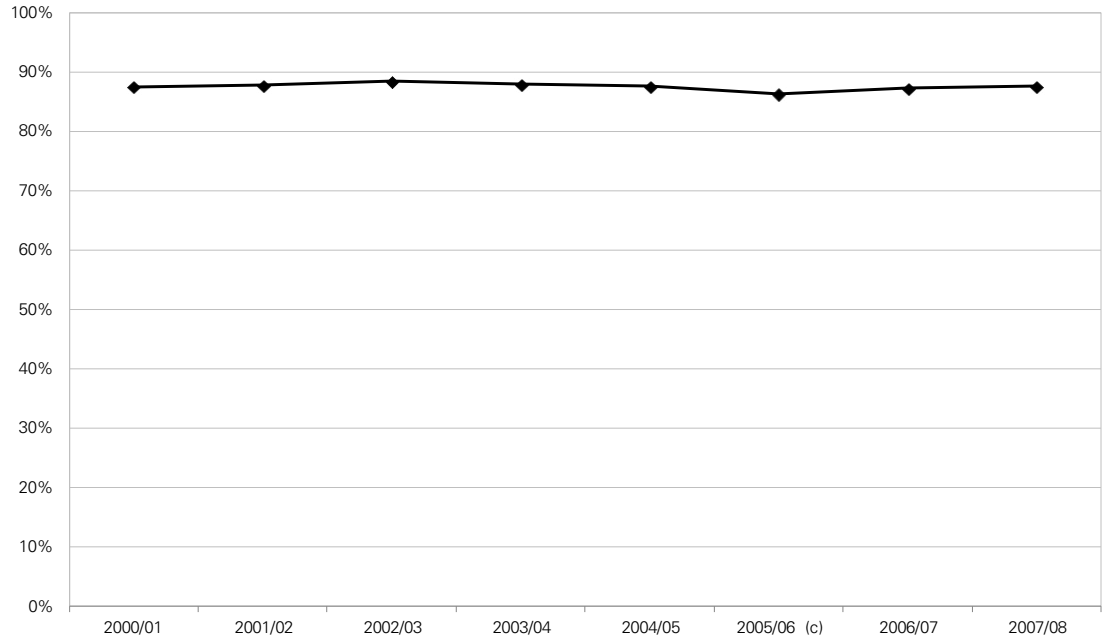
For the purposes of the primary series analysis, one dose of MMR vaccine is required to be considered complete for age from birth. Given the trivalent nature of the vaccine, these analyses apply to mumps and rubella immunization rates as well.

Figure 2.28 shows, that with the exception of 2005/06 where the rate was slightly lower, the immunization rates at two years of age for measles in Manitoba have been remarkably stable at around 88%. At the regional level, Assiniboine and Parkland RHAs exceeded the provincial average in the first time period while Central and North Eastman RHAs are slightly below (Figure 2.29). Figures 2.30 and 2.31 show rates at the RHA district and Winnipeg CA level.

In terms of factors associated with having received the recommended measles vaccination, we see that once again children in the lowest income quintile are less likely to have received measles vaccination (Table 2.9). Younger maternal age at birth was also associated with lower rates as was larger family size. In addition, children who had continuity of care were more likely to have received the measles vaccine.

The complete from birth crude measles immunization rates by sociodemographic factors can be found at the end of this section in Table 2.16.

Figure 2.28: Manitoba Measles Immunization Rates, Aged 2
Percent of children who are complete/partial from birth for measles vaccination, 2000/01–2007/08



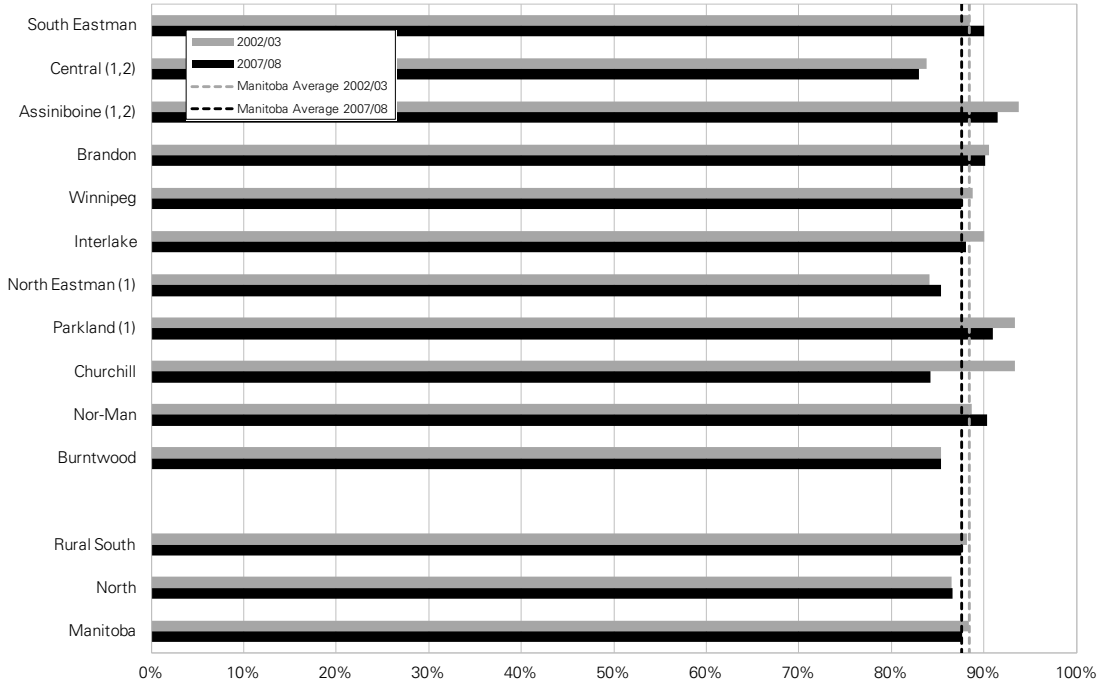
Linear trend test: Complete from birth p= 0.0133

'c' indicates the complete from birth rate for this fiscal year, was statistically different from the complete from birth rate in 2007/08

Source: Manitoba Centre for Health Policy, 2011

Figure 2.29: RHA Measles Immunization Rates, Aged 2

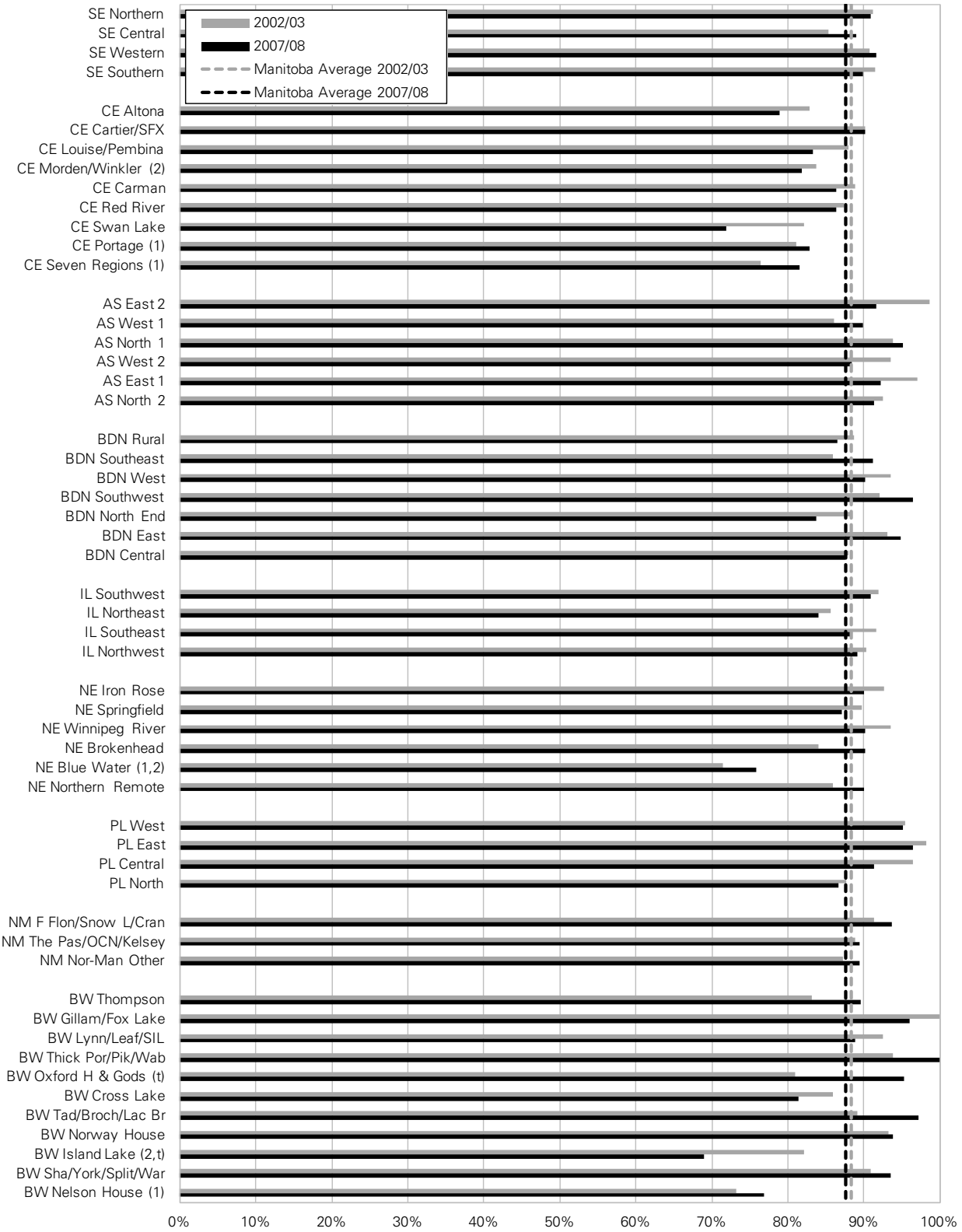
Percent of children who are complete from birth for the measles vaccination, 2002/03 and 2007/08



'1' indicates area's rate was statistically different from Manitoba average in first time period
'2' indicates area's rate was statistically different from Manitoba average in second time period
't' indicates change over time was statistically significant for that area
's' indicates data suppressed due to small numbers

Source: Manitoba Centre for Health Policy, 2011

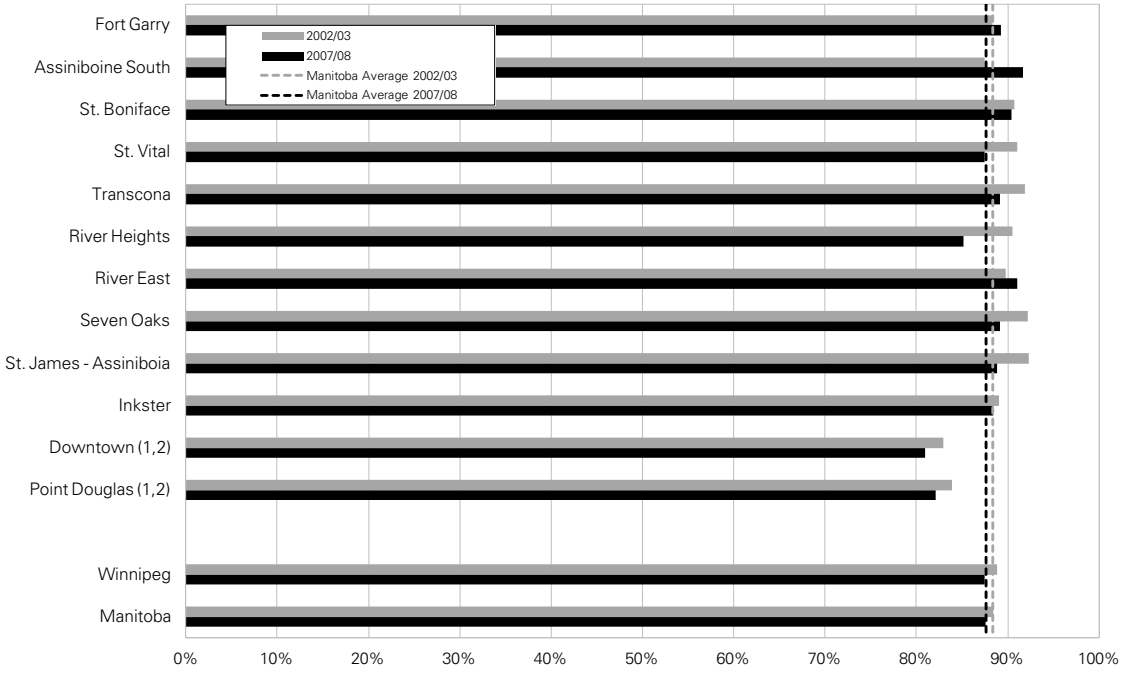
Figure 2.30: District Measles Immunization Rates, Aged 2
Percent of children who are complete from birth for the measles vaccination, 2002/03 and 2007/08



Source: Manitoba Centre for Health Policy, 2011

Figure 2.31: Winnipeg CA Measles Immunization Rates, Aged 2

Percent of children who are complete from birth for the measles vaccination, 2002/03 and 2007/08

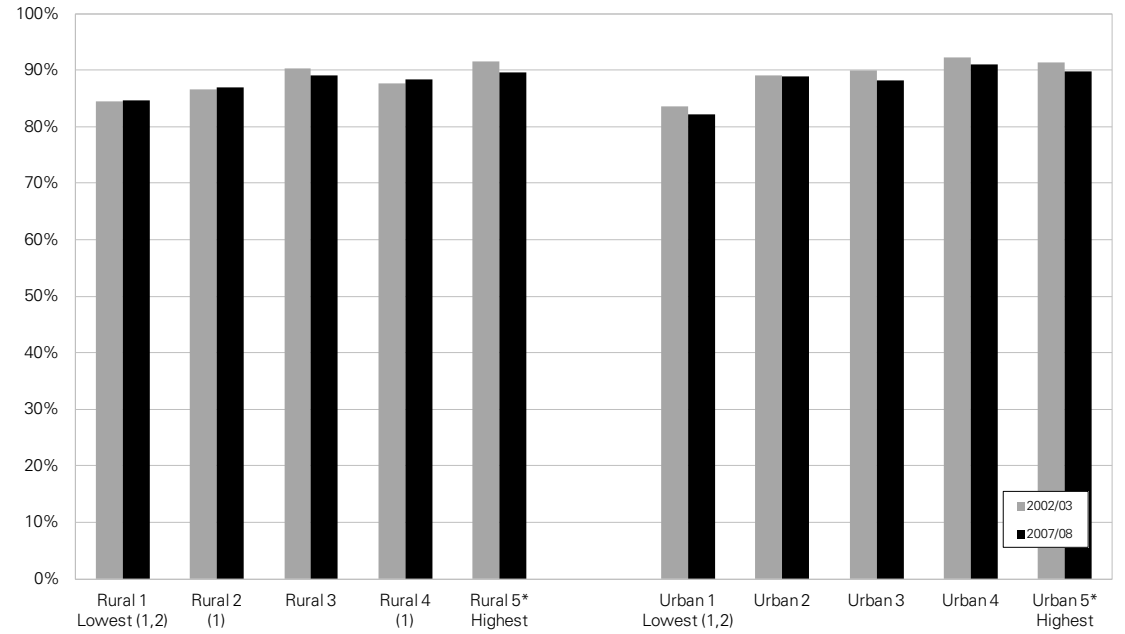


'1' indicates area's rate was statistically different from Manitoba average in first time period
'2' indicates area's rate was statistically different from Manitoba average in second time period
't' indicates change over time was statistically significant for that area
's' indicates data suppressed due to small numbers

Source: Manitoba Centre for Health Policy, 2011

Figure 2.32: Measles Immunization Rates by Income Quintile, Aged 2

Percent of children who are complete from birth for the measles vaccination, 2002/03 and 2007/08



'1' indicates quintile's rate was statistically different from reference group in first time period
'2' indicates quintile's rate was statistically different from reference group in second time period
't' indicates change over time was statistically significant for that quintile
's' indicates data suppressed due to small numbers[1]
'*' indicates the reference group. Rural 5 is the reference group for rural quintiles; Urban 5 is the reference group for urban quintiles

Source: Manitoba Centre for Health Policy, 2011

Table 2.9: Factors Associated with Being Complete from Birth for the Measles Immunization, Aged 2
Adjusted Odds Ratio (95% Confidence Interval), 2007/08

Factor	Category	Adjusted Odds Ratio (95% CI)	
		Model 1	Model 2
Coverage from Birth	Covered from Birth	***Reference***	***Reference***
	Not Covered from Birth	0.34 (0.27,0.42)	0.20 (0.17,0.23)
Income Quintile	Quintile 1 (lowest)	0.69 (0.55,0.86)	0.85 (0.71,1.01)
	Quintile 2	0.94 (0.74,1.18)	1.10 (0.91,1.32)
	Quintile 3	0.89 (0.71,1.12)	1.05 (0.87,1.26)
	Quintile 4	0.94 (0.74,1.20)	1.12 (0.93,1.37)
	Quintile 5 (highest)	***Reference***	***Reference***
Mother's Age at Birth	Unknown	2.04 (0.61,6.80)	0.94 (0.50,1.76)
	18 and younger	0.59 (0.46,0.77)	0.82 (0.64,1.05)
	19-24	0.62 (0.53,0.72)	0.75 (0.66,0.85)
	25-34	***Reference***	***Reference***
	35 and older	1.06 (1.00,1.29)	1.06 (0.90,1.24)
Continuity of Care	No Continuity of Care	0.55 (0.47,0.63)	0.60 (0.53,0.68)
	Less than 3 Physician Visits*	0.32 (0.26,0.39)	0.19 (0.17,0.23)
	Continuity of Care	***Reference***	***Reference***
Provider Type	Mixed Providers	2.10 (1.70,2.59)	
	Regional Health Unit	1.52 (1.23,1.87)	
	Other/Unspecified	0.94 (0.65,1.36)	
	Physician	***Reference***	
Region of Residence	Brandon	1.28 (0.91,1.81)	1.55 (1.17,2.07)
	North	1.17 (0.90,1.52)	2.27 (1.87,2.76)
	Rural South	1.23 (1.04,1.47)	1.45 (1.28,1.64)
	Winnipeg	***Reference***	***Reference***
Sex of Child	Male	1.09 (0.96,1.23)	1.03 (0.92,1.14)
	Female	***Reference***	***Reference***
Number of Children in the Family	1 Child	1.09 (0.93,1.27)	1.14 (1.00,1.30)
	2-3 Children	***Reference***	***Reference***
	4 or more Children	0.40 (0.34,0.47)	0.45 (0.39,0.51)

Model 1–children with no immunizations are excluded from the adjusted model

Model 2–children with no immunizations are included in the adjusted model; provider type not included as a covariate

'*' for children with less than 3 physician visits, we were unable to define continuity of care

Source: Manitoba Centre for Health Policy, 2011

The Primary Series—Varicella (includes aged four to six and Grade Four catch up programs)

Varicella–zoster virus is a DNA virus from the herpes virus family with humans as the only reservoir. Infection with zoster virus causes primary illness (chickenpox) and enters a dormant stage in the sensory nerve ganglia where it may become reactivated and cause **herpes zoster** (shingles). As it is an infectious virus that is spread both through the airborne route and direct contact, the attack rate in households may approach 90% (Public Health Agency of Canada, 2006). The complications of chicken pox are many and include skin infections, otitis media, pneumonia, necrotizing fasciitis, **hepatitis**, and encephalitis. Complications are more common in adults, adolescents, and the immunosuppressed. Varicella significantly increases the risk of severe invasive streptococcal infections (Davies et al., 1996). Primary varicella infection is not reportable in Manitoba, unless an outbreak is identified.

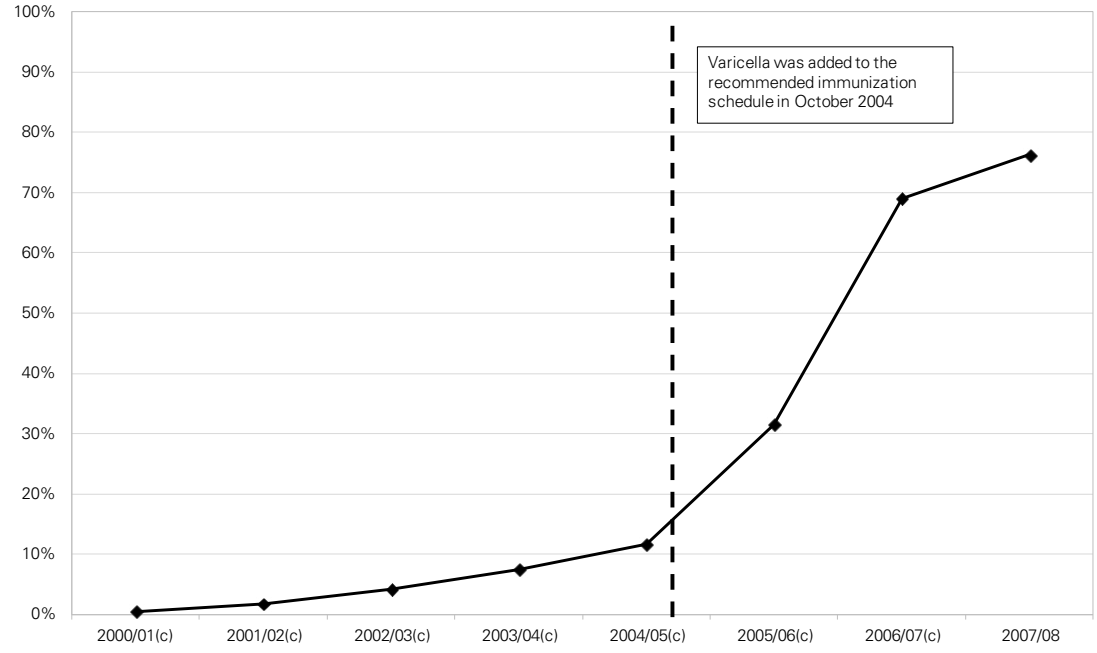
Manitoba added the live attenuated varicella vaccine to its immunization schedule in 2004 for children 12 months of age, with catch up programs for ages four to six and Grade Four. For the purposes of this analysis, a single dose of varicella vaccine is required to be considered complete for age from birth. Since program introduction, varicella vaccine immunization rates have risen steadily reaching 77% in 2007/08 (Figure 2.33). Central, Interlake, North Eastman, and Burntwood RHAs had rates below the provincial average in 2007/08. Brandon and Winnipeg were above the Manitoba average (Figure 2.34). RHA district, Winnipeg CA, and income quintile rates are depicted in Figures 2.35–2.37. Factors positively associated with receiving varicella included living in a higher income area, having no siblings, and having continuity of care. Whether children received vaccinations from physicians, regional health units, or both did not influence complete from birth status (Table 2.10).

Pre–school and Grade Four catch up data are illustrated in Figures 2.38–2.47. In 2007/08, 30% of seven–year–olds had received a single dose of varicella vaccine, and the progressively increasing vaccine uptake after program initiation in 2004 is evident Figure 2.38. In 2007/08, 16% of children aged 11 (Grade Four) had received a single dose of varicella vaccine. Lower rates for children aged 11 compared to those aged seven can be partially explained by the observation that the vaccine is only offered to children who have not had chickenpox. Given the high incidence of this disease in childhood, the proportion of susceptible children at age 11 is much lower than at age seven.

The complete from birth crude varicella immunization rates by sociodemographic factors can be found at the end of this section in Tables 2.17–2.19.

Figure 2.33: Manitoba Varicella Immunization Rates, Aged 2

Percent of children who are complete from birth for the varicella vaccination, 2000/01–2007/08

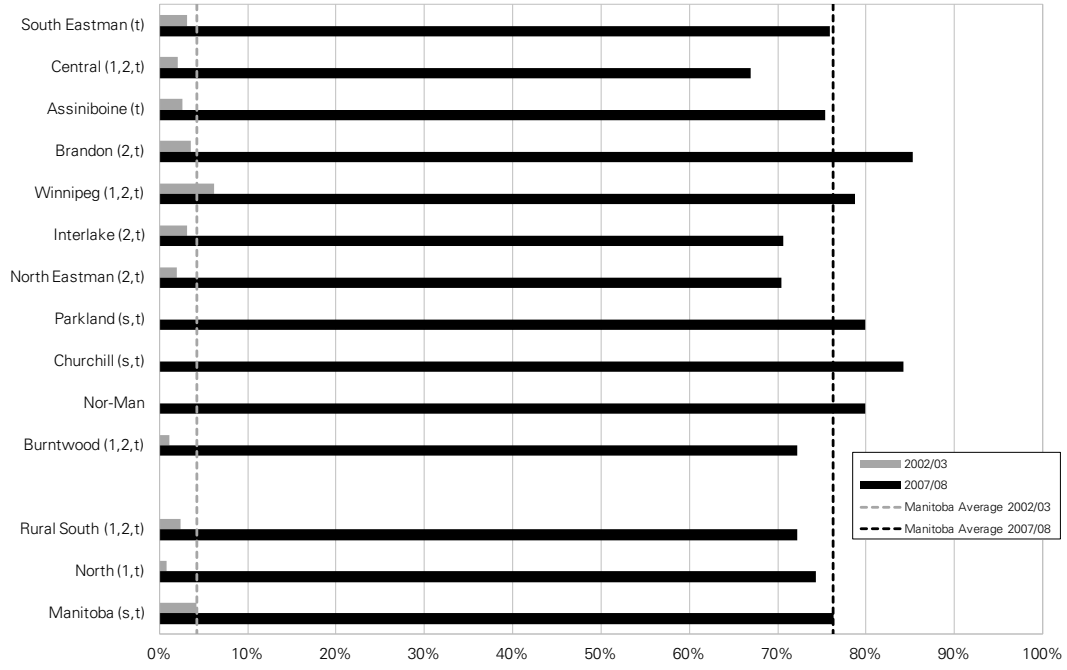


Linear trend test: Complete from birth p<0.0001
'c' indicates the complete from birth rate for this fiscal year was statistically different from the complete from birth rate in 2007/08

Source: Manitoba Centre for Health Policy, 2011

Figure 2.34: RHA Varicella Immunization Rates, Aged 2

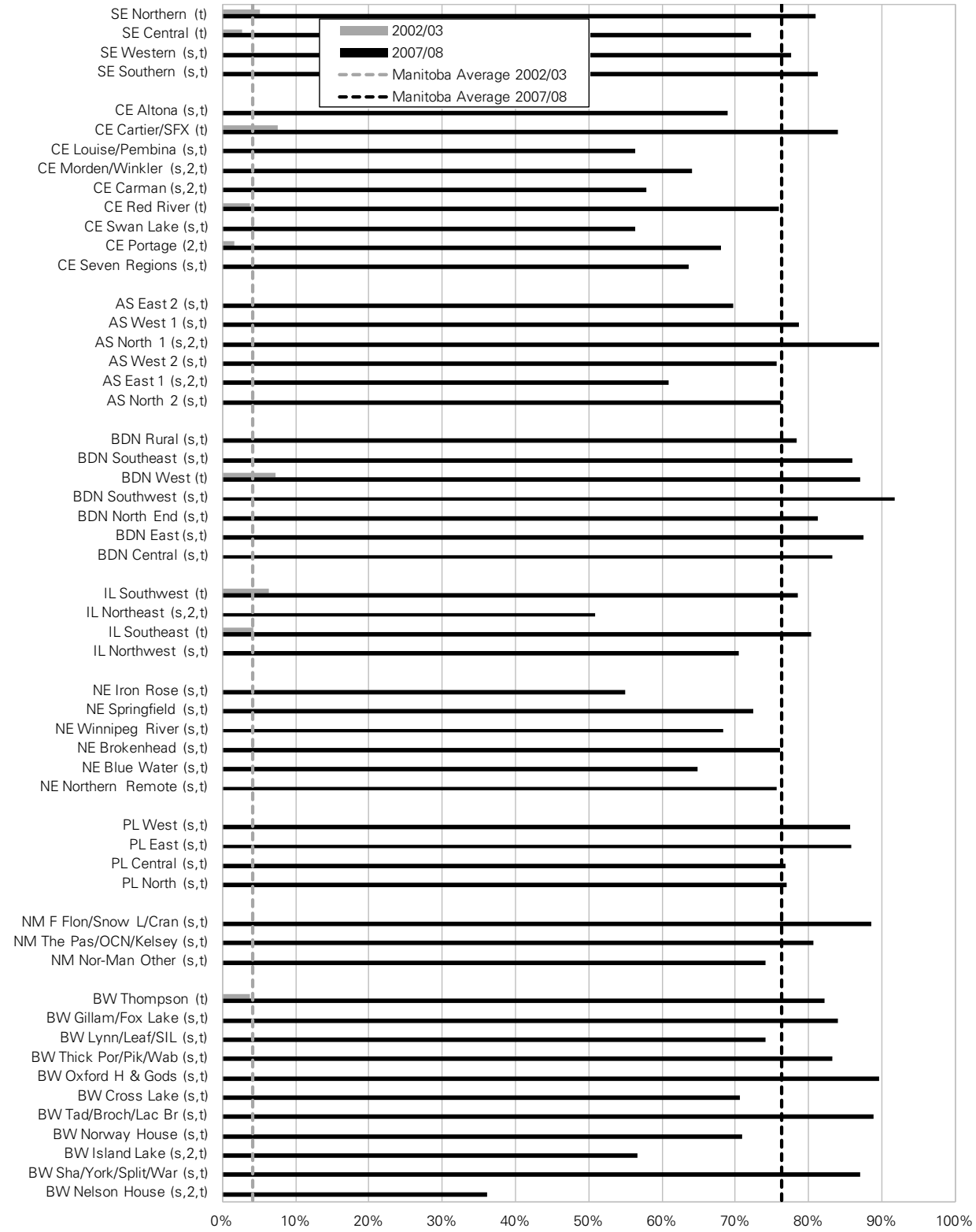
Percent of children who are complete from birth for the varicella vaccination, 2002/03 and 2007/08



'1' indicates area's rate was statistically different from Manitoba average in first time period
'2' indicates area's rate was statistically different from Manitoba average in second time period
't' indicates change over time was statistically significant for that area
's' indicates data suppressed due to small numbers
Varicella was added to the recommended immunization schedule in October 2004

Source: Manitoba Centre for Health Policy, 2011

Figure 2.35: RHA District Varicella Immunization Rates, Aged 2
Percent of children who are complete from birth for the varicella vaccination, 2002/03 and 2007/08

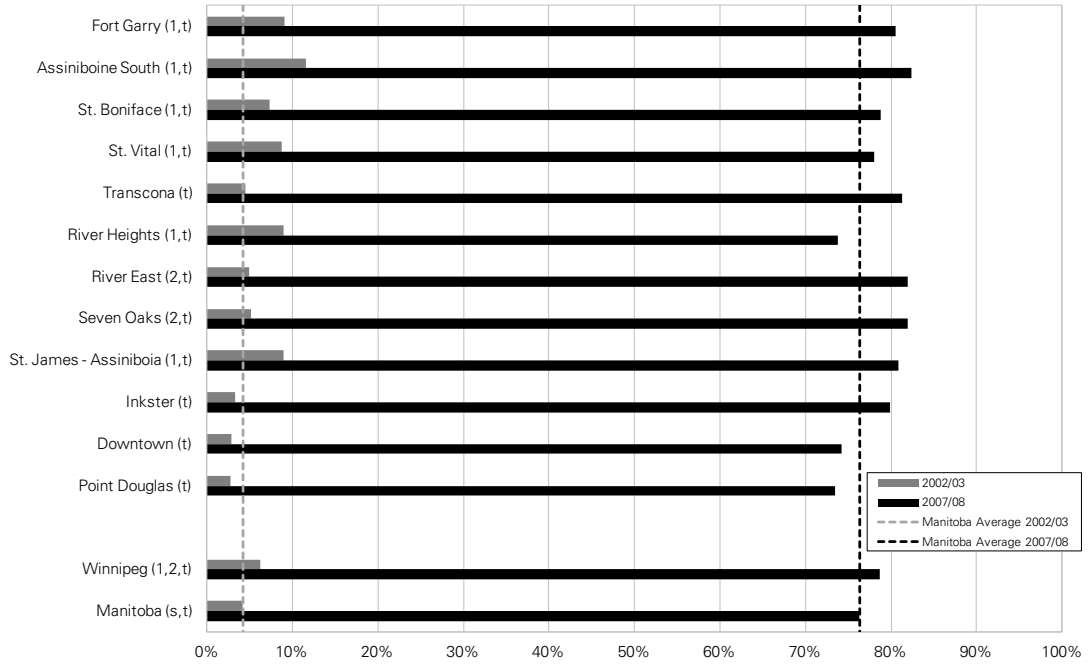


Varicella was added to the recommended immunization schedule in October 2004

Source: Manitoba Centre for Health Policy, 2011

Figure 2.36: Winnipeg CA Varicella Immunization Rates, Aged 2

Percent of children who are complete from birth for the varicella vaccination, 2003/04 and 2007/08

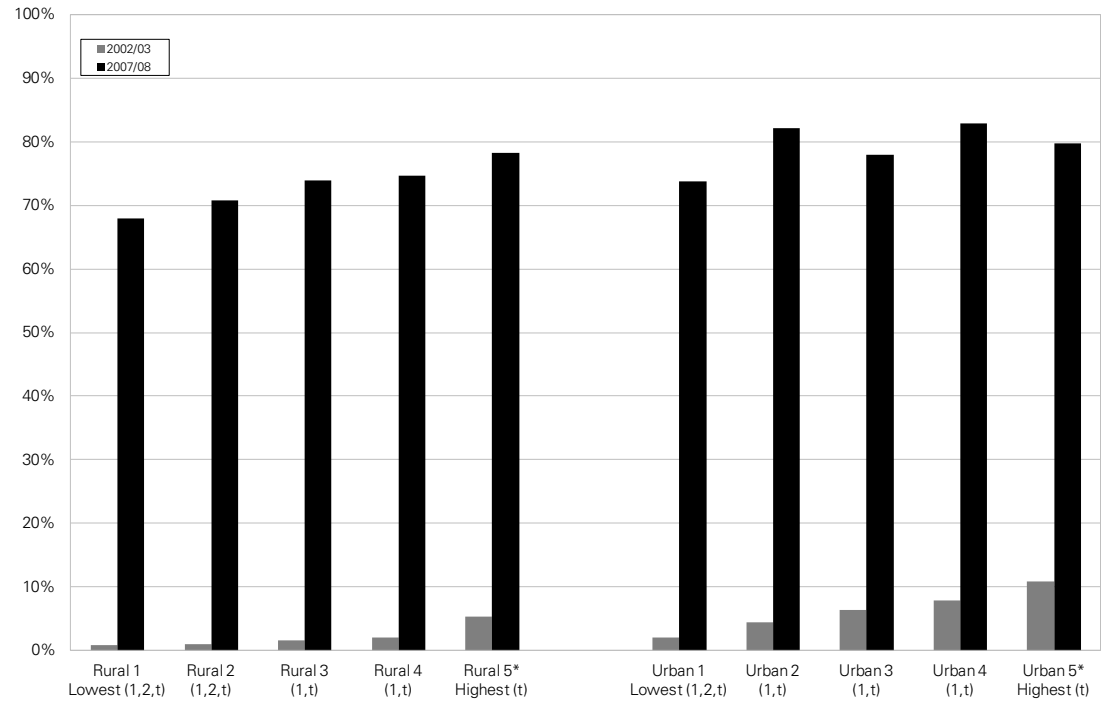


'1' indicates area's rate was statistically different from Manitoba average in first time period
'2' indicates area's rate was statistically different from Manitoba average in second time period
't' indicates change over time was statistically significant for that area
's' indicates data suppressed due to small numbers
Varicella was added to the recommended immunization schedule in October 2004

Source: Manitoba Centre for Health Policy, 2011

Figure 2.37: Varicella Immunization Rates by Income Quintile, Aged 2

Percent of children who are complete from birth for the varicella vaccination, 2002/03 and 2007/08



'1' indicates quintile's rate was statistically different from reference group in first time period
'2' indicates quintile's rate was statistically different from reference group in second time period
't' indicates change over time was statistically significant for that quintile
's' indicates data suppressed due to small numbers
'*' indicates the reference group. Rural 5 is the reference group for rural quintiles; Urban 5 is the reference group for urban quintiles
Varicella was added to the recommended immunization schedule in October 2004

Source: Manitoba Centre for Health Policy, 2011

Table 2.10: Factors Associated with Being Complete from Birth for the Varicella Immunization, Aged 2
Adjusted Odds Ratio (95% Confidence Interval), 2007/08

Factor	Category	Adjusted Odds Ratio (95% CI)	
		Model 1	Model 2
Coverage from Birth	Covered from Birth	***Reference***	***Reference***
	Not Covered from Birth	0.50 (0.42, 0.59)	0.28 (0.25, 0.33)
Income Quintile	Quintile 1 (lowest)	0.81 (0.70, 0.94)	0.85 (0.74, 0.97)
	Quintile 2	0.99 (0.85, 1.15)	1.04 (0.90, 1.19)
	Quintile 3	0.87 (0.75, 1.01)	0.92 (0.80, 1.05)
	Quintile 4	1.03 (0.88, 1.20)	1.09 (0.94, 1.25)
	Quintile 5 (highest)	***Reference***	***Reference***
Mother's Age at Birth	Unknown	1.56 (0.74, 3.32)	1.10 (0.63, 1.93)
	18 and younger	0.94 (0.77, 1.15)	1.04 (0.86, 1.27)
	19-24	0.89 (0.80, 0.99)	0.93 (0.84, 1.03)
	25-34	***Reference***	***Reference***
	35 and older	1.12 (0.98, 1.27)	1.11 (0.98, 1.26)
Continuity of Care	No Continuity of Care	0.71 (0.64, 0.78)	0.69 (0.63, 0.76)
	Less than 3 Physician Visits*	0.44 (0.38, 0.51)	0.28 (0.25, 0.32)
	Continuity of Care	***Reference***	***Reference***
Provider Type	Mixed Providers	1.10 (0.96, 1.25)	
	Regional Health Unit	0.92 (0.80, 1.05)	
	Other/Unspecified	0.81 (0.59, 1.09)	
	Physician	***Reference***	
Region of Residence	Brandon	1.93 (1.47, 2.52)	1.88 (1.48, 2.39)
	North	1.29 (1.07, 1.55)	1.55 (1.34, 1.81)
	Rural South	0.89 (0.79, 1.00)	0.90 (0.82, 0.99)
	Winnipeg	***Reference***	***Reference***
Sex of Child	Male	0.97 (0.89, 1.06)	0.96 (0.89, 1.04)
	Female	***Reference***	***Reference***
Number of Children in the Family	1 Child	1.18 (1.06, 1.31)	1.21 (1.09, 1.33)
	2-3 Children	***Reference***	***Reference***
	4 or more Children	0.50 (0.45, 0.56)	0.49 (0.44, 0.55)

Model 1–children with no immunizations are excluded from the adjusted model

Model 2–children with no immunizations are included in the adjusted model; provider type not included as a covariate

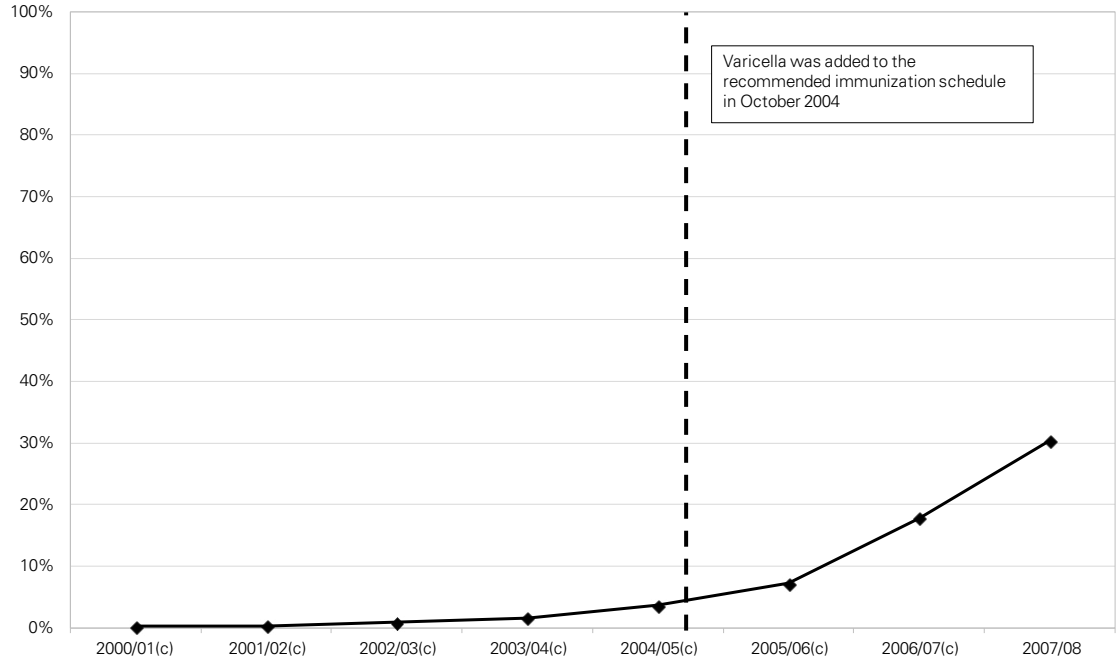
'*' for children with less than 3 physician visits, we were unable to define continuity of care

Varicella was added to the recommended immunization schedule in October 2004

Source: Manitoba Centre for Health Policy, 2011

Figure 2.38: Manitoba Varicella Immunization Rates, Aged 7

Percent of children who are complete from birth for the varicella vaccination, 2000/01–2007/08

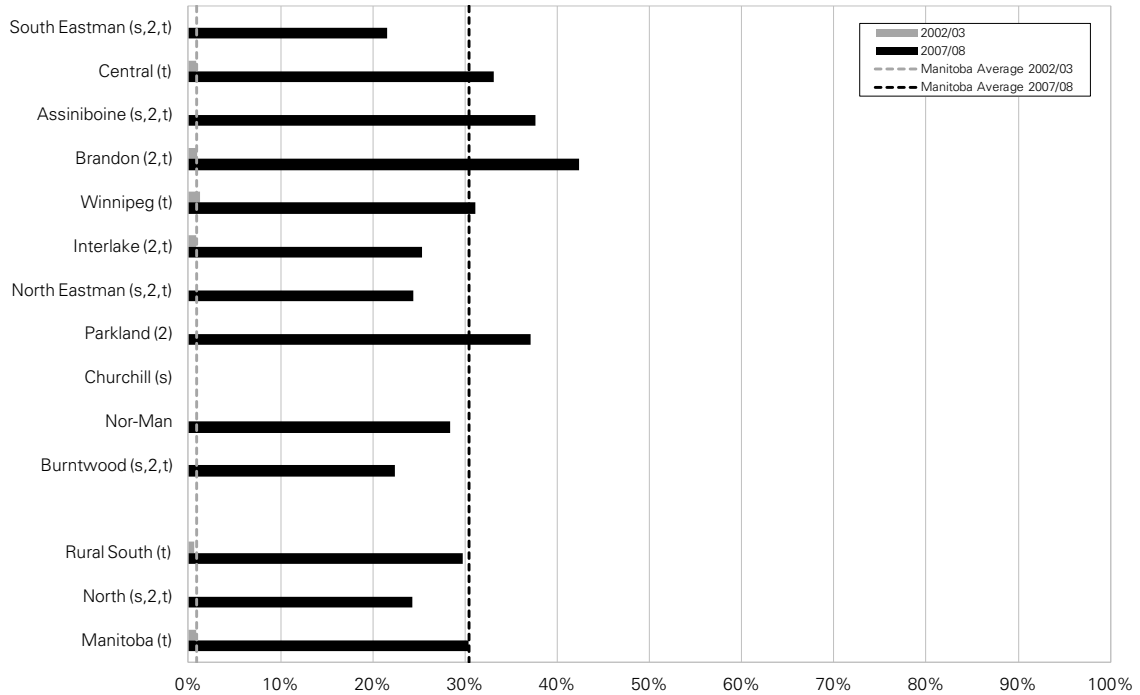


Linear trend test: Complete from birth p<0.0001
'c' indicates the complete from birth rate for this fiscal year was statistically different from the complete from birth rate in 2007/08

Source: Manitoba Centre for Health Policy, 2011

Figure 2.39: RHA Varicella Immunization Rates, Aged 7

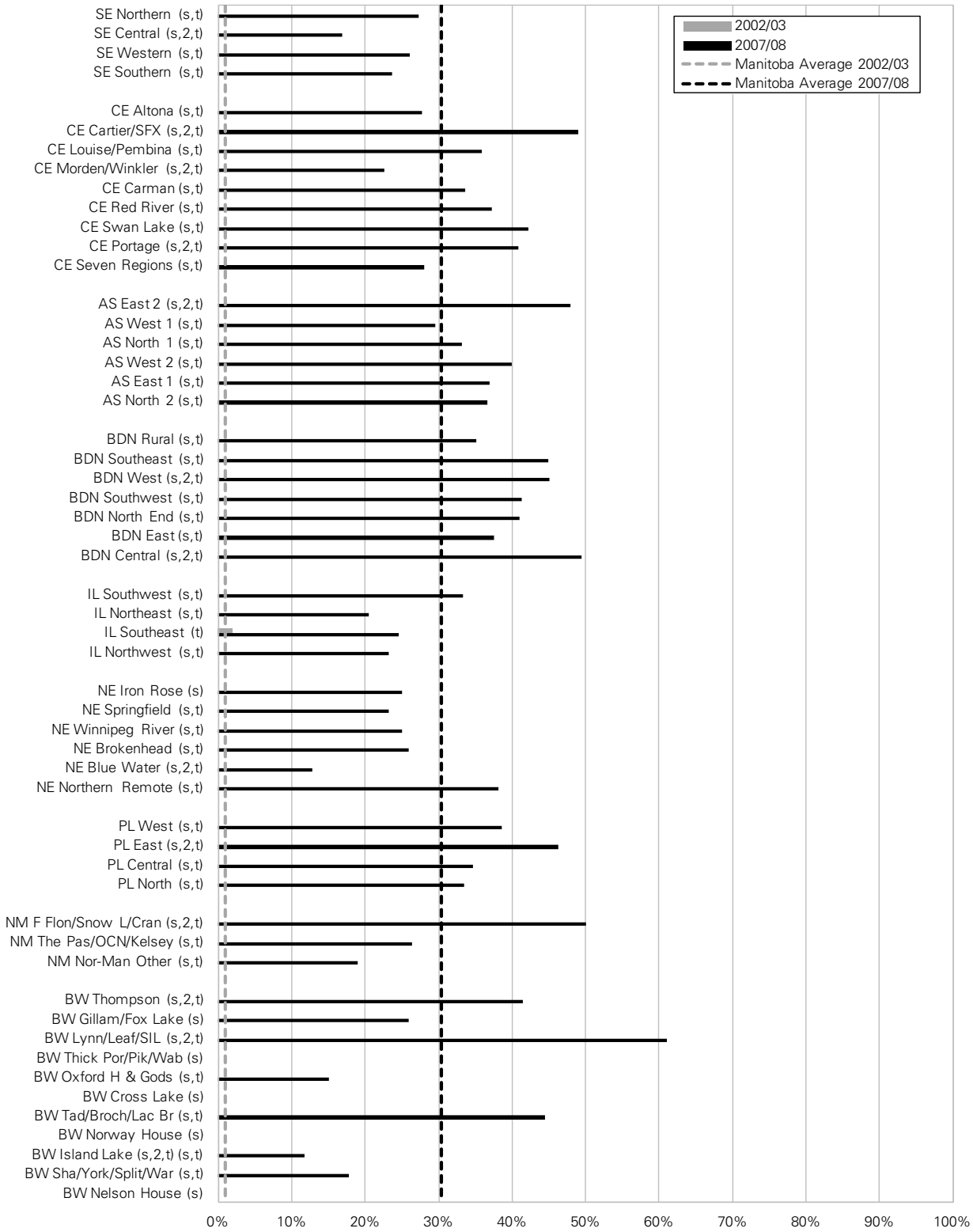
Percent of children who are complete from birth for the varicella vaccination, 2002/03 and 2007/08



'1' indicates area's rate was statistically different from Manitoba average in first time period
'2' indicates area's rate was statistically different from Manitoba average in second time period
't' indicates change over time was statistically significant for that area
's' indicates data suppressed due to small numbers
Varicella was added to the recommended immunization schedule in October 2004

Source: Manitoba Centre for Health Policy, 2011

Figure 2.40: RHA District Varicella Immunization Rates, Aged 7
Percent of children who are complete from birth for the varicella vaccination, 2002/03 and 2007/08

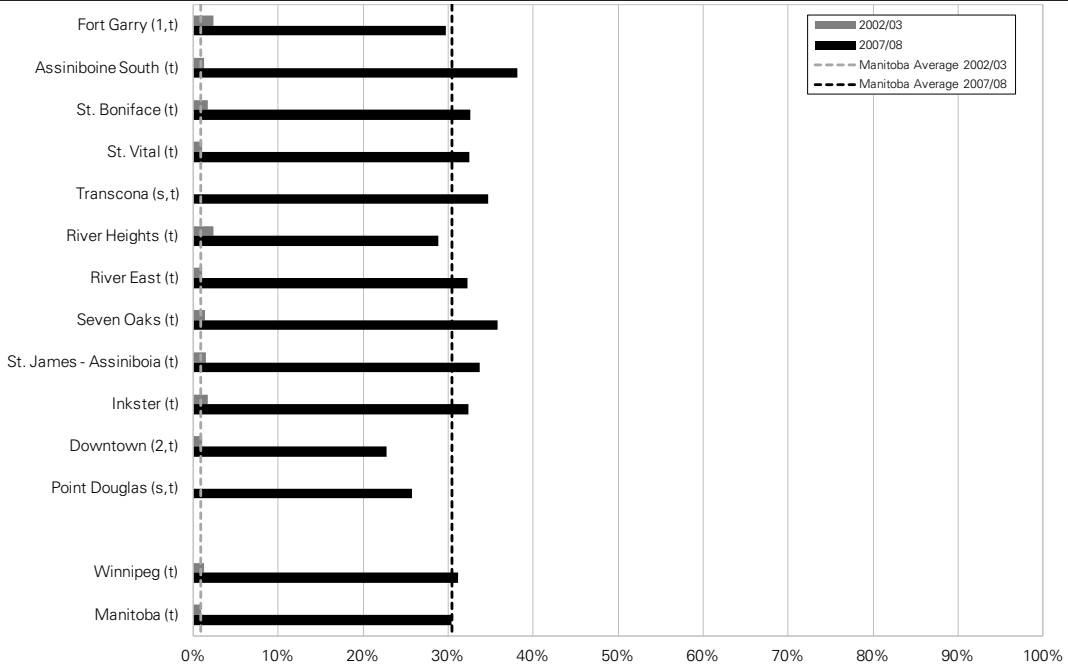


Varicella was added to the recommended immunization schedule in October 2004

Source: Manitoba Centre for Health Policy, 2011

Figure 2.41: Winnipeg CA Varicella Immunization Rates, Aged 7

Percent of children who are complete from birth for the varicella vaccination, 2003/04 and 2007/08

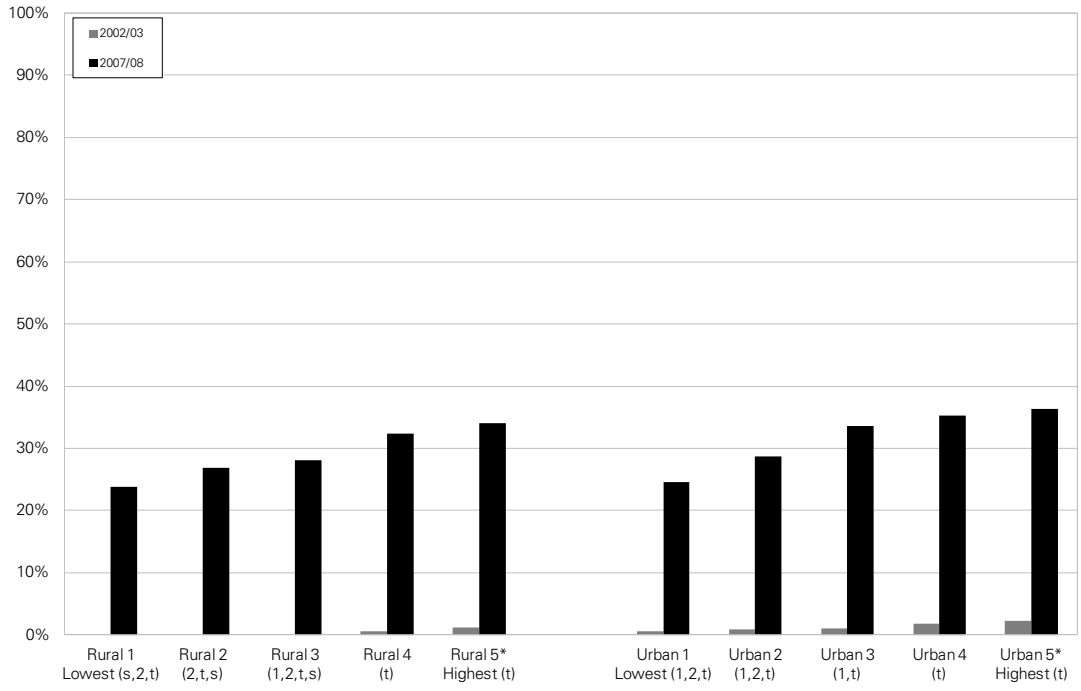


'1' indicates area's rate was statistically different from Manitoba average in first time period
'2' indicates area's rate was statistically different from Manitoba average in second time period
't' indicates change over time was statistically significant for that area
's' indicates data suppressed due to small numbers
Varicella was added to the recommended immunization schedule in October 2004

Source: Manitoba Centre for Health Policy, 2011

Figure 2.42: Varicella Immunization Rates by Income Quintile, Aged 7

Percent of children who are complete from birth for the varicella vaccination, 2002/03 and 2007/08

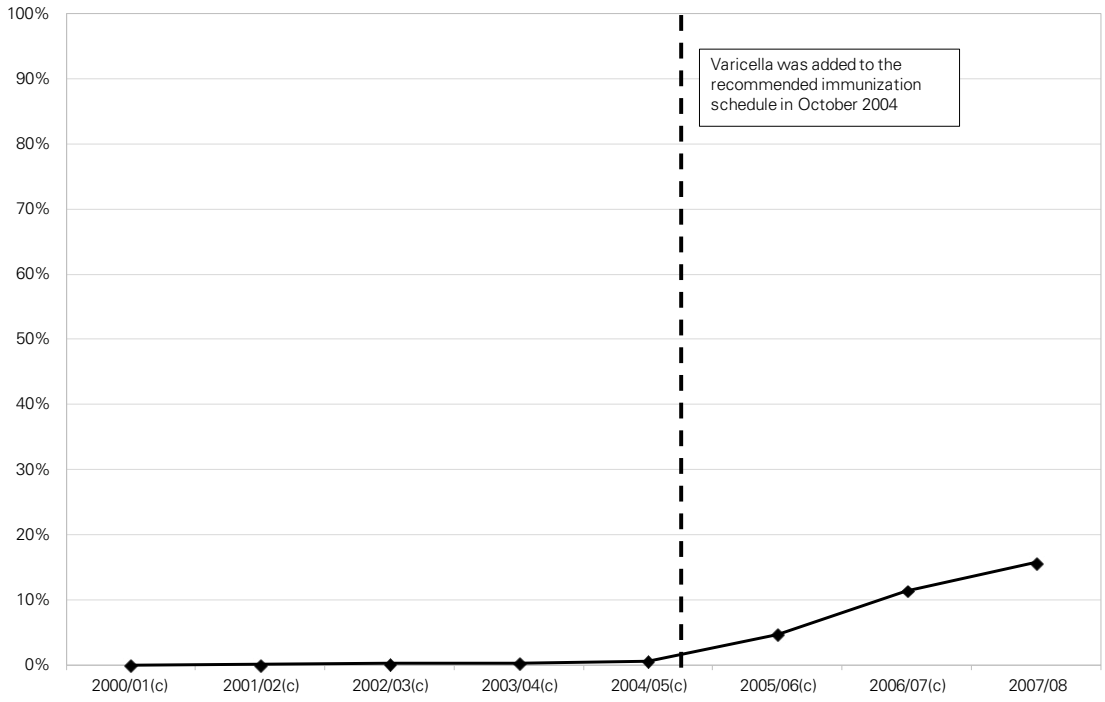


'1' indicates quintile's rate was statistically different from reference group in first time period
'2' indicates quintile's rate was statistically different from reference group in second time period
't' indicates change over time was statistically significant for that quintile
's' indicates data suppressed due to small numbers
'*' indicates the reference group. Rural 5 is the reference group for rural quintiles; Urban 5 is the reference group for urban quintiles
Varicella was added to the recommended immunization schedule in October 2004

Source: Manitoba Centre for Health Policy, 2011

Figure 2.43: Manitoba Varicella Immunization Rates, Aged 11

Percent of children who are complete from birth for the Varicella vaccination, 2000/01–2007/08

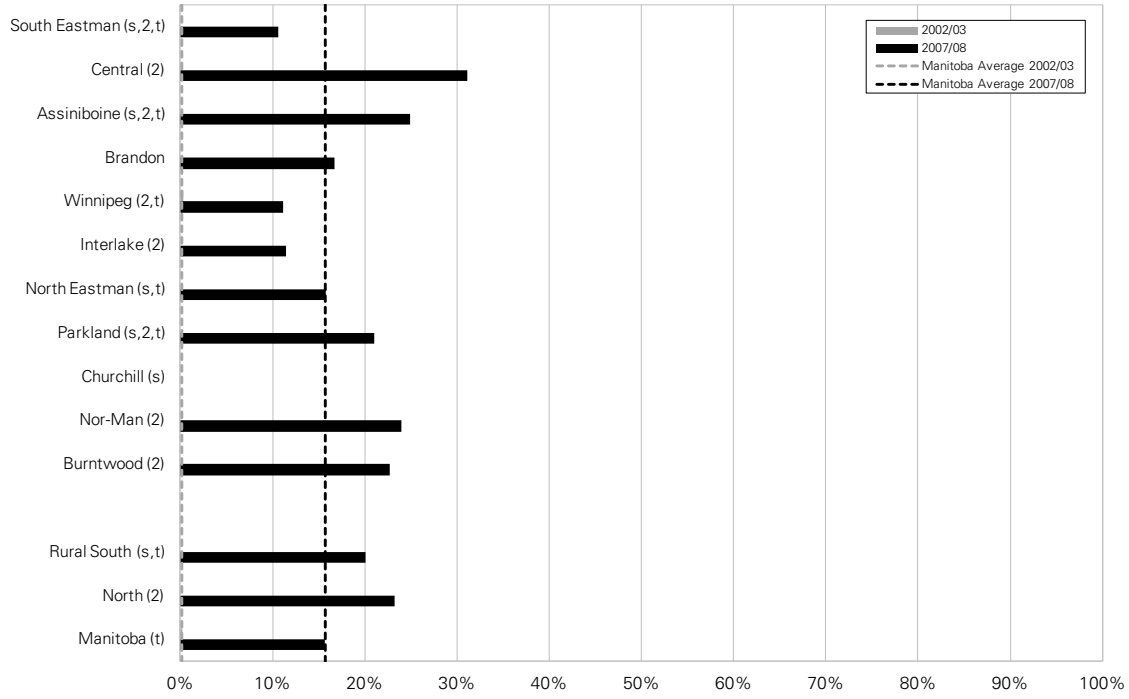


Linear trend test: Complete from birth p<0.0001
'c' indicates the complete from birth rate for this fiscal year was statistically different from the complete from birth rate in 2007/08

Source: Manitoba Centre for Health Policy, 2011

Figure 2.44: RHA Varicella Immunization Rates, Aged 11

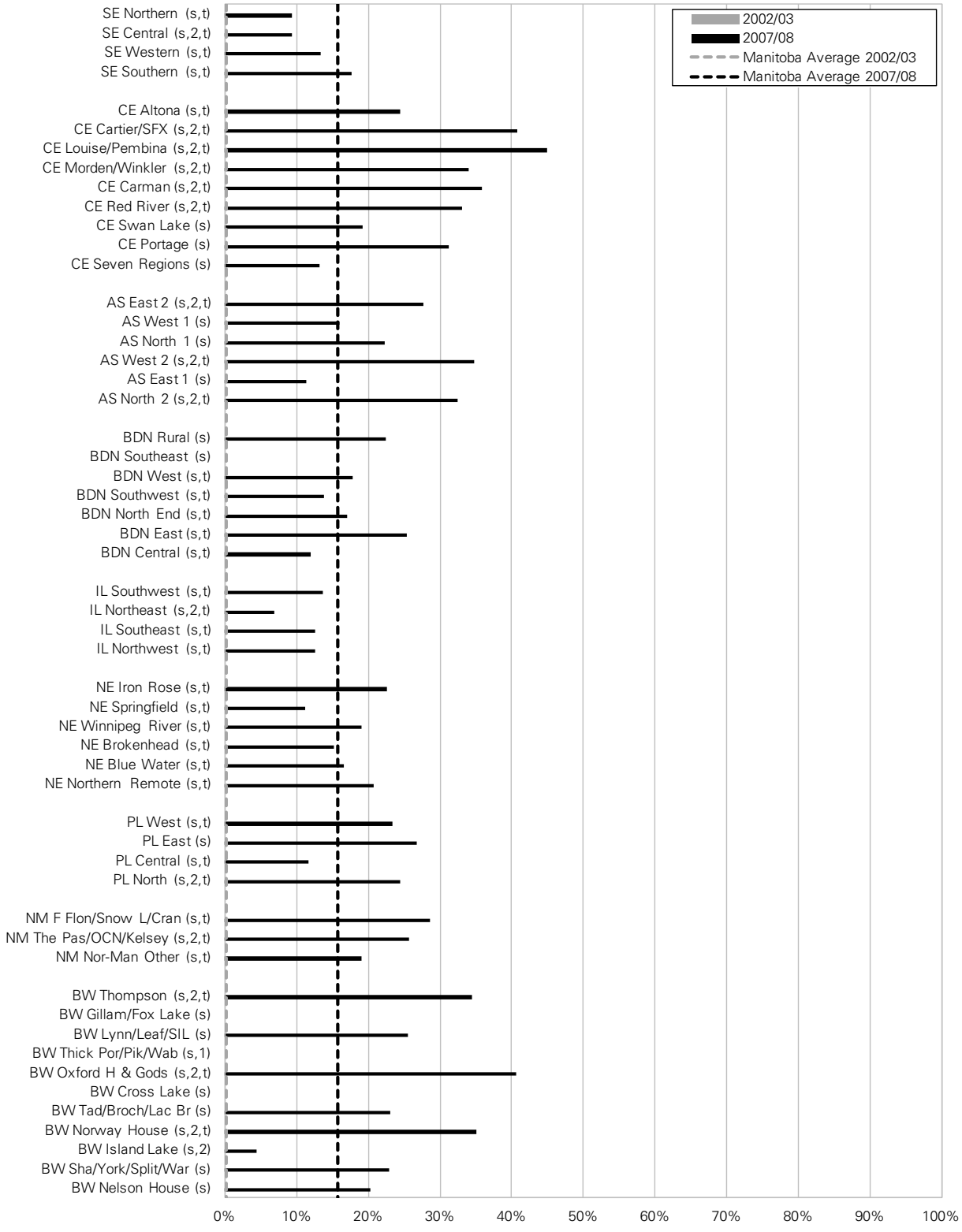
Percent of children who are complete from birth for the varicella vaccination, 2002/03 and 2007/08



'1' indicates area's rate was statistically different from Manitoba average in first time period
'2' indicates area's rate was statistically different from Manitoba average in second time period
't' indicates change over time was statistically significant for that area
's' indicates data suppressed due to small numbers
Varicella was added to the recommended immunization schedule in October 2004

Source: Manitoba Centre for Health Policy, 2011

Figure 2.45: RHA District Varicella Immunization Rates, Aged 11
Percent of children who are complete from birth for the varicella vaccination, 2002/03 and 2007/08

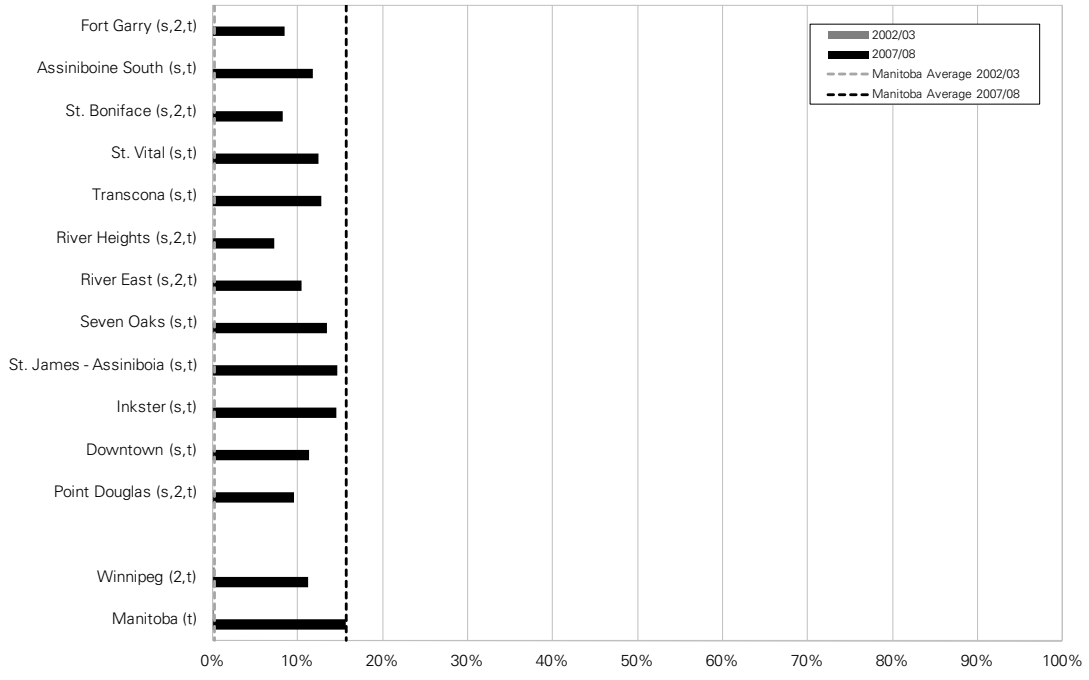


Varicella was added to the recommended immunization schedule in October 2004

Source: Manitoba Centre for Health Policy, 2011

Figure 2.46: Winnipeg CA Varicella Immunization Rates, Aged 11

Percent of children who are complete from birth for the varicella vaccination, 2003/04 and 2007/08

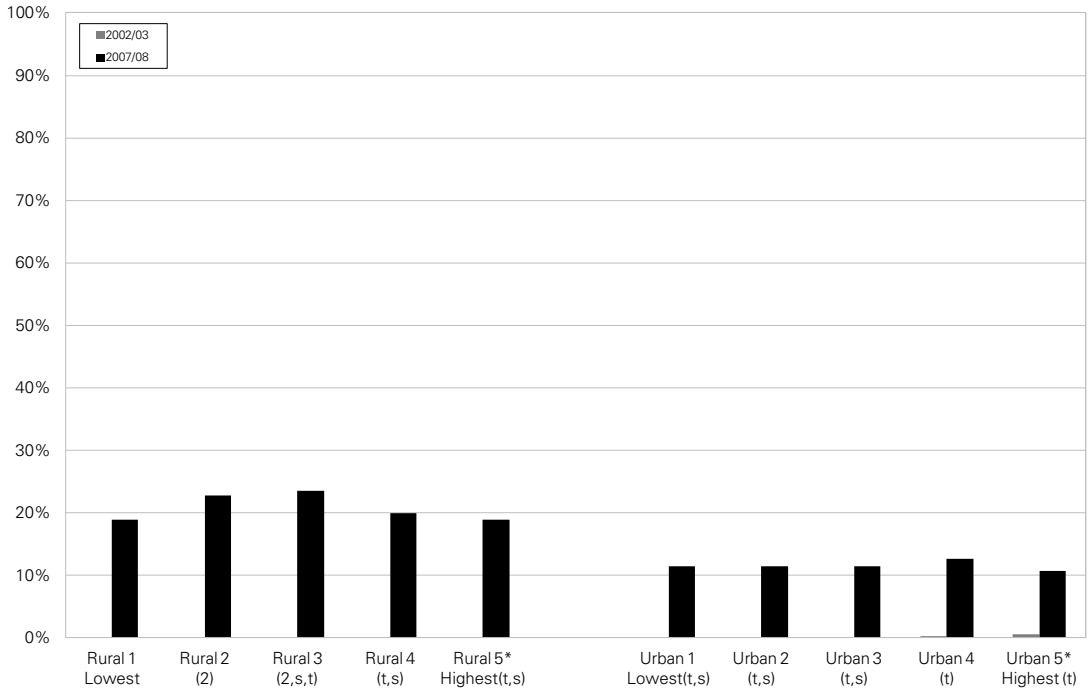


'1' indicates area's rate was statistically different from Manitoba average in first time period
'2' indicates area's rate was statistically different from Manitoba average in second time period
't' indicates change over time was statistically significant for that area
's' indicates data suppressed due to small numbers
Varicella was added to the recommended immunization schedule in October 2004

Source: Manitoba Centre for Health Policy, 2011

Figure 2.47: Varicella Immunization Rates by Income Quintile, Aged 11

Percent of children who are complete from birth for the varicella vaccination, 2002/03 and 2007/08



'1' indicates quintile's rate was statistically different from reference group in first time period
'2' indicates quintile's rate was statistically different from reference group in second time period
't' indicates change over time was statistically significant for that quintile
's' indicates data suppressed due to small numbers
'*' indicates the reference group. Rural 5 is the reference group for rural quintiles; Urban 5 is the reference group for urban quintiles
Varicella was added to the recommended immunization schedule in October 2004

Source: Manitoba Centre for Health Policy, 2011

Table 2.11: Complete from Birth Crude Rates for Tetanus Immunization by Sociodemographic Factors, Aged 2, 2002/03 and 2007/08

Factor	Category	% Complete from Birth	
		2002/03	2007/08
Coverage from Birth	Covered from Birth (t,l) ***Reference***	74.70	76.80
	Not Covered from Birth (1,2,t,l)	43.00	33.70
Income Quintile	Rural 1 (lowest) (1,2)	60.50	62.80
	Rural 2 (1,2)	67.90	68.80
	Rural 3 (2,l)	75.40	73.70
	Rural 4 (2)	74.20	75.00
	Rural 5 (highest) (t) ***Reference***	78.00	82.80
	Urban 1 (lowest) (1,2)	65.00	63.10
	Urban 2 (1,2)	73.50	75.50
	Urban 3	77.40	77.00
	Urban 4	80.10	82.80
	Urban 5 (highest) ***Reference***	80.80	79.40
Mother's Age at Birth	Unknown	75.90	65.70
	18 and younger (1,2)	66.10	65.80
	19-24 (1,2)	67.10	69.20
	25-34 ***Reference***	75.60	75.80
	35 and older	74.60	75.10
Continuity of Care	No Continuity of Care (1,2,t)	68.20	70.80
	Less than 3 Physician Visits* (1,2,l)	44.10	47.50
	Continuity of Care (l) ***Reference***	80.60	81.70
Provider Type	Mixed Providers (1,t,l)	76.10	80.10
	Regional Health Unit (1,2)	69.90	70.90
	Other/Unspecified (1,2)	57.10	58.40
	Physician ***Reference***	78.90	80.30
Region of Residence	Brandon	74.20	75.90
	North (1,2)	62.80	64.10
	Rural South	72.50	74.10
	Winnipeg (1)	74.70	75.00
	Manitoba ***Reference***	72.70	73.60
Number of Children in the Family	1 Child (1,2)	80.70	79.90
	2-3 Children (t,l) ***Reference***	73.10	75.60
	4 or more Children (1,2)	54.10	54.40

'1' indicates quintile's rate was statistically different from reference group in first time period

'2' indicates quintile's rate was statistically different from reference group in second time period

't' indicates change over time was statistically significant

's' indicates data suppressed due to small numbers

'l' indicates a significant linear trend over time

'*' for children with less than 3 physician visits, we were unable to define continuity of care

Source: Manitoba Centre for Health Policy, 2011

Table 2.12: Complete from Birth Crude Rates for Pertussis Immunization by Sociodemographic Factors, Aged 2, 2002/03 and 2007/08

Factor	Category	% Complete from Birth	
		2002/03	2007/08
Coverage from Birth	Covered from Birth (t,l) ***Reference***	74.60	76.80
	Not Covered from Birth (1,2,t,l)	43.00	33.60
Income Quintile	Rural 1 (Lowest) (1,2)	60.50	62.80
	Rural 2 (1,2)	67.80	68.80
	Rural 3 (2,l)	75.30	73.60
	Rural 4 (2)	74.10	75.00
	Rural 5 (highest) (t) ***Reference***	78.00	82.80
	Urban 1 (lowest) (1,2)	64.80	62.90
	Urban 2 (1)	73.30	75.50
	Urban 3	77.10	76.80
	Urban 4	80.10	82.80
	Urban 5 (highest) ***Reference***	80.50	79.40
Mother's Age at Birth	Unknown	75.90	65.70
	18 and younger (1,2)	66.10	65.80
	19-24 (1,2,l)	66.90	69.10
	25-34 ***Reference***	75.50	75.80
	35 and older	74.30	75.00
Continuity of Care	No Continuity of Care (1,2,t)	68.10	70.70
	Less than 3 Physician Visits* (1,2,l)	44.10	47.50
	Continuity of Care (l) ***Reference***	80.40	81.70
Provider Type	Mixed Providers (t,l)	75.90	80.00
	Regional Health Unit (1,2)	69.90	70.90
	Other/Unspecified (1,2)	56.60	58.40
	Physician ***Reference***	78.70	80.20
Region of Residence	Brandon	74.20	75.90
	North (1,2)	62.80	64.10
	Rural South	72.50	74.10
	Winnipeg (1)	74.50	74.90
	Manitoba ***Reference***	72.60	73.50
Number of Children in the Family	1 Child (1,2)	80.70	79.80
	2-3 Children (t,l) ***Reference***	72.90	75.60
	4 or more Children (1,2)	54.00	54.40

'1' indicates quintile's rate was statistically different from reference group in first time period

'2' indicates quintile's rate was statistically different from reference group in second time period

't' indicates change over time was statistically significant

's' indicates data suppressed due to small numbers

'l' indicates a significant linear trend over time

*' for children with less than 3 physician visits, we were unable to define continuity of care

Source: Manitoba Centre for Health Policy, 2011

Table 2.13: Complete from Birth Crude Rates for *Haemophilus influenzae* type B (Hib) Immunization by Sociodemographic Factors, Aged 2, 2002/03 and 2007/08

Factor	Category	% Complete from Birth	
		2002/03	2007/08
Coverage from Birth	Covered from Birth (t)	73.90	76.60
	Not Covered from Birth (1,2,t) ***Reference***	39.60	31.00
Income Quintile	Rural 1 (Lowest) (1,2,l)	60.00	62.70
	Rural 2 (1,2)	67.20	68.60
	Rural 3 (1,2)	69.40	73.20
	Rural 4 (2)	73.90	74.50
	Rural 5 (highest) (t) ***Reference***	77.70	82.50
	Urban 1 (lowest) (1,2)	64.10	61.90
	Urban 2 (1,2)	72.90	74.80
	Urban 3	76.70	76.60
	Urban 4	79.60	82.60
	Urban 5 (highest) ***Reference***	80.40	79.20
Mother's Age at Birth	Unknown (l)	70.40	65.70
	18 and younger (1,2)	64.80	65.40
	19-24 (1,2,l)	66.10	68.70
	25-34 ***Reference***	74.70	75.40
	35 and older	73.40	74.40
Continuity of Care	No Continuity of Care (1,2,t,l)	66.60	70.40
	Less than 3 Physician Visits* (1,2,l)	42.20	46.90
	Continuity of Care (l) ***Reference***	80.10	81.20
Provider Type	Mixed Providers (1,t,l)	74.60	79.00
	Regional Health Unit (1,2,t)	67.50	70.50
	Other/Unspecified (1,2)	54.00	58.40
	Physician ***Reference***	78.50	79.90
Region of Residence	Brandon	73.80	75.30
	North (1,2,t,l)	57.90	63.90
	Rural South	72.10	73.70
	Winnipeg (1,l)	74.00	74.40
	Manitoba (l) ***Reference***	71.70	73.10
Number of Children in the Family	1 Child (1,2)	80.10	79.20
	2-3 Children (t,l) ***Reference***	72.00	75.30
	4 or more Children (1,2)	52.60	54.00

'1' indicates quintile's rate was statistically different from reference group in first time period

'2' indicates quintile's rate was statistically different from reference group in second time period

't' indicates change over time was statistically significant

's' indicates data suppressed due to small numbers

'l' indicates a significant linear trend over time

'*' for children with less than 3 physician visits, we were unable to define continuity of care

Source: Manitoba Centre for Health Policy, 2011

Table 2.14: Complete from Birth Crude Rates for Polio, Aged 2 by Sociodemographic Factors, 2002/03 and 2007/08

Factor	Category	% Complete from Birth	
		2002/03	2007/08
Coverage from Birth	Covered from Birth (l) ***Reference***	91.80	91.80
	Not Covered from Birth (1,2,t,l)	61.20	50.50
Income Quintile	Rural 1 (Lowest) (1,2)	84.60	83.80
	Rural 2 (1,2,l)	88.50	86.70
	Rural 3 (1,l)	89.80	90.30
	Rural 4 (1)	89.70	90.30
	Rural 5 (highest) (l) ***Reference***	92.90	92.40
	Urban 1 (lowest) (1,2,t)	87.00	83.30
	Urban 2	90.70	90.00
	Urban 3	91.70	90.00
	Urban 4 (2)	93.30	93.90
	Urban 5 (highest) ***Reference***	92.50	89.90
Mother's Age at Birth	Unknown (l)	105.60	90.00
	18 and younger	88.90	88.30
	19-24 (1)	87.40	87.90
	25-34 (t,l) ***Reference***	91.00	89.20
	35 and older (l)	90.10	87.70
Continuity of Care	No Continuity of Care (1,2)	88.70	89.10
	Less than 3 Physician Visits* (1,2)	66.20	66.00
	Continuity of Care (l) ***Reference***	94.50	93.80
Provider Type	Mixed Providers (2)	96.20	96.20
	Regional Health Unit (1,2,l)	90.50	90.20
	Other/Unspecified (1,2,l)	82.30	77.90
	Physician ***Reference***	95.20	94.30
Region of Residence	Brandon (2)	92.60	92.20
	North (1,2)	84.50	86.30
	Rural South(l)	89.90	88.70
	Winnipeg (t,l)	90.70	88.80
	Manitoba (t,l) ***Reference***	89.90	88.70
Number of Children in the Family	1 Child (1,2)	94.40	93.00
	2-3 Children (l) ***Reference***	90.10	89.50
	4 or more Children (1,2,l)	79.60	77.70

'1' indicates quintile's rate was statistically different from reference group in first time period

'2' indicates quintile's rate was statistically different from reference group in second time period

't' indicates change over time was statistically significant

's' indicates data suppressed due to small numbers

'l' indicates a significant linear trend over time

'*' for children with less than 3 physician visits, we were unable to define continuity of care

Source: Manitoba Centre for Health Policy, 2011

Table 2.15: Complete from Birth Crude Rates for Pneumococcal Conjugate (PCV-7) Immunization by Sociodemographic Factors, Aged 2, 2002/03 and 2007/08

Factor	Category	% Complete from Birth	
		2002/03	2007/08
Coverage from Birth	Covered from Birth (t,l) ***Reference***	0.10	73.40
	Not Covered from Birth (1,2,l)	0.90	22.80
Income Quintile	Rural 1 (Lowest) (2,t,l)	s	59.40
	Rural 2 (2,l)	0.00	64.00
	Rural 3 (2,l)	0.00	69.70
	Rural 4 (2,l)	0.00	70.30
	Rural 5 (highest) (t,l) ***Reference***	s	77.90
	Urban 1 (lowest) (2,t,l)	s	59.00
	Urban 2 (2,t,l)	s	71.80
	Urban 3 (t,l)	s	72.50
	Urban 4 (t,l)	s	79.10
	Urban 5 (highest) (t,l) ***Reference***	0.70	76.20
Mother's Age at Birth	Unknown (l)	0.00	58.60
	18 and younger (2,l)	0.00	61.90
	19-24 (2,t,l)	s	65.70
	25-34 (t,l) ***Reference***	0.20	71.80
	35 and older (t,l)	0.40	70.40
Continuity of Care	No Continuity of Care (2,t,l)	s	67.00
	Less than 3 Physician Visits* (2,l)	0.00	41.90
	Continuity of Care (t,l) ***Reference***	0.20	77.90
Provider Type	Mixed Providers (2,t,l)	s	72.70
	Regional Health Unit (2,t,l)	s	66.50
	Other/Unspecified (2,t,l)	s	50.40
	Physician (t,l) ***Reference***	0.20	77.20
Region of Residence	Brandon (t,l)	s	72.70
	North (2,t,l)	s	61.50
	Rural South(t,l)	s	69.30
	Winnipeg (t,l)	0.20	71.20
	Manitoba (t,l) ***Reference***	0.20	69.60
Number of Children in the Family	1 Child (2,t,l)	0.20	76.00
	2-3 Children (t,l) ***Reference***	0.20	71.80
	4 or more Children (2,l)	0.00	49.40

'1' indicates quintile's rate was statistically different from reference group in first time period
'2' indicates quintile's rate was statistically different from reference group in second time period
't' indicates change over time was statistically significant
's' indicates data suppressed due to small numbers
'l' indicates a significant linear trend over time
*' for children with less than 3 physician visits, we were unable to define continuity of care
PCV-7 was added to the recommended immunization schedule in October 2004

Source: Manitoba Centre for Health Policy, 2011

Table 2.16: Complete from Birth Crude Rates for Measles Immunization by Sociodemographic Factors, Aged 2, 2002/03 and 2007/08

Factor	Category	% Complete from Birth	
		2002/03	2007/08
Coverage from Birth	Covered from Birth ***Reference***	89.80	89.60
	Not Covered from Birth (1,2,t)	68.40	62.40
Income Quintile	Rural 1 (Lowest) (1,2,l)	84.40	84.60
	Rural 2 (1)	86.60	87.00
	Rural 3 (l)	90.30	89.10
	Rural 4 (1,l)	87.70	88.30
	Rural 5 (highest) (l) ***Reference***	91.60	89.60
	Urban 1 (lowest) (1,2)	83.60	82.20
	Urban 2	89.10	88.90
	Urban 3	90.00	88.10
	Urban 4	92.20	91.00
	Urban 5 (highest) ***Reference***	91.40	89.80
Mother's Age at Birth	Unknown (l)	113.00	101.40
	18 and younger	87.50	86.30
	19-24 (1,2)	86.00	85.60
	25-34 (l) ***Reference***	89.40	88.40
	35 and older	89.00	87.50
Continuity of Care	No Continuity of Care (1,2)	87.40	87.50
	Less than 3 Physician Visits* (1,2,l)	65.10	66.10
	Continuity of Care ***Reference***	92.90	92.70
Provider Type	Mixed Providers (1,2)	94.80	94.50
	Regional Health Unit (1,2)	90.70	90.40
	Other/Unspecified (1,2)	84.80	84.50
	Physician ***Reference***	92.90	92.40
Region of Residence	Brandon	90.50	90.10
	North	86.50	86.60
	Rural South(l)	88.20	87.50
	Winnipeg	88.80	87.60
	Manitoba (l) ***Reference***	88.40	87.60
Number of Children in the Family	1 Child (1,2,t,l)	93.10	91.50
	2-3 Children (t,l) ***Reference***	88.30	88.60
	4 or more Children (1,2,l)	78.80	76.40

'1' indicates quintile's rate was statistically different from reference group in first time period

'2' indicates quintile's rate was statistically different from reference group in second time period

't' indicates change over time was statistically significant

's' indicates data suppressed due to small numbers

'l' indicates a significant linear trend over time

'*' for children with less than 3 physician visits, we were unable to define continuity of care

Source: Manitoba Centre for Health Policy, 2011

Table 2.17: Complete from Birth Crude Rates for Varicella Immunization by Sociodemographic Factors, Aged 2, 2002/03 and 2007/08

Factor	Category	% Complete from Birth	
		2002/03	2007/08
Coverage from Birth	Covered from Birth (t,l) ***Reference***	4.00	78.40
	Not Covered from Birth (1,2,t,l)	7.80	50.60
Income Quintile	Rural 1 (Lowest) (1,2,t,l)	0.80	68.00
	Rural 2 (1,2,t,l)	1.00	70.80
	Rural 3 (1,t,l)	1.60	73.90
	Rural 4 (1,t,l)	2.00	74.60
	Rural 5 (highest) (t,l) ***Reference***	5.40	78.20
	Urban 1 (lowest) (1,2,t,l)	2.10	73.70
	Urban 2 (1,t,l)	4.50	82.10
	Urban 3 (1,t,l)	6.40	78.00
	Urban 4 (1,t,l)	7.80	82.90
	Urban 5 (highest)(t,l) ***Reference***	10.90	79.80
Mother's Age at Birth	Unknown (t,l)	s	78.60
	18 and younger (1,t,l)	0.70	77.00
	19-24 (1,t,l) ***Reference***	1.80	75.30
	25-34 (t,l)	5.00	76.60
	35 and older (1,t,l)	7.20	76.40
Continuity of Care	No Continuity of Care (1,2,t,l)	2.30	75.40
	Less than 3 Physician Visits* (1,2,t,l)	2.20	51.10
	Continuity of Care (t,l) ***Reference***	6.00	82.90
Provider Type	Mixed Providers (1,2,t,l)	4.10	80.70
	Regional Health Unit (1,2,t,l)	1.40	74.30
	Other/Unspecified (2,t,l)	4.00	70.80
	Physician (t,l) ***Reference***	5.70	83.30
Region of Residence	Brandon (2,t,l)	3.50	85.30
	North (1,t,l)	0.80	74.30
	Rural South(1,2,t,l)	2.40	72.20
	Winnipeg (1,2,t,l)	6.20	78.70
	Manitoba (t,l) ***Reference***	4.20	76.30
Number of Children in the Family	1 Child (1,2,t,l)	7.00	82.50
	2-3 Children (t,l) ***Reference***	3.70	77.60
	4 or more Children (1,2,t,l)	0.90	59.80

'1' indicates quintile's rate was statistically different from reference group in first time period

'2' indicates quintile's rate was statistically different from reference group in second time period

't' indicates change over time was statistically significant

's' indicates data suppressed due to small numbers

'l' indicates a significant linear trend over time

*' for children with less than 3 physician visits, we were unable to define continuity of care

Varicella was added to the recommended immunization schedule in October 2004

Source: Manitoba Centre for Health Policy, 2011

Table 2.18: Complete from Birth Crude Rates for Varicella Immunization by Sociodemographic Factors, Aged 7, 2002/03 and 2007/08

Factor	Category	% Complete from Birth	
		2002/03	2007/08
Coverage from Birth	Covered from Birth (t,l) ***Reference***	0.80	31.30
	Not Covered from Birth (1,2,t,l)	1.60	26.00
Income Quintile	Rural 1 (Lowest) (1,2,t,l)	s	23.80
	Rural 2 (2,t,l)	s	26.90
	Rural 3 (1,2,t,l)	s	28.10
	Rural 4 (t,l)	0.60	32.30
	Rural 5 (highest) (t,l) ***Reference***	1.20	34.10
	Urban 1 (lowest) (1,2,t,l)	0.60	24.60
	Urban 2 (1,2,t,l)	0.90	28.70
	Urban 3 (1,t,l)	1.00	33.60
	Urban 4 (t,l)	1.80	35.30
	Urban 5 (highest) (t,l) ***Reference***	2.20	36.40
Mother's Age at Birth	Unknown (t,l)	s	19.80
	18 and younger (1,2,t,l)	s	24.20
	19-24 (1,2,t,l)	0.50	26.80
	25-34 (t,l) ***Reference***	1.20	31.80
	35 and older (t,l)	1.10	34.60
Continuity of Care	No Continuity of Care (1,2,t,l)	0.70	32.30
	Less than 3 Physician Visits* (1,2,t,l)	0.60	24.80
	Continuity of Care (t,l) ***Reference***	1.40	35.60
Provider Type	Mixed Providers (2,t,l)	0.90	38.00
	Regional Health Unit (1,2,t,l)	0.50	25.10
	Other/Unspecified (2,t,l)	s	17.40
	Physician (t,l) ***Reference***	1.20	33.20
Region of Residence	Brandon (2,t,l)	1.00	42.40
	North (1,2,t,l)	s	24.30
	Rural South(t,l)	0.60	29.80
	Winnipeg (1,t,l)	1.30	31.20
	Manitoba (t,l) ***Reference***	0.90	30.40
Number of Children in the Family	1 Child (t,l)	0.80	33.60
	2-3 Children (t,l) ***Reference***	1.10	32.50
	4 or more Children (1,2,t,l)	0.30	22.10

'1' indicates quintile's rate was statistically different from reference group in first time period

'2' indicates quintile's rate was statistically different from reference group in second time period

't' indicates change over time was statistically significant

's' indicates data suppressed due to small numbers

'l' indicates a significant linear trend over time

*' for children with less than 3 physician visits, we were unable to define continuity of care

Varicella was added to the recommended immunization schedule in October 2004

Source: Manitoba Centre for Health Policy, 2011

Table 2.19: Complete from Birth Crude Rates for Varicella Immunization by Sociodemographic Factors, Aged 11, 2002/03 and 2007/08

Factor	Category	% Complete from Birth	
		2002/03	2007/08
Coverage from Birth	Covered from Birth (t,l) ***Reference***	0.10	15.60
	Not Covered from Birth (1,t,l)	0.30	16.10
Income Quintile	Rural 1 (Lowest) (l)	0.00	18.90
	Rural 2 (2,l)	0.00	22.80
	Rural 3 (2,t,l)	s	23.50
	Rural 4 (t,l)	s	20.00
	Rural 5 (highest) (t,l) ***Reference***	s	18.90
	Urban 1 (lowest) (t,l)	s	11.50
	Urban 2 (t,l)	s	11.50
	Urban 3 (t,l)	s	11.50
	Urban 4 (t,l)	0.30	12.70
	Urban 5 (highest) (t,l) ***Reference***	0.50	10.70
Mother's Age at Birth	Unknown (t,l)	0.00	14.90
	18 and younger (t,l)	0.00	14.50
	19-24 (t,l)	s	15.40
	25-34 (t,l) ***Reference***	0.20	15.30
	35 and older (2,t,l)	0.40	18.80
Continuity of Care	No Continuity of Care (t,l)	0.10	16.30
	Less than 3 Physician Visits* (1,t,l)	0.10	15.50
	Continuity of Care (t,l) ***Reference***	0.30	15.40
Provider Type	Mixed Providers (2,t,l)	0.20	17.90
	Regional Health Unit (2,t,l)	0.20	17.00
	Other/Unspecified (2,l)	s	9.90
	Physician (t,l) ***Reference***	s	4.20
Region of Residence	Brandon (l)	0.00	16.70
	North (2,l)	0.00	23.20
	Rural South(2,t,l)	s	20.10
	Winnipeg (2,t,l)	0.30	11.30
	Manitoba (t,l) ***Reference***	0.20	15.70
Number of Children in the Family	1 Child (2,t,l)	0.30	19.20
	2-3 Children (t,l) ***Reference***	0.20	14.90
	4 or more Children (t,l)	s	15.50

'1' indicates quintile's rate was statistically different from reference group in first time period

'2' indicates quintile's rate was statistically different from reference group in second time period

't' indicates change over time was statistically significant

's' indicates data suppressed due to small numbers

'l' indicates a significant linear trend over time

*' for children with less than 3 physician visits, we were unable to define continuity of care

Varicella was added to the recommended immunization schedule in October 2004

Source: Manitoba Centre for Health Policy, 2011

Table 2.20: Children Registered with Manitoba Health for Insured Benefits by Year, Aged 7

Coverage	Age	2000/01		2001/02		2002/03		2003/04		2004/05		2005/06		2006/07		2007/08	
		n	(%)	n	(%)	n	(%)	n	(%)	n	(%)	n	(%)	n	(%)	n	(%)
Not Covered From Birth	7	2,421	14.5	2,194	13.4	2,249	14.0	2,328	14.9	2,316	15.4	2,298	15.4	2,491	16.4	2,473	16.7
Covered From Birth		14,269	85.5	14,232	86.6	13,802	86.0	13,247	85.1	12,704	84.6	12,670	84.6	12,683	83.6	12,333	83.3

Source: Manitoba Centre for Health Policy, 2011

The Pre–school Booster: Overview

Manitoba's immunization schedule recommends immunization with diphtheria, tetanus, pertussis, polio (DTaP–IPV), MMR, and varicella (if not immune) at age four to six. These vaccinations comprise the pre–school booster. Table 2.20 defines the continuously registered and not continuously registered populations by year for age seven.

The Pre–school Booster—Tetanus and Diphtheria

Five doses of tetanus toxoid are recommended and required before age seven to be considered complete for age from birth. Immunization rates for tetanus at seven years of age over an eight year period are presented in Figure 2.48. In 2007/08, 94% of children in Manitoba had received one or more tetanus immunizations with 73% receiving the complete five dose series and 21% receiving between one and four doses. This analysis indicates that 6% of children had no record of any tetanus immunizations. The trend over time appears to be declining with rates for both complete and complete plus partial from birth lower in 2007/08 than in 2000/01, 2001/02, 2002/03, and 2003/04. Most partially immunized children had four of five tetanus toxoid doses (Figure 2.49). Although five doses are recommended, it is reassuring that the majority of children who were partially immunized received four of five doses (Figure 2.49). Figure 2.50 illustrates that some of the decline in complete from birth at age seven in this cohort was due to missed pre–school boosters as in 2000/01—88% of children received their fifth dose between age four and seven while only 84% of four– to seven–year–olds received their final dose in 2007/08.

The next analysis looks at the RHA rates of tetanus immunization at age seven at two different time points, 2002/03 and 2007/08 (Figure 2.51). South Eastman, Brandon, and Winnipeg experienced increases in immunization rates from 2002/03 to 2007/08. In 2007/08, Central, Assiniboine, Parkland, and NOR–MAN rates were significantly above the Manitoba average while the Winnipeg and Burntwood RHA rates were below the Manitoba average.

Figures 2.52 and 2.53 illustrate RHA districts and Winnipeg CAs differences with some fairly striking variation. Using the North Eastman (NE) RHA in 2007/08 as an example, we see that complete from birth immunization rates for tetanus in the Iron Rose district (89%) is noticeably higher than those in the Northern Remote district (64%). In 2007/08, similar differences between the Winnipeg CAs are seen with Transcona at 81% and Point Douglas at 61%.

The relationship between socioeconomic status and immunization status in both rural and urban settings is illustrated in Figure 2.54. Seven–year–old children from lower income quintiles are less likely to have five doses of tetanus toxoid administered than those in higher income quintiles.

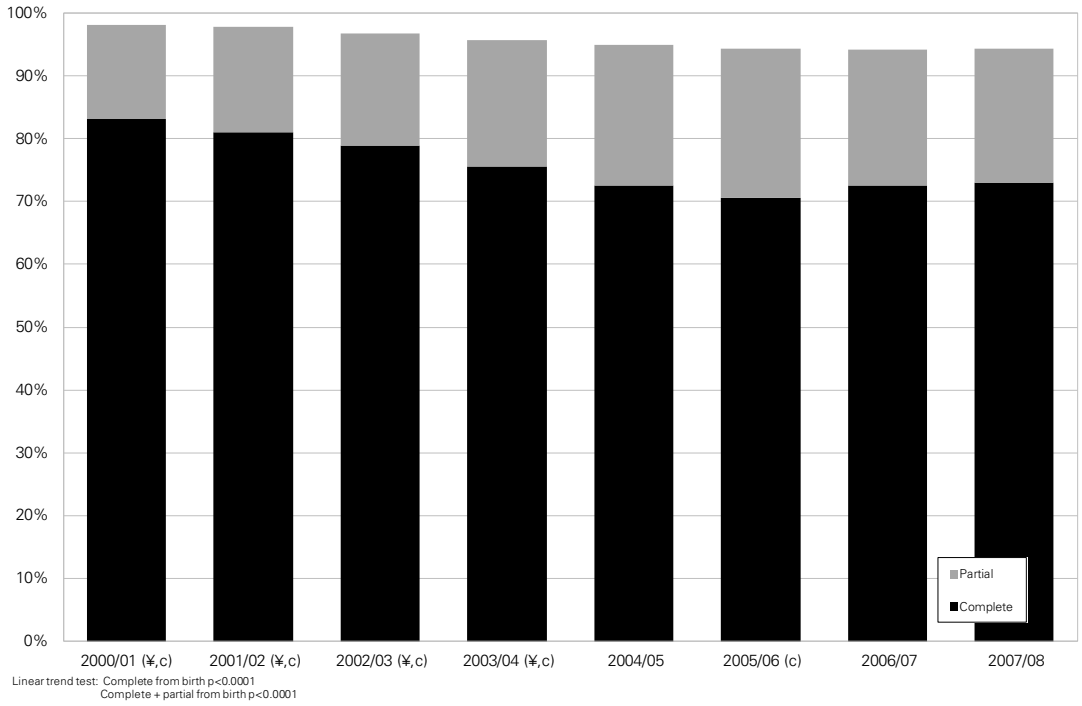
In order to better understand the factors that are associated with receiving five doses of tetanus antigen by age seven, logistic regression models were developed (Table 2.21). The complete from birth crude tetanus immunization rates by sociodemographic factors can be found at the end of this section in Table 2.25.

Children who were not continuously registered with Manitoba Health from birth were significantly less likely to have five doses of tetanus than those who were continuously registered. For example, in 2007/08, only 36% of those children who were not continuously registered had received all recommended doses according to their MIMS record compared to 81% of those who were continuously registered from birth (Table 2.25). This likely represents an underreporting of rates in this group as updating MIMS with vaccine doses delivered in another jurisdiction requires manual input and

happens to varying degrees depending on location and provider type. The impact on rates overall is dependent on the proportion of the total population that fall into this category. Table 2.20 presents the continuously registered and not continuously registered populations by year. Some of the observed decline over time is due to an increase in the proportion of non–continuously registered seven–year–olds from 13% in 2001/02 to 17% in 2007/08. Complete for age from birth coverage in this group dropped by 14% between 2001/02 and 2007/08. However, the entire decline is not due to declining coverage in non–continuously registered seven–year–olds as the rate in continuously registered seven–year–olds declined from 84% to 81% over the same period. Maternal age at birth, once again, plays a role in coverage rates—mothers aged 24 and younger were less likely to have their child receive all five tetanus doses by age seven than mothers aged 25 –34. This finding is not surprising and has been noted elsewhere in the literature (Wiecha & Gann, 1994; Luman, McCauley, Shefer, & Chu, 2003). Male and female children were equally as likely to be fully immunized against tetanus while children from families with four or more children were less likely to be completely immunized when compared to children from families with two or three children.

There was no difference in coverage rates based on whether physicians or regional health units delivered the five doses. In fact, children who received vaccinations from a mix of providers had a higher likelihood of receiving all doses. Higher levels of interaction with the system may mean that a child is more likely to be immunized. Continuity of care was significantly associated with complete tetanus coverage as children who did not have continuity of care were less likely to receive a complete series (Martens et al., 2008; Mennito & Darden, 2010).

Figure 2.48: Manitoba Tetanus Immunization Rates, Aged 7
Percent of children who are complete/partial from birth for the tetanus vaccination, 2000/01–2007/08

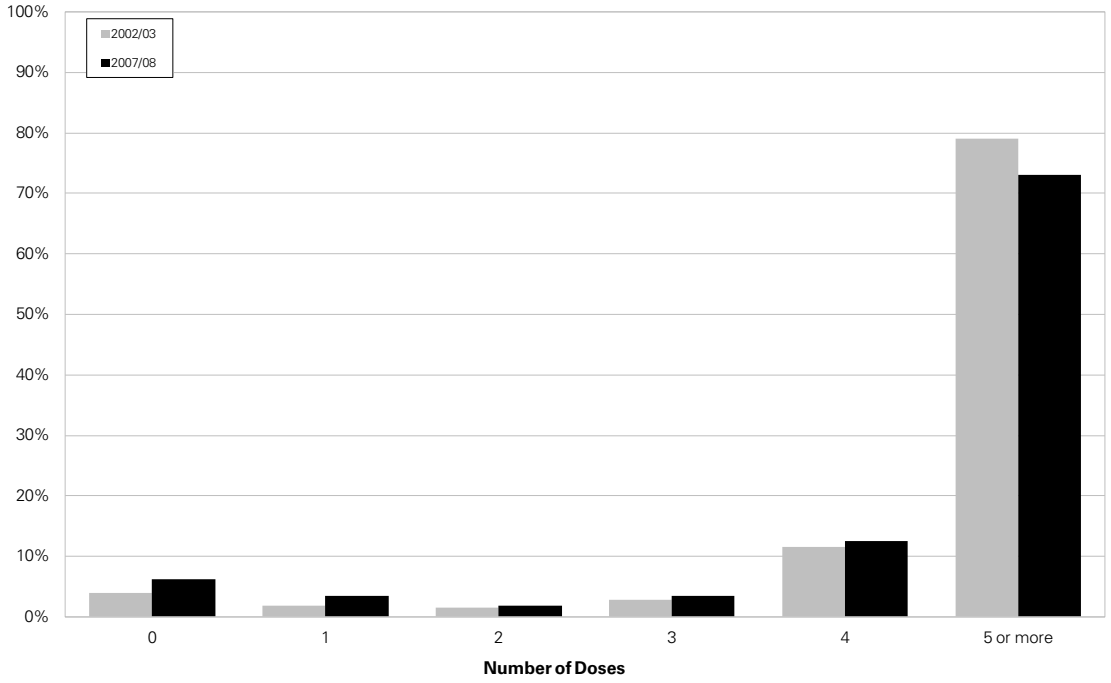


Linear trend test: Complete from birth p<0.0001
Complete + partial from birth p<0.0001

'c' indicates the complete from birth rate for this fiscal year, was statistically different from the complete from birth rate in 2007/08
'¥' indicates the complete + partial from birth rate for this fiscal year was statistically different from the complete + partial from birth rate in 2007/08

Source: Manitoba Centre for Health Policy, 2011

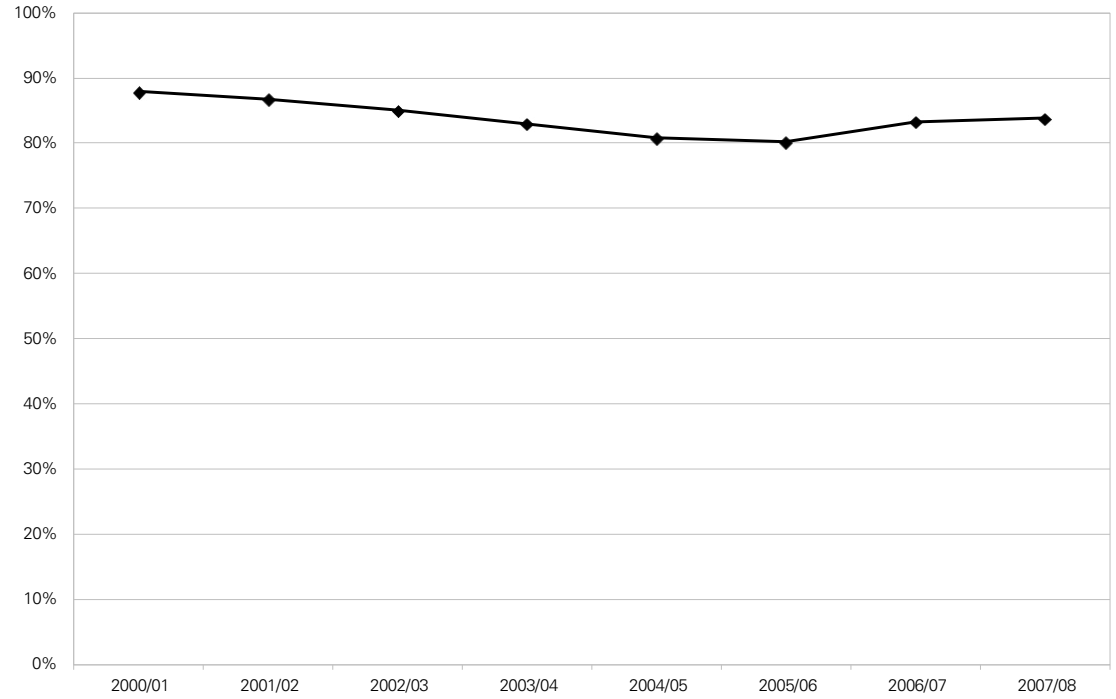
Figure 2.49: Tetanus Immunization Rates by the Number of Doses Received, Aged 7, 2002/03 and 2007/08



Source: Manitoba Centre for Health Policy, 2011

Figure 2.50: Pre-School Tetanus Booster Rates, Aged 7

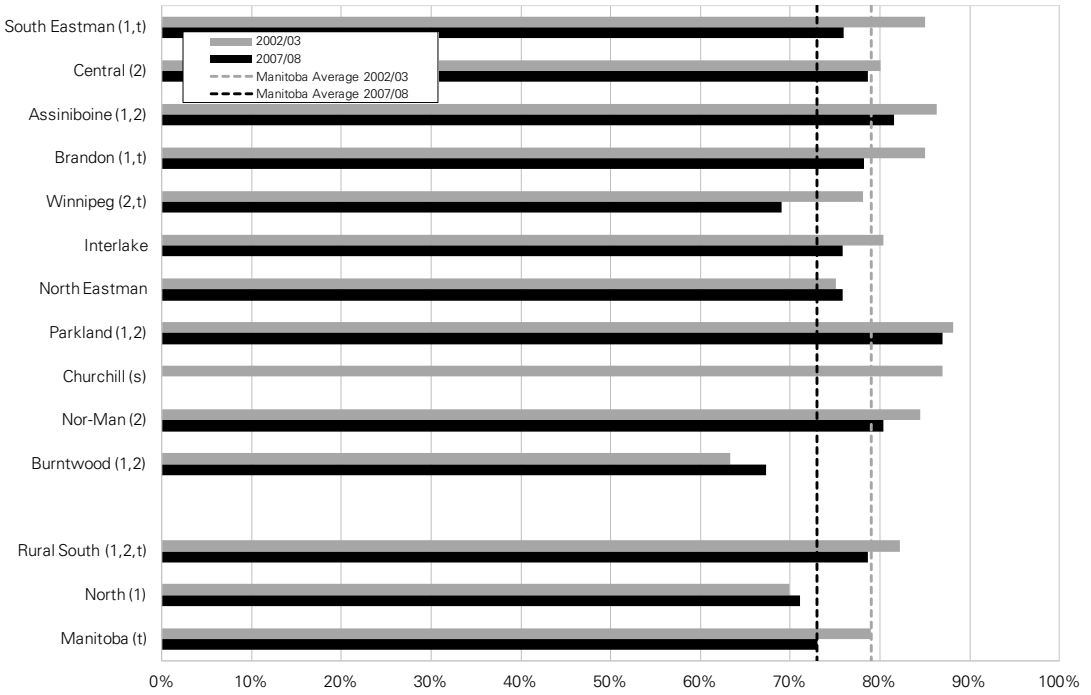
Percent of children who received a tetanus immunization after age 4 and by age 7



Source: Manitoba Centre for Health Policy, 2011

Figure 2.51: RHA Tetanus Immunization Rates, Aged 7

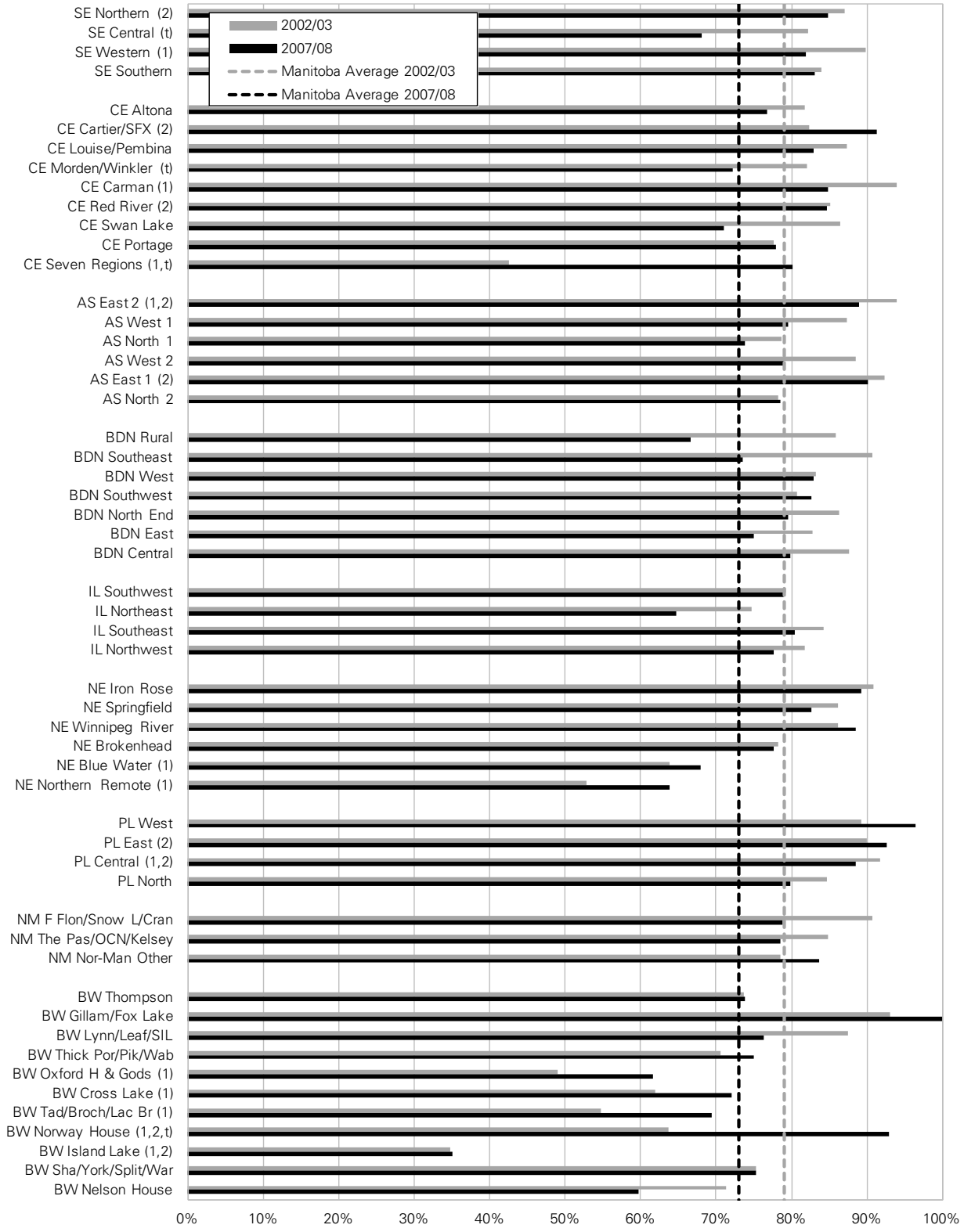
Percent of children who are complete from birth for the tetanus vaccination, 2002/03 and 2007/08



'1' indicates area's rate was statistically different from Manitoba average in first time period
'2' indicates area's rate was statistically different from Manitoba average in second time period
't' indicates change over time was statistically significant for that area
's' indicates data suppressed due to small numbers

Source: Manitoba Centre for Health Policy, 2011

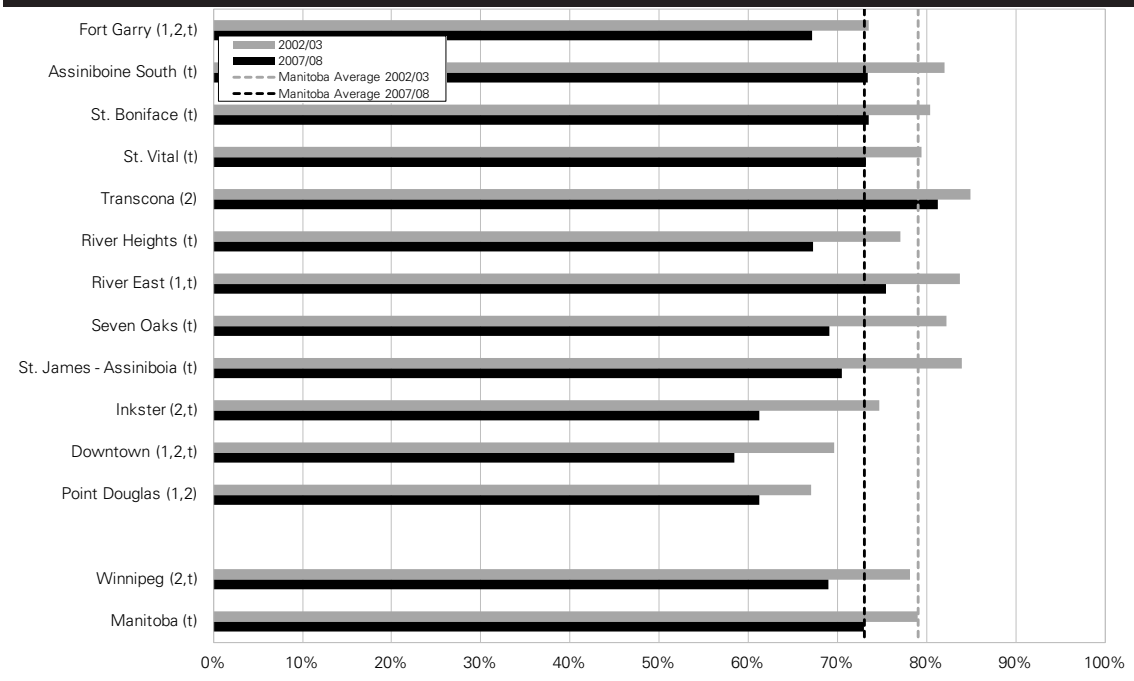
Figure 2.52: RHA District Tetanus Immunization Rates, Aged 7
Percent of children who are complete from birth for the tetanus vaccination, 2002/03 and 2007/08



Source: Manitoba Centre for Health Policy, 2011

Figure 2.53: Winnipeg CA Tetanus Immunization Rates, Aged 7

Percent of children who are complete from birth for the tetanus vaccination, 2002/03 and 2007/08

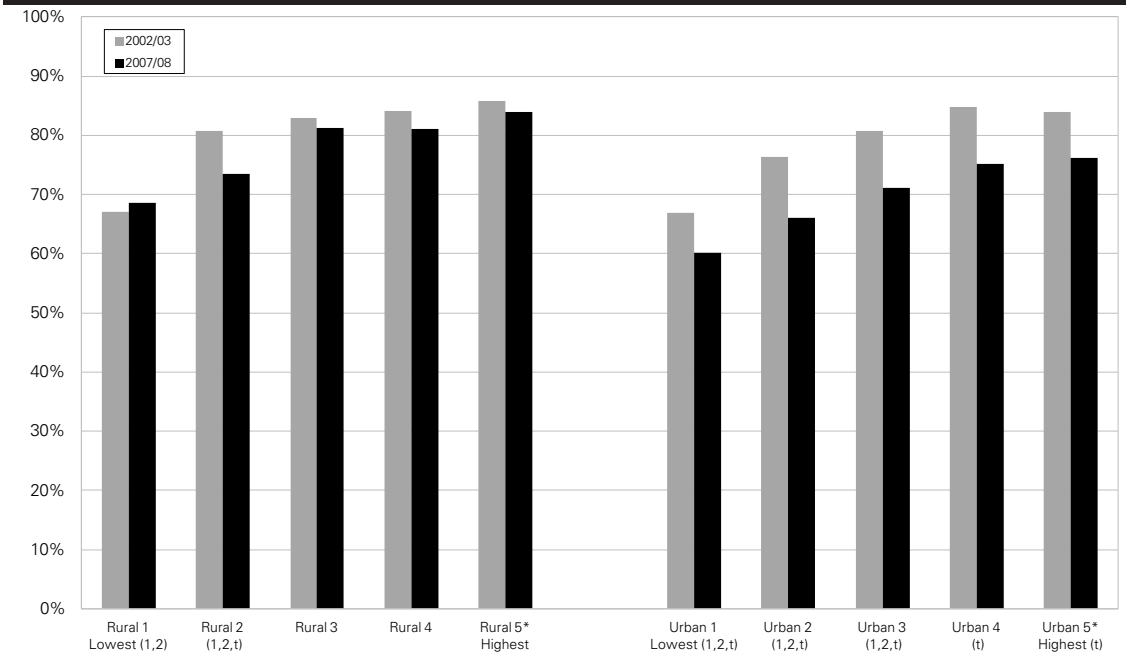


'1' indicates area's rate was statistically different from Manitoba average in first time period
'2' indicates area's rate was statistically different from Manitoba average in second time period
't' indicates change over time was statistically significant for that area
's' indicates data suppressed due to small numbers

Source: Manitoba Centre for Health Policy, 2011

Figure 2.54: Tetanus Immunization Rates by Income Quintile, Aged 7

Percent of children who are complete from birth for the tetanus vaccination, 2002/03 and 2007/08



'1' indicates quintile's rate was statistically different from reference group in first time period
'2' indicates quintile's rate was statistically different from reference group in second time period
't' indicates change over time was statistically significant for that quintile
's' indicates data suppressed due to small numbers
'*' indicates the reference group. Rural 5 is the reference group for rural quinitiles; Urban 5 is the reference group for urban quintiles

Source: Manitoba Centre for Health Policy, 2011

Table 2.21: Factors Associated with Being Complete from Birth for the Tetanus Immunization, Aged 7
Adjusted Odds Ratio (95% Confidence Interval), 2007/08

Factor	Category	Adjusted Odds Ratio (95% CI)	
		Model 1	Model 2
Coverage from Birth	Covered from Birth	***Reference***	***Reference***
	Not Covered from Birth	0.15 (0.14,0.17)	0.12 (0.11,0.13)
Income Quintile	Quintile 1 (lowest)	0.45 (0.39,0.52)	0.49 (0.43,0.56)
	Quintile 2	0.64 (0.55,0.74)	0.67 (0.58,0.77)
	Quintile 3	0.84 (0.72,0.98)	0.84 (0.73,0.97)
	Quintile 4	0.90 (0.77,1.04)	0.92 (0.80,1.07)
	Quintile 5 (highest)	***Reference***	***Reference***
Mother's Age at Birth	Unknown	0.34 (0.18,0.65)	0.30 (0.17,0.53)
	18 and younger	0.79 (0.66,0.95)	0.89 (0.75,1.07)
	19-24	0.84 (0.76,0.93)	0.86 (0.78,0.95)
	25-34	***Reference***	***Reference***
	35 and older	1.06 (0.92,1.22)	0.97 (0.86,1.11)
Continuity of Care	No Continuity of Care	0.84 (0.74,0.94)	0.86 (0.77,0.97)
	Less than 3 Physician Visits*	0.57 (0.51,0.64)	0.49 (0.44,0.54)
	Continuity of Care	***Reference***	***Reference***
Provider Type	Mixed Providers	1.63 (1.43,1.86)	
	Regional Health Unit	1.13 (0.97,1.31)	
	Other/Unspecified	0.50 (0.36,0.68)	
	Physician	***Reference***	
Region of Residence	Brandon	1.59 (1.24,2.04)	1.95 (1.55,2.46)
	North	1.11 (0.92,1.34)	1.45 (1.25,1.67)
	Rural South	1.88 (1.67,2.13)	2.19 (1.98,2.41)
	Winnipeg	***Reference***	***Reference***
Sex of Child	Male	0.95 (0.87,1.03)	0.98 (0.91,1.07)
	Female	***Reference***	***Reference***
Number of Children in the Family	1 Child	0.89 (0.78,1.01)	0.87 (0.77,0.98)
	2-3 Children	***Reference***	***Reference***
	4 or more Children	0.53 (0.48,0.59)	0.52 (0.47,0.58)

Model 1–children with no immunizations are excluded from the adjusted model

Model 2–children with no immunizations are included in the adjusted model; provider type not included as a covariate

'*' for children with less than 3 physician visits, we were unable to define continuity of care

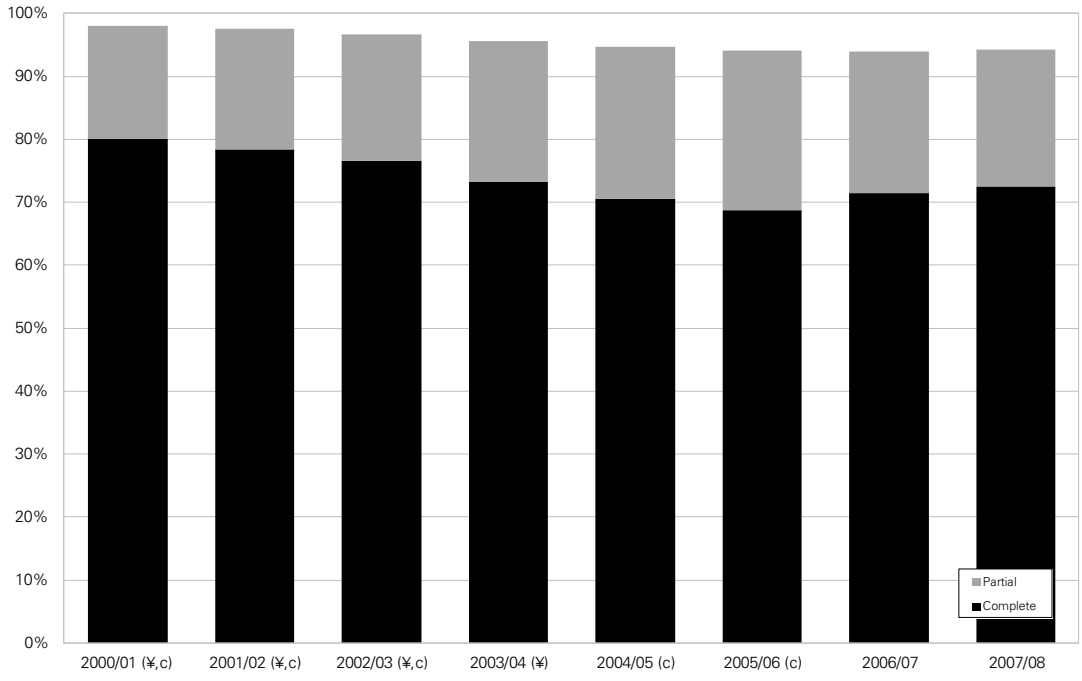
Source: Manitoba Centre for Health Policy, 2011

The Pre–school Booster—Pertussis

Five doses of the pertussis antigen are recommended and required by age seven to be considered complete for age from birth. The pertussis antigen is delivered to children aged four to six as part of the DTaP–IPV (**Quadracel®**) **quadrivalent** vaccine. In 2007/08, 73% of Manitoba's seven–year–olds had received all five recommended doses with 94% receiving at least one dose (Figure 2.55). Although the proportion of children complete for age from birth has improved since 2004/05, rates appear to have significantly declined from 2000/01 when 80% were complete for age from birth. As discussed in the previous section, some of the observed decline over time is due to an increase in proportion of non–continuously registered seven–year–olds from 14% in 2002/03 to 17% in 2007/08 (Table 2.20). Complete for age from birth immunization rate in this group dropped by 13% between 2002/03 and 2007/08. However, the entire decline is once again not due to declining coverage in non–continuously registered seven–year–olds as the rate in continuously registered seven–year–olds also declined from 81% to 80% over the same period (Table 2.26). While rates decreased between 2002/03 and 2007/08 in all regions, with the notable exception of North Eastman where there was a statistically significant increase, statistically significant declines were noted in South Eastman, Brandon, and Winnipeg (Figure 2.56). RHA district and Winnipeg CA rates are shown in Figures 2.57 and 2.58.

Once again the positive association between income quintile and complete for age from birth is noted (Figure 2.59 and Table 2.22). Although provider type was not significantly associated with complete from birth immunization rates, continuity of care was once again noted to contribute to complete for age from birth status. Having three or more siblings was associated with lower rates.

Figure 2.55: Manitoba Pertussis Immunization Rates, Aged 7
Percent of children who are complete/partial from birth for the pertussis vaccination, 2000/01–2007/08



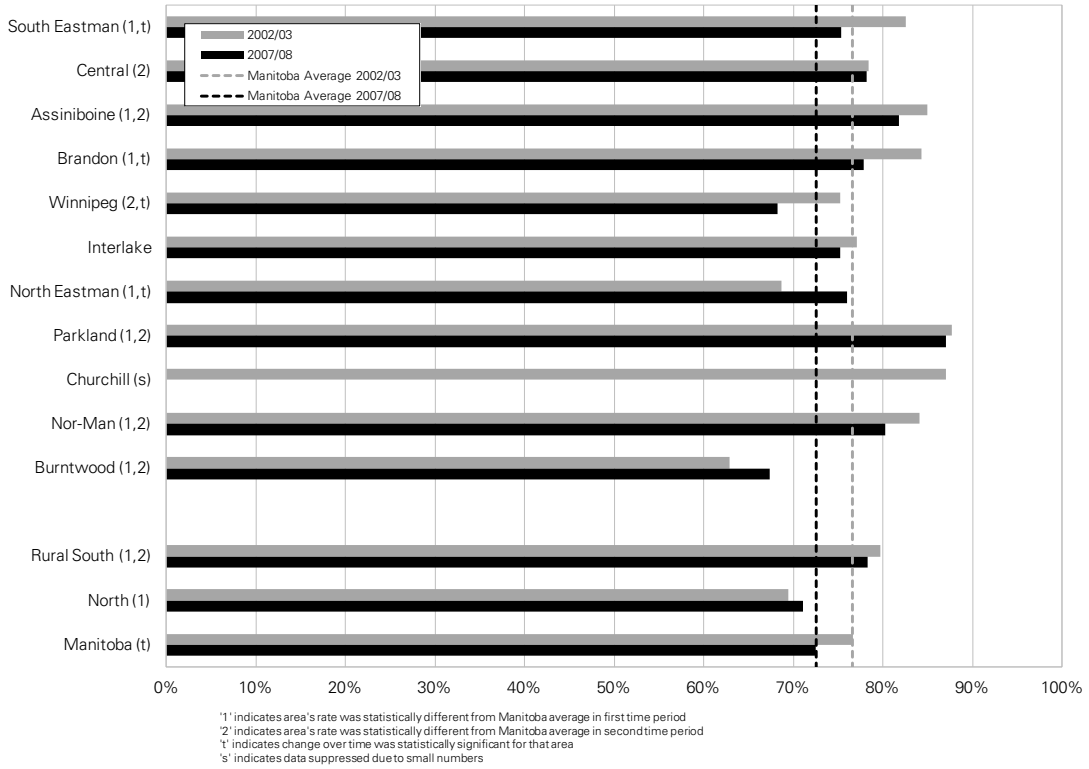
Linear trend test: Complete from birth p<0.0001
Complete + partial from birthp<0.0001

'c' indicates the complete from birth for this fiscal year was statistically different from the complete from birth rate in 2007/08
'¥' indicates the complete + partial from birth rate was statistically different in this fiscal year from the complete + partial from birth rate in 2007/08

Source: Manitoba Centre for Health Policy, 2011

Figure 2.56: RHA Pertussis Immunization Rates, Aged 7

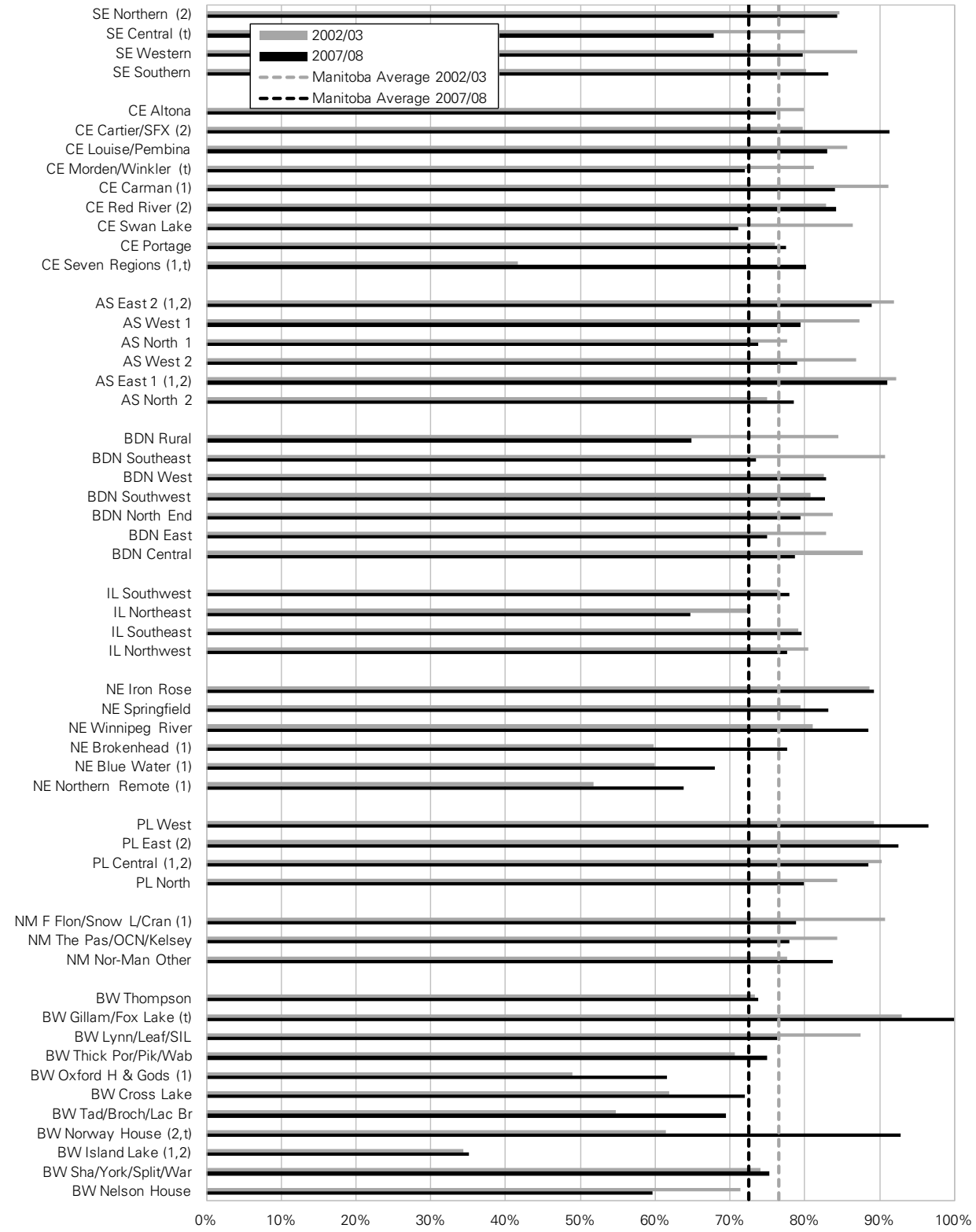
Percent of children who are complete from birth for the pertussis vaccination, 2002/03 and 2007/08



'1' indicates area's rate was statistically different from Manitoba average in first time period
'2' indicates area's rate was statistically different from Manitoba average in second time period
't' indicates change over time was statistically significant for that area
's' indicates data suppressed due to small numbers

Source: Manitoba Centre for Health Policy, 2011

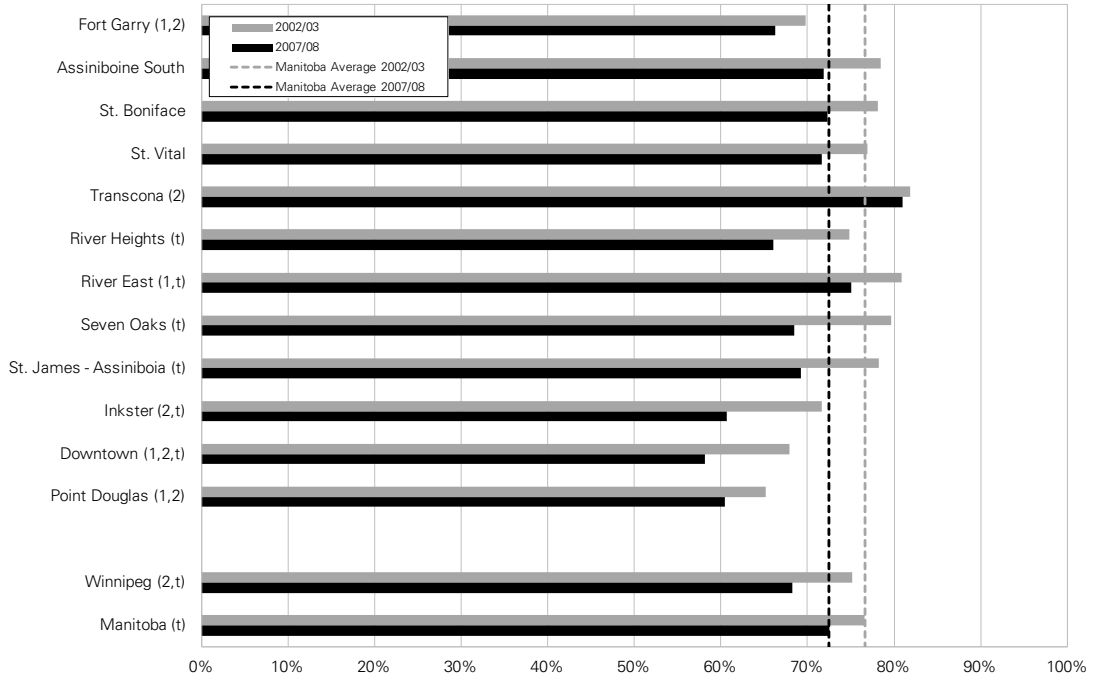
Figure 2.57: RHA District Pertussis Immunization Rates, Aged 7
Percent of children who are complete from birth for the pertussis vaccination, 2002/03 and 2007/08



Source: Manitoba Centre for Health Policy, 2011

Figure 2.58: Winnipeg CA Pertussis Immunization Rates, Aged 7

Percent of children who are complete from birth for the pertussis vaccination, 2002/03 and 2007/08

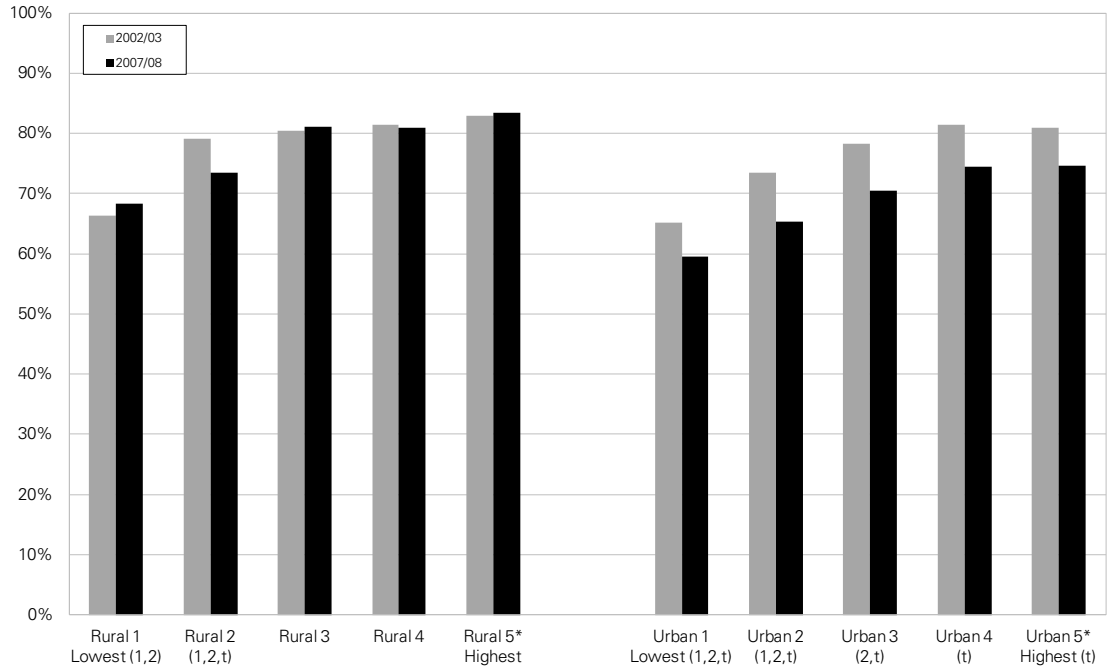


'1' indicates area's rate was statistically different from Manitoba average in first time period
'2' indicates area's rate was statistically different from Manitoba average in second time period
't' indicates change over time was statistically significant for that area
's' indicates data suppressed due to small numbers

Source: Manitoba Centre for Health Policy, 2011

Figure 2.59: Pertussis Immunization Rates by Income Quintile, Aged 7

Percent of children who are complete from birth for the pertussis vaccination 2002/03 and 2007/08



'1' indicates quintile's rate was statistically different from reference group in first time period
'2' indicates quintile's rate was statistically different from reference group in second time period
't' indicates change over time was statistically significant for that quintile
's' indicates data suppressed due to small numbers
'*' indicates the reference group. Rural 5 is the reference group for rural quintiles; Urban 5 is the reference group for urban quintiles

Source: Manitoba Centre for Health Policy, 2011

Table 2.22: Factors Associated with Being Complete from Birth for the Pertussis Immunization, Aged 7
Adjusted Odds Ratio (95% Confidence Interval), 2007/08

Factor	Category	Adjusted Odds Ratio (95% CI)	
		Model 1	Model 2
Coverage from Birth	Covered from Birth	***Reference***	***Reference***
	Not Covered from Birth	0.16 (0.14,0.18)	0.12 (0.11,0.14)
Income Quintile	Quintile 1 (lowest)	0.48 (0.42,0.55)	0.51 (0.45,0.58)
	Quintile 2	0.67 (0.58,0.78)	0.70 (0.61,0.80)
	Quintile 3	0.88 (0.76,1.02)	0.88 (0.76,1.01)
	Quintile 4	0.94 (0.81,1.09)	0.96 (0.84,1.11)
	Quintile 5 (highest)	***Reference***	***Reference***
Mother's Age at Birth	Unknown	0.48 (0.42,0.55)	0.51 (0.45,0.58)
	18 and younger	0.67 (0.58,0.78)	0.70 (0.61,0.80)
	19-24	0.88 (0.76,1.02)	0.87 (0.79,0.96)
	25-34	***Reference***	***Reference***
	35 and older	1.04 (0.91,1.20)	0.96 (0.85,1.09)
Continuity of Care	No Continuity of Care	0.82 (0.73,0.92)	0.85 (0.76,0.95)
	Less than 3 Physician Visits*	0.57 (0.51,0.63)	0.49 (0.44,0.54)
	Continuity of Care	***Reference***	***Reference***
Provider Type	Mixed Providers	1.65 (1.45,1.88)	
	Regional Health Unit	1.16 (1.00,1.35)	
	Other/Unspecified	0.46 (0.34,0.64)	
	Physician	***Reference***	
Region of Residence	Brandon	1.60 (1.25,2.05)	1.97 (1.57,2.48)
	North	1.13 (0.94,1.36)	1.50 (1.30,1.73)
	Rural South	1.91 (1.69,2.15)	2.23 (2.03,2.46)
	Winnipeg	***Reference***	***Reference***
Sex of Child	Male	0.94 (0.86,1.02)	0.97 (0.90,1.05)
	Female	***Reference***	***Reference***
Number of Children in the Family	1 Child	0.90 (0.79,1.02)	0.88 (0.78,1.00)
	2-3 Children	***Reference***	***Reference***
	4 or more Children	0.53 (0.48,0.59)	0.52 (0.47,0.58)

Model 1–children with no immunizations are excluded from the adjusted model

Model 2–children with no immunizations are included in the adjusted model; provider type not included as a covariate

'*' for children with less than 3 physician visits, we were unable to define continuity of care

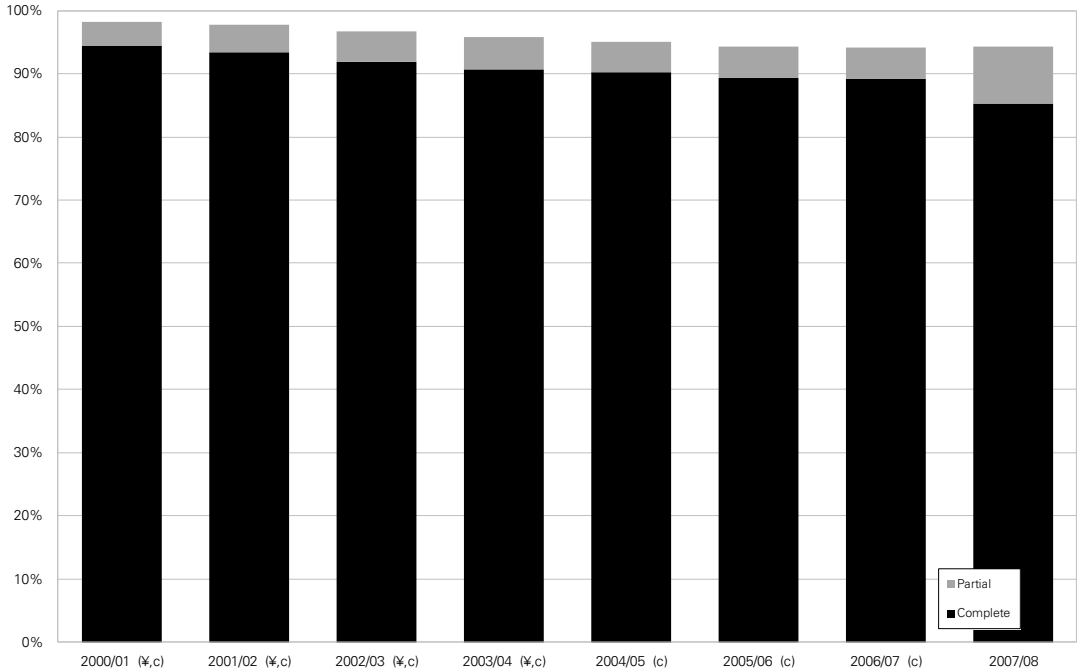
Source: Manitoba Centre for Health Policy, 2011

The Pre–school Booster—Polio

Manitoba's recommended immunization schedule includes a polio booster between the ages of four and six delivered as part of the quadrivalent DTaP–IPV. NACI recommends that four doses of IPV (two, four, 18 months, and four to six years) are required for protection. Up until 2007/08 Manitoba considered three doses as complete for age from birth, however, this was changed in 2007/08 and is reflected in this analysis.

The proportion of seven–year–olds who have received the recommended IPV doses appears to have been declining over the last eight years (Figure 2.60). From a high of 94% in 2000/01 to a low of 85% in 2007/08, this represents a substantial decline in polio immunization rates. Some of this decline is likely due to the increase in the number of required doses from three to four. In keeping with other age seven analyses, some of the decline is due to the increase in the proportion of non–continuously registered seven–year–olds and a decrease in this group's complete from birth immunization rate. However, rates are declining in the continuously registered population as well (Table 2.27). Regional rates are seen in Figure 2.61 and show a decline across all regions between 2002/03 and 2007/08. Figures 2.63 and 2.64 once again illustrate within region variability. Figure 2.65 shows the rates by income quintile. The logistic regression results can be seen in Table 2.23.

Figure 2.60: Manitoba Polio Immunization Rates, Aged 7
Percent of children who are complete/partial from birth for the polio vaccination, 2000/01–2007/08

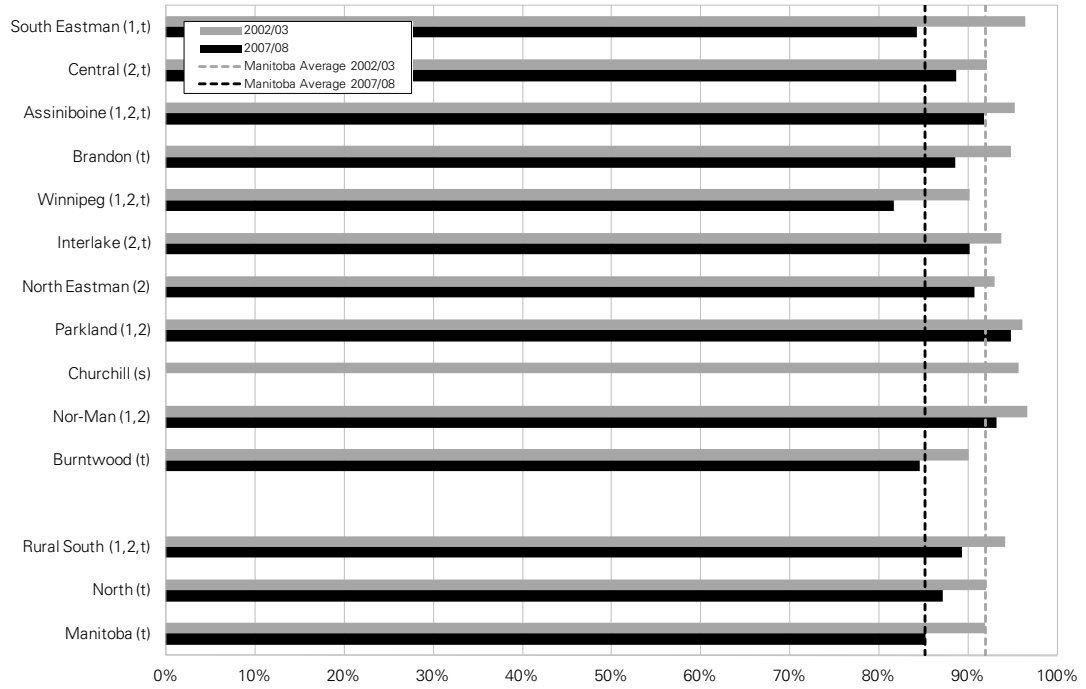


Linear trend test: Complete from birth p<0.0001
Complete + partial from birth p<0.0001
'c' indicates the complete from birth rate was statistically different from the complete from birth rate in 2007/08
'¥' indicates the complete + partial from birth rate was statistically different from the complete + partial from birth rate in 2007/08
An additional dose of the polio vaccine was added to the recommended immunization schedule in 2007

Source: Manitoba Centre for Health Policy, 2011

Figure 2.61: RHA Polio Immunization Rates, Aged 7

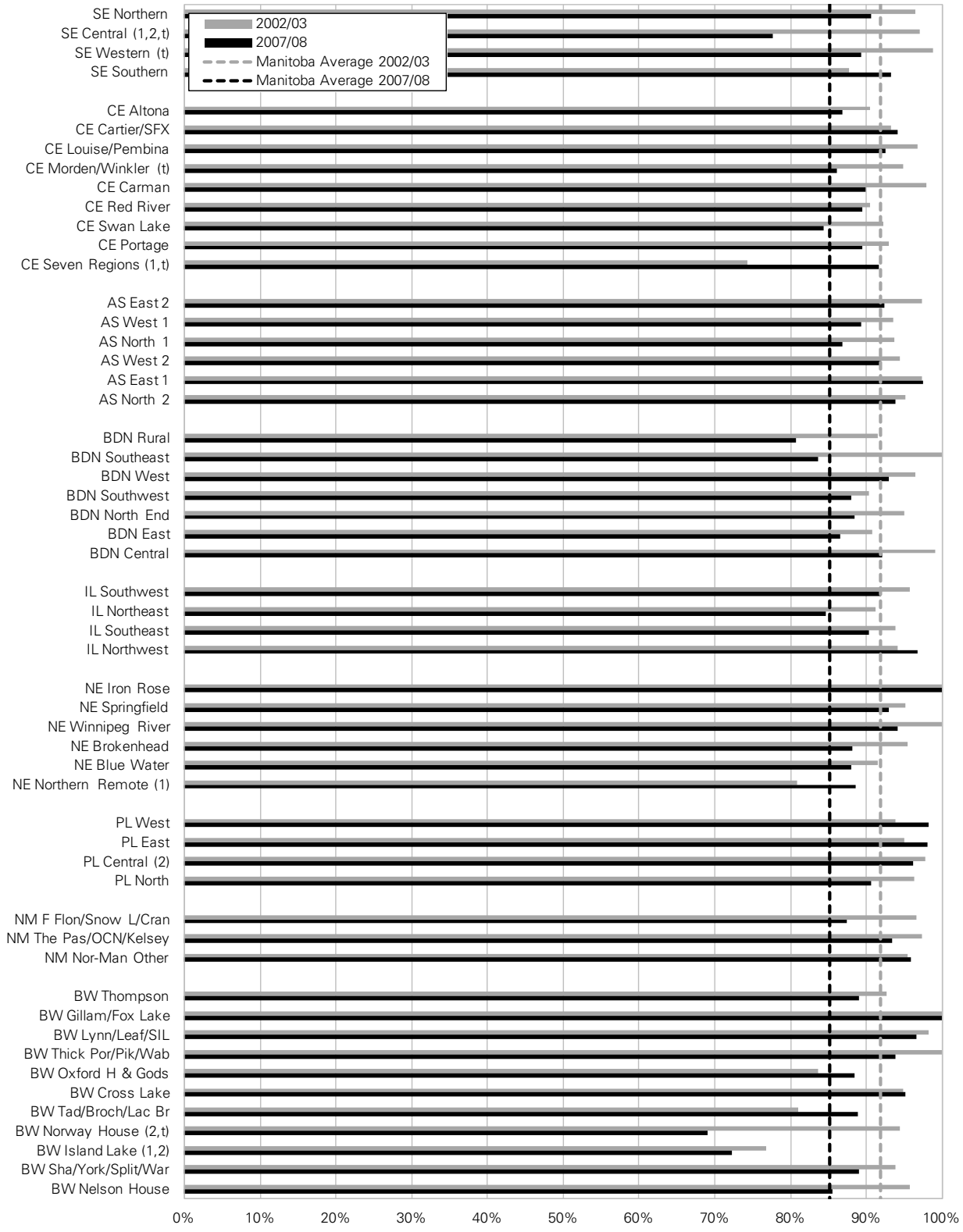
Percent of children who are complete from birth for the polio vaccination, 2002/03 and 2007/08



'1' indicates area's rate was statistically different from Manitoba average in first time period
'2' indicates area's rate was statistically different from Manitoba average in second time period
't' indicates change over time was statistically significant for that area
's' indicates data suppressed due to small numbers
An additional dose of the polio vaccine was added to the recommended immunization schedule in 2007

Source: Manitoba Centre for Health Policy, 2011

Figure 2.62: RHA District Polio Immunization Rates, Aged 7
Percent of children who are complete from birth for the polio vaccination, 2002/03 and 2007/08

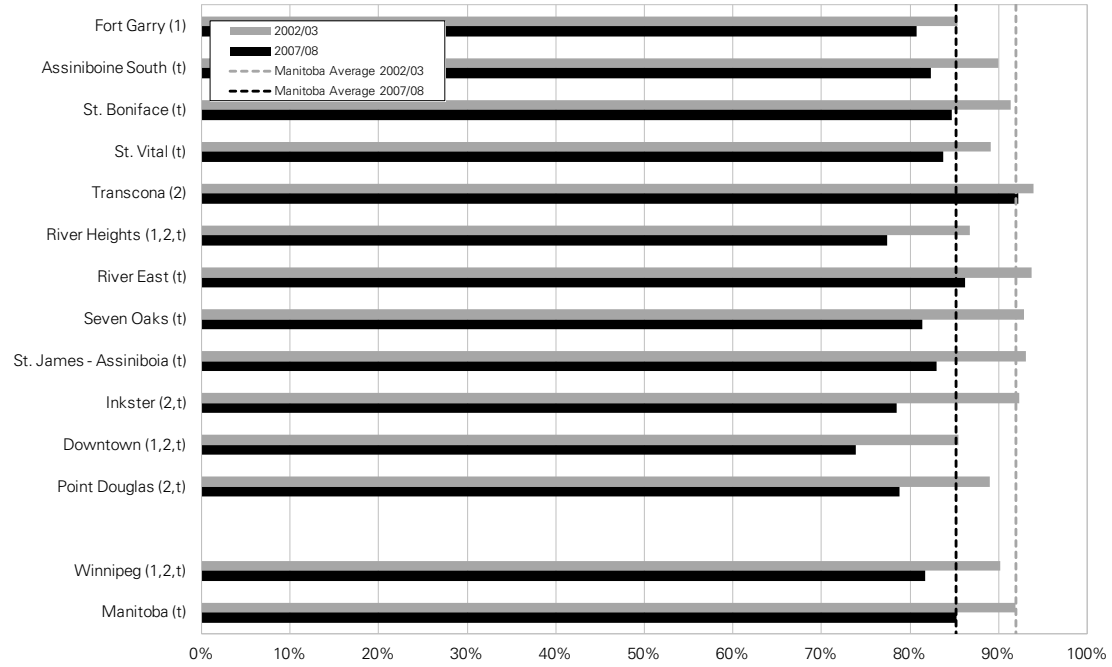


An additional dose of the polio vaccine was added to the recommended immunization schedule in 2007

Source: Manitoba Centre for Health Policy, 2011

Figure 2.63: Winnipeg CA Polio Immunization Rates, Aged 7

Percent of children who are complete from birth for the polio vaccination, 2002/03 and 2007/08

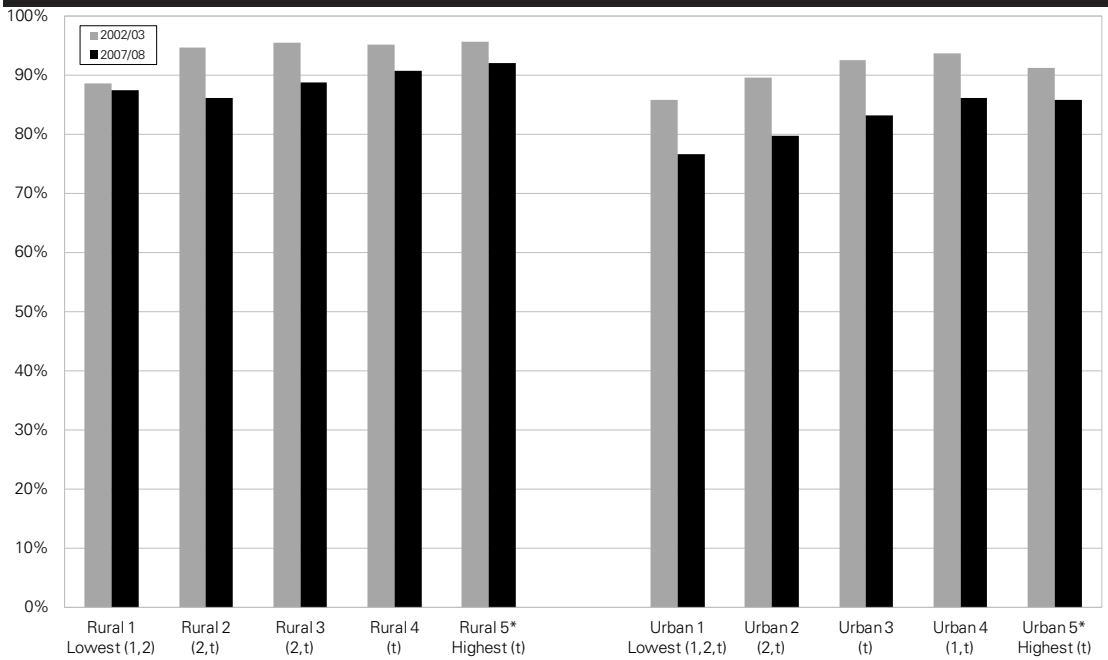


'1' indicates area's rate was statistically different from Manitoba average in first time period
'2' indicates area's rate was statistically different from Manitoba average in second time period
't' indicates change over time was statistically significant for that area
's' indicates data suppressed due to small numbers
An additional dose of the polio vaccine was added to the recommended immunization schedule in 2007

Source: Manitoba Centre for Health Policy, 2011

Figure 2.64: Polio Immunization Rates by Income Quintile, Aged 7

Percent of children who are complete from birth for the polio vaccination, 2002/03 and 2007/08



'1' indicates quintile's rate was statistically different from reference group in first time period
'2' indicates quintile's rate was statistically different from reference group in second time period
't' indicates change over time was statistically significant for that quintile
's' indicates data suppressed due to small numbers
'*' indicates the reference group. Rural 5 is the reference group for rural quinitiles; Urban 5 is the reference group for urban quintiles
An additional dose of the polio vaccine was added to the recommended immunization schedule in 2007

Source: Manitoba Centre for Health Policy, 2011

Table 2.23: Factors Associated with Being Complete from Birth for the Polio Immunization, Aged 7
Adjusted Odds Ratio (95% Confidence Interval), 2007/08

Factor	Category	Adjusted Odds Ratio (95% CI)	
		Model 1	Model 2
Coverage from Birth	Covered from Birth	***Reference***	***Reference***
	Not Covered from Birth	0.06 (0.05, 0.07)	0.06 (0.05, 0.07)
Income Quintile	Quintile 1 (lowest)	0.48 (0.39, 0.59)	0.56 (0.47, 0.67)
	Quintile 2	0.62 (0.50, 0.77)	0.68 (0.57, 0.82)
	Quintile 3	0.74 (0.59, 0.92)	0.76 (0.63, 0.91)
	Quintile 4	0.89 (0.71, 1.12)	0.94 (0.78, 1.13)
	Quintile 5 (highest)	***Reference***	***Reference***
Mother's Age at Birth	Unknown	0.41 (0.22, 0.76)	0.34 (0.20, 0.57)
	18 and younger	1.04 (0.78, 1.40)	1.33 (1.02, 1.73)
	19-24	0.92 (0.79, 1.07)	0.97 (0.85, 1.10)
	25-34	***Reference***	***Reference***
	35 and older	0.97 (0.00, 1.19)	0.85 (0.72, 0.99)
Continuity of Care	No Continuity of Care	0.82 (0.69, 0.97)	0.92 (0.79, 1.07)
	Less than 3 Physician Visits*	0.66 (0.56, 0.77)	0.48 (0.42, 0.55)
	Continuity of Care	***Reference***	***Reference***
Provider Type	Mixed Providers	3.64 (2.96, 4.48)	
	Regional Health Unit	1.48 (1.19, 1.84)	
	Other/Unspecified	0.73 (0.51, 1.04)	
	Physician	***Reference***	
Region of Residence	Brandon	1.58 (1.09, 2.27)	2.19 (1.62, 2.97)
	North	0.76 (0.58, 1.00)	1.50 (1.24, 1.82)
	Rural South	1.97 (1.64, 2.36)	2.59 (2.28, 2.95)
	Winnipeg	***Reference***	***Reference***
Sex of Child	Male	0.95 (0.84, 1.08)	1.02 (0.92, 1.14)
	Female	***Reference***	***Reference***
Number of Children in the Family	1 Child	0.94 (0.78, 1.14)	0.88 (0.75, 1.03)
	2-3 Children	***Reference***	***Reference***
	4 or more Children	0.46 (0.40, 0.54)	0.49 (0.43, 0.56)

Model 1–children with no immunizations are excluded from the adjusted model

Model 2–children with no immunizations are included in the adjusted model; provider type not included as a covariate

An additional dose of the polio vaccine was added to the recommended immunization schedule in 2007

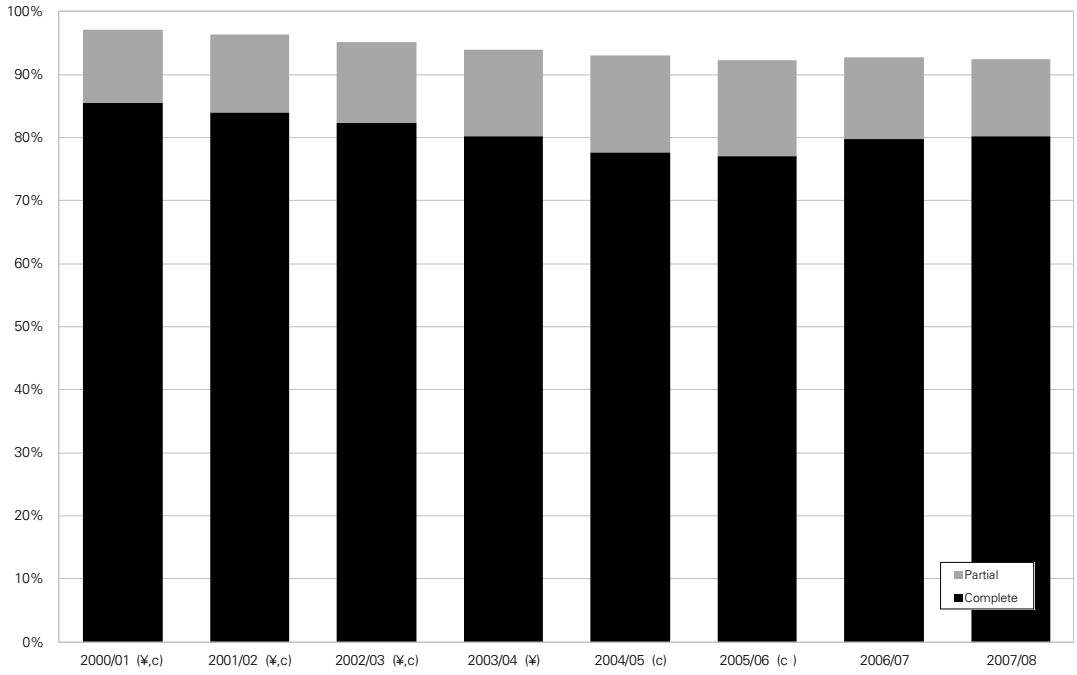
'*' for children with less than 3 physician visits, we were unable to define continuity of care

Source: Manitoba Centre for Health Policy, 2011

The Pre–school Booster—Measles, Mumps, Rubella

Manitoba implemented a two dose measles program in 1996; and for the purposes of this analysis, two doses are required to be counted as complete for age from birth. The pre–school measles booster is delivered as a live attenuated virus as part of the trivalent measles, mumps, and rubella (MMR) vaccine. In 2007/08, 80% of children in Manitoba had received both required doses (Figure 2.65). As with other components of the pre–school booster, there is a downward trend in the proportion of Manitoba children who have received the recommended two dose schedule. Rates have decline from 86% in 2000/01 to 80% in 2007/08. Most of the observed decline over time is due to an increase in proportion of non–continuously registered seven–year–olds from 13% in 2001/02 to 17% in 2007/08 (Table 2.20). Figures 2.66–2.69 show the rates by RHA, RHA district, Winnipeg CA, and income quintile. The results of the logistic regression can be seen in Table 2.24. The complete from birth crude measles immunization rates by sociodemographic factors can be found at the end of this section in Table 2.28.

Figure 2.65: Manitoba Measles Immunization Rates, Aged 7
Percent of children who are complete/partial from birth for the measles vaccination, 2000/01–2007/08



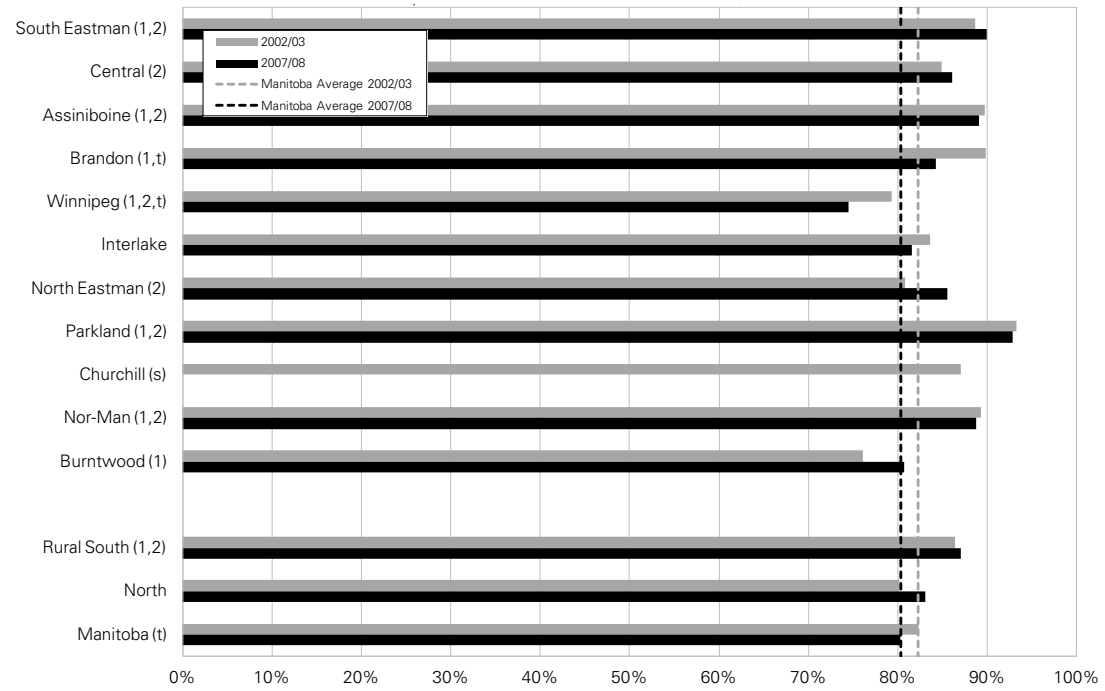
Linear trend test: Complete from birth p<0.0001
Complete + partial from birth p<0.0001

'c' indicates the complete from birth for this fiscal year rate was statistically different from the complete from birth rate in 2007/08
'¥' indicates the complete + partial from birth rate was statistically different in this fiscal year from the complete + partial from birth rate in 2007/08

Source: Manitoba Centre for Health Policy, 2011

Figure 2.66: RHA Measles Immunization Rates, Aged 7

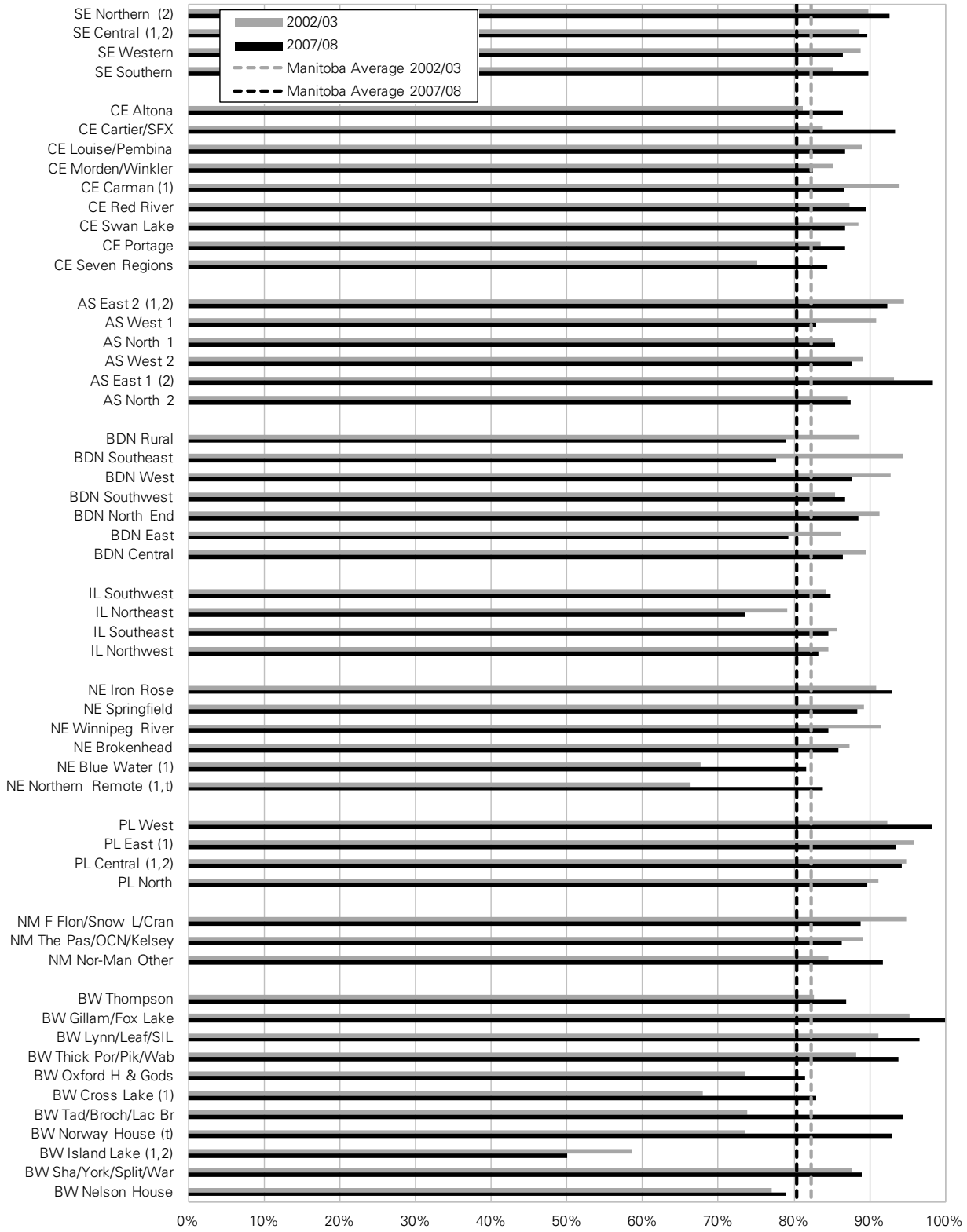
Percent of children who are complete from birth for the measles vaccination, 2002/03 and 2007/08



'1' indicates area's rate was statistically different from Manitoba average in first time period
'2' indicates area's rate was statistically different from Manitoba average in second time period
't' indicates change over time was statistically significant for that area
's' indicates data suppressed due to small numbers

Source: Manitoba Centre for Health Policy, 2011

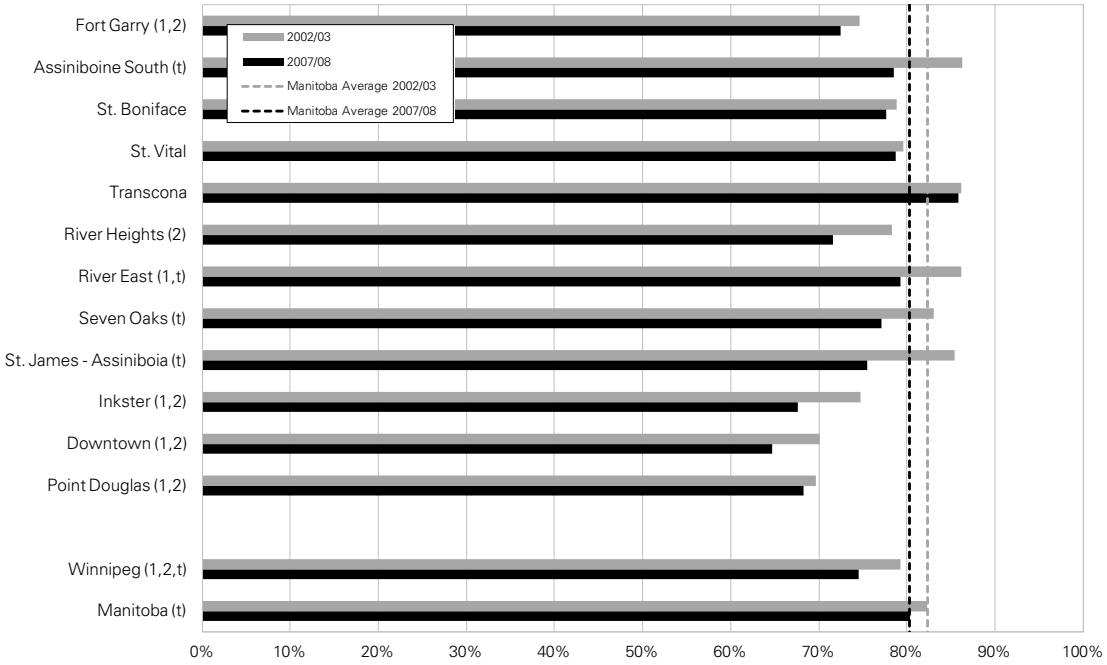
Figure 2.67: RHA District Measles Immunization Rates, Aged 7
Percent of children who are complete from birth for the measles vaccination, 2002/03 and 2007/08



Source: Manitoba Centre for Health Policy, 2011

Figure 2.68: Winnipeg CA Measles Immunization Rates, Aged 7

Percent of children who are complete from birth for the measles vaccination, 2002/03 and 2007/08

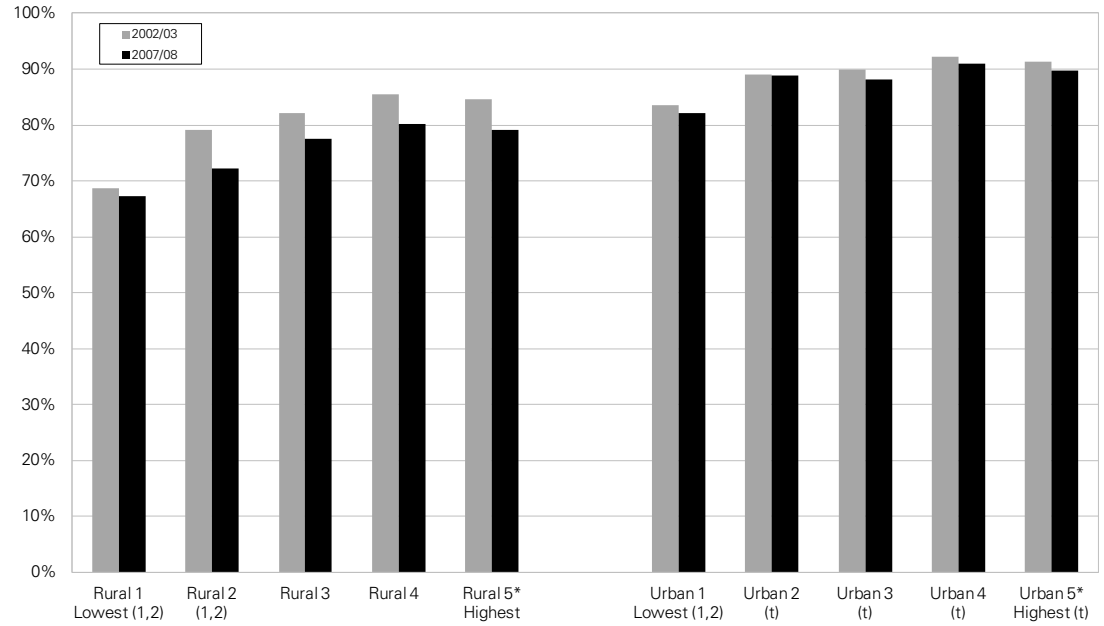


'1' indicates area's rate was statistically different from Manitoba average in first time period
'2' indicates area's rate was statistically different from Manitoba average in second time period
't' indicates change over time was statistically significant for that area
's' indicates data suppressed due to small numbers

Source: Manitoba Centre for Health Policy, 2011

Figure 2.69: Measles Immunization Rates by Income Quintile, Aged 7

Percent of children who are complete from birth for the measles vaccination, 2002/03 and 2007/08



'1' indicates quintile's rate was statistically different from reference group in first time period
'2' indicates quintile's rate was statistically different from reference group in second time period
't' indicates change over time was statistically significant for that quintile
's' indicates data suppressed due to small numbers
'*' indicates the reference group. Rural 5 is the reference group for rural quintiles; Urban 5 is the reference group for urban quintiles

Source: Manitoba Centre for Health Policy, 2011

Table 2.24: Factors Associated with Being Complete from Birth for the Measles Immunization, Aged 7
Adjusted Odds Ratio (95% Confidence Interval), 2007/08

Factor	Category	Adjusted Odds Ratio (95% CI)	
		Model 1	Model 2
Coverage from Birth	Covered from Birth	***Reference***	***Reference***
	Not Covered from Birth	0.20 (0.18,0.23)	0.15 (0.14,0.17)
Income Quintile	Quintile 1 (lowest)	0.42 (0.36,0.50)	0.49 (0.42,0.56)
	Quintile 2	0.75 (0.63,0.89)	0.80 (0.68,0.93)
	Quintile 3	0.84 (0.71,1.00)	0.85 (0.73,0.99)
	Quintile 4	0.94 (0.79,1.12)	0.98 (0.84,1.15)
	Quintile 5 (highest)	***Reference***	***Reference***
Mother's Age at Birth	Unknown	0.47 (0.26,0.84)	0.37 (0.23,0.61)
	18 and younger	0.81 (0.66,1.00)	0.97 (0.80,1.19)
	19-24	0.94 (0.83,1.06)	0.97 (0.87,1.08)
	25-34	***Reference***	***Reference***
	35 and older	1.13 (0.00,1.33)	0.99 (0.87,1.14)
Continuity of Care	No Continuity of Care	0.78 (0.68,0.89)	0.84 (0.74,0.95)
	Less than 3 Physician Visits*	0.52 (0.46,0.59)	0.44 (0.39,0.49)
	Continuity of Care	***Reference***	***Reference***
Provider Type	Mixed Providers	2.32 (1.98,2.71)	
	Regional Health Unit	1.58 (1.32,1.89)	
	Other/Unspecified	0.54 (0.40,0.74)	
	Physician	***Reference***	
Region of Residence	Brandon	1.52 (1.15,2.02)	2.09 (1.63,2.69)
	North	1.24 (1.00,1.55)	2.17 (1.83,2.56)
	Rural South	2.31 (2.00,2.67)	3.00 (2.69,3.34)
	Winnipeg	***Reference***	***Reference***
Sex of Child	Male	0.94 (0.85,1.03)	0.99 (0.91,1.08)
	Female	***Reference***	***Reference***
Number of Children in the Family	1 Child	0.82 (0.71,0.95)	0.80 (0.71,0.92)
	2-3 Children	***Reference***	***Reference***
	4 or more Children	0.65 (0.57,0.73)	0.64 (0.57,0)

Model 1–children with no immunizations are excluded from the adjusted model

Model 2–children with no immunizations are included in the adjusted model; provider type not included as a covariate

'*' for children with less than 3 physician visits, we were unable to define continuity of care

Source: Manitoba Centre for Health Policy, 2011

Table 2.25: Complete from Birth Crude Rates for Tetanus Immunization by Sociodemographic Factors, Aged 7, 2002/03 and 2007/08

Factor	Category	% Complete from Birth	
		2002/03	2007/08
Coverage from Birth	Covered from Birth (t,l) ***Reference***	83.80	80.50
	Not Covered from Birth (1,2,t,l)	49.70	35.60
Income Quintile	Rural 1 (lowest) (1,2,l)	67.00	68.50
	Rural 2 (1,2,t,l)	80.70	73.50
	Rural 3 (l)	83.00	81.30
	Rural 4 (l)	84.10	81.10
	Rural 5 (highest) (l) ***Reference***	85.80	83.90
	Urban 1 (lowest) (1,2,t,l)	66.90	60.10
	Urban 2 (1,2,t,l)	76.30	66.00
	Urban 3 (1,2,t,l)	80.80	71.10
	Urban 4 (t,l)	84.80	75.20
	Urban 5 (highest) (t,l) ***Reference***	84.00	76.10
Mother's Age at Birth	Unknown (1,2,t,l)	51.30	24.20
	18 and younger (1,l)	74.40	72.40
	19-24 (1,2,t,l)	75.30	70.90
	25-34 (t,l) ***Reference***	81.50	74.20
	35 and older (1,t,l)	78.90	74.50
Continuity of Care	No Continuity of Care (1,t,l)	80.00	77.50
	Less than 3 Physician Visits* (1,2,t,l)	70.10	64.40
	Continuity of Care (t,l) ***Reference***	85.40	79.40
Provider Type	Mixed Providers (1,2,l)	82.80	81.40
	Regional Health Unit (1,2,l)	75.10	73.60
	Other/Unspecified (1,2,t,l)	62.00	41.10
	Physician (t,l) ***Reference***	84.90	78.40
Region of Residence	Brandon (1,2,t,l)	84.80	78.20
	North (1)	69.90	71.10
	Rural South(1,2,t,l)	82.20	78.60
	Winnipeg (2,t,l)	78.10	69.00
	Manitoba (t,l) ***Reference***	79.00	73.00
Number of Children in the Family	1 Child (2,t,l)	80.10	73.50
	2-3 Children (t,l) ***Reference***	81.90	76.50
	4 or more Children (1,2,t,l)	67.30	62.10

'1' indicates quintile's rate was statistically different from reference group in first time period

'2' indicates quintile's rate was statistically different from reference group in second time period

't' indicates change over time was statistically significant

's' indicates data suppressed due to small numbers

'l' indicates a significant linear trend over time

'*' for children with less than 3 physician visits, we were unable to define continuity of care

Source: Manitoba Centre for Health Policy, 2011

Table 2.26: Complete from Birth Crude Rates for Pertussis Immunization by Sociodemographic Factors, Aged 7, 2002/03 and 2007/08

Factor	Category	% Complete from Birth	
		2002/03	2007/08
Coverage from Birth	Covered from Birth (l) ***Reference***	81.20	80.00
	Not Covered from Birth (1,2,t,l)	48.10	35.40
Income Quintile	Rural 1 (Lowest) (1,2)	66.30	68.30
	Rural 2 (1,2,t,l)	79.10	73.50
	Rural 3 (l)	80.50	81.10
	Rural 4 (l)	81.50	80.90
	Rural 5 (highest) ***Reference***	82.90	83.40
	Urban 1 (lowest) (1,2,t,l)	65.10	59.50
	Urban 2 (1,2,t,l)	73.40	65.40
	Urban 3 (2,t,l)	78.20	70.50
	Urban 4 (t,l)	81.50	74.50
	Urban 5 (highest) (t,l) ***Reference***	81.00	74.60
Mother's Age at Birth	Unknown (1,2,t,l)	47.40	23.10
	18 and younger (1,l)	73.00	72.20
	19-24 (1,2,t,l)	73.40	70.60
	25-34 (t,l) ***Reference***	78.90	73.70
	35 and older (1,l)	75.80	73.70
Continuity of Care	No Continuity of Care (1,l)	77.60	76.90
	Less than 3 Physician Visits* (1,2,t,l)	68.20	63.90
	Continuity of Care (t,l) ***Reference***	82.50	78.80
Provider Type	Mixed Providers (2)	80.80	81.10
	Regional Health Unit (1,2,l)	74.20	73.50
	Other/Unspecified (1,2,t,l)	60.90	39.10
	Physician (t,l) ***Reference***	81.50	77.60
Region of Residence	Brandon (1,2,t,l)	84.20	77.80
	North (1)	69.40	71.10
	Rural South (1,2,l)	79.70	78.30
	Winnipeg (2,t,l)	75.20	68.20
	Manitoba (2,t,l) ***Reference***	76.60	72.50
Number of Children in the Family	1 Child (2,t,l)	77.50	73.00
	2-3 Children (t,l) ***Reference***	79.20	75.90
	4 or more Children (1,2,t,l)	65.80	61.70

'1' indicates quintile's rate was statistically different from reference group in first time period

'2' indicates quintile's rate was statistically different from reference group in second time period

't' indicates change over time was statistically significant

's' indicates data suppressed due to small numbers

'l' indicates a significant linear trend over time

*' for children with less than 3 physician visits, we were unable to define continuity of care

Source: Manitoba Centre for Health Policy, 2011

Table 2.27: Complete from Birth Crude Rates for Polio Immunization by Sociodemographic Factors, Aged 7, 2002/03 and 2007/08

Factor	Category	% Complete from Birth	
		2002/03	2007/08
Coverage from Birth	Covered from Birth (t,l) ***Reference***	96.00	92.80
	Not Covered from Birth (1,2,t,l)	67.10	47.60
Income Quintile	Rural 1 (Lowest) (1,2)	88.60	87.50
	Rural 2 (2,t,l)	94.60	86.10
	Rural 3 (2,t,l)	95.50	88.70
	Rural 4 (t,l)	95.10	90.70
	Rural 5 (highest) (t,l) ***Reference***	95.60	92.00
	Urban 1 (lowest) (1,2,t,l)	85.80	76.60
	Urban 2 (2,t,l)	89.50	79.80
	Urban 3 (t,l)	92.50	83.20
	Urban 4 (1,t,l)	93.70	86.10
	Urban 5 (highest) (t,l) ***Reference***	91.20	85.80
Mother's Age at Birth	Unknown (1,2,t,l)	84.20	38.50
	18 and younger (2)	91.90	90.80
	19-24 (t)	91.40	85.40
	25-34 (t,l) ***Reference***	92.40	85.30
	35 and older (t,l)	91.00	84.40
Continuity of Care	No Continuity of Care (1,t)	93.40	88.80
	Less than 3 Physician Visits* (2,t)	87.00	79.50
	Continuity of Care (1,t,l) ***Reference***	94.70	88.90
Provider Type	Mixed Providers (1,2,t)	97.00	94.80
	Regional Health Unit (1,2,t,l)	93.50	88.10
	Other/Unspecified (1,2,t,l)	89.10	64.30
	Physician (t) ***Reference***	95.80	90.20
Region of Residence	Brandon (t)	94.70	88.50
	North (t)	92.00	87.10
	Rural South(1,2,t,l)	94.10	89.30
	Winnipeg (1,2,t,l)	90.20	81.80
	Manitoba (t,l) ***Reference***	91.90	85.20
Number of Children in the Family	1 Child (1,t)	94.40	87.60
	2-3 Children (t,l) ***Reference***	92.50	87.00
	4 or more Children (1,2,t,l)	87.90	78.30

'1' indicates quintile's rate was statistically different from reference group in first time period
'2' indicates quintile's rate was statistically different from reference group in second time period
't' indicates change over time was statistically significant
's' indicates data suppressed due to small numbers
'l' indicates a significant linear trend over time
'*' for children with less than 3 physician visits, we were unable to define continuity of care
An additional dose of the polio vaccine was added to the recommended immunization schedule in 2007

Source: Manitoba Centre for Health Policy, 2011

Table 2.28: Complete from Birth Crude Rates for Measles Immunization by Sociodemographic Factors, Aged 7, 2002/03 and 2007/08

Factor	Category	% Complete from Birth	
		2002/03	2007/08
Coverage from Birth	Covered from Birth ***Reference***	85.90	86.20
	Not Covered from Birth (1,2,t)	60.10	51.10
Income Quintile	Rural 1 (Lowest) (1,2)	68.70	67.30
	Rural 2 (1,2)	79.20	72.20
	Rural 3	82.10	77.50
	Rural 4	85.50	80.20
	Rural 5 (highest) ***Reference***	84.60	79.10
	Urban 1 (lowest) (1,2,l)	83.60	82.20
	Urban 2 (t,l)	89.10	88.90
	Urban 3 (t,l)	90.00	88.10
	Urban 4 (t,l)	92.20	91.00
	Urban 5 (highest) (t,l) ***Reference***	91.40	89.80
Mother's Age at Birth	Unknown (2,t,l)	75.00	44.00
	18 and younger (1)	77.80	80.80
	19-24 (1,l)	79.90	80.20
	25-34 (t,l) ***Reference***	84.00	80.60
	35 and older (l)	82.00	80.70
Continuity of Care	No Continuity of Care (1)	83.40	84.00
	Less than 3 Physician Visits* (1,2)	74.40	73.50
	Continuity of Care (t) ***Reference***	87.70	85.10
Provider Type	Mixed Providers (1,2)	89.00	90.70
	Regional Health Unit (2)	84.00	86.10
	Other/Unspecified (1,2)	65.20	55.60
	Physician (t) ***Reference***	85.00	83.20
Region of Residence	Brandon (1,t,l)	89.70	84.30
	North	80.20	83.10
	Rural South(1,2)	86.40	87.10
	Winnipeg (1,2,t,l)	79.30	74.60
	Manitoba (l) ***Reference***	82.30	80.30
Number of Children in the Family	1 Child (2,t,l)	83.40	79.40
	2-3 Children (t,l) ***Reference***	84.20	82.20
	4 or more Children (1,2,l)	74.00	74.90

'1' indicates quintile's rate was statistically different from reference group in first time period

'2' indicates quintile's rate was statistically different from reference group in second time period

't' indicates change over time was statistically significant

's' indicates data suppressed due to small numbers

'l' indicates a significant linear trend over time

'*' for children with less than 3 physician visits, we were unable to define continuity of care

Source: Manitoba Centre for Health Policy, 2011

The School Based Program—Overview

Public Health Nurses deliver Manitoba's school–based immunization program and offer programs in Grade Four (HBV, Men–C, and varicella), in Grade Six (HPV–female only), and in Grade Eight or Nine (tetanus, diphtheria, pertussis). HPV is excluded from these analyses as it was added to the provincial immunization schedule in 2009. Table 2.29 defines the continuously registered and not continuously registered populations by year for ages 11 and 17.

Table 2.29: Children Registered with Manitoba Health for Insured Benefits by Year, Aged 11 and 17

Coverage	Age	2000/01		2001/02		2002/03		2003/04		2004/05		2005/06		2006/07		2007/08	
		n	(%)	n	(%)	n	(%)	n	(%)	n	(%)	n	(%)	n	(%)	n	(%)
Not Covered From Birth	11	3,100	18.0	3,081	18.0	3,160	18.4	3,070	18.4	3,242	19.0	3,064	18.2	3,122	19.0	3,264	20.4
Covered From Birth		14,103	82.0	13,991	82.0	13,998	81.6	13,657	81.6	13,798	81.0	13,747	81.8	13,296	81.0	12,760	79.6
Not Covered From Birth	17	3,769	23.1	3,882	23.4	3,763	22.6	3,860	23.0	3,752	22.5	3,888	22.9	3,905	22.3	4,153	23.5
Covered From Birth		12,571	76.9	12,676	76.6	12,898	77.4	12,913	77.0	12,922	77.5	13,077	77.1	13,622	77.7	13,488	76.5

Source: Manitoba Centre for Health Policy, 2011

The School Based Program—Hepatitis B Virus

Hepatitis B virus (HBV) is a small enveloped DNA virus from the *Hepadnaviridae*. People infected with HBV may present a wide variety of signs and symptoms such as anorexia, nausea, malaise, jaundice, and, rarely, fulminant fatal hepatitis. Asymptomatic **seroconversion** is common with disease severity being age related—that is, the likelihood of severe illness increases with age (American Academy of Pediatrics, 2006). In Manitoba, over 150 cases are reported every year; but these include acute cases, newly identified chronic cases, and unknown and unidentified cases. Approximately five to 10 new acute cases are identified annually (Manitoba Health Communicable Disease Control, 2010).

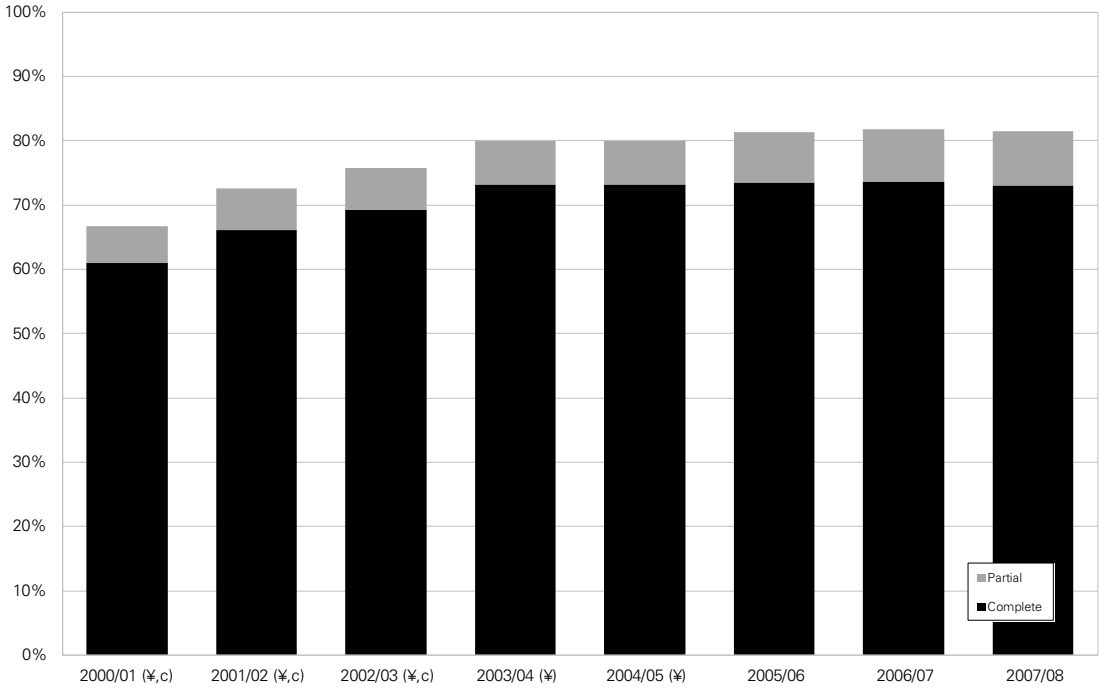
The HBV vaccines used in Manitoba's program are highly effective and safe biologics produced by recombinant DNA technology. Manitoba introduced its Grade Four school based HBV immunization program in 1998. It is important to remember that travel vaccines such as Twinrix®, which includes a hepatitis B component, are not publically funded and may not be entered into MIMS if given by private providers.

To be considered complete for age from birth for this analysis, all three recommended doses of HBV vaccine are required. The proportion of Grade Four children completely immunized against HBV was 73% in 2007/08 with 82% having received at least one dose (Figure 2.70). Immunization rates have been increasing over time with a statistically significantly higher rate in 2007/08 compared to 2000/01, 2001/02, and 2002/03. In 2007/08, complete from birth immunization rates were higher than the provincial average in South Eastman, Assiniboine, Brandon, and Parkland and below the provincial average in Winnipeg and Burntwood. South Eastman, Assiniboine, North Eastman, and Burntwood had higher rates in 2007/08 compared to 2002/03 (Figure 2.71). Although RHA rates are relatively tightly clustered, at the RHA district (Figure 2.72) and Winnipeg CA (Figure 2.73) level we see fairly large variations in immunization rates. For example, in Winnipeg, rates in 2007/08 for Assiniboine South are 78% compared to 57% in Downtown (Figure 2.73).

In terms of factors associated with receiving three doses of HBV, higher income quintiles, continuity of care, and older maternal age at birth are associated with higher rates (Table 2.30 and Figure 2.74). Children from families with four or more children are less likely to be complete for age from birth than those from families with fewer than four children. The complete from birth crude HBV immunization rates by sociodemographic factors can be found at the end of this section in Table 2.33.

Figure 2.70: Manitoba Hepatitis B (HBV) Immunization Rates, Aged 11

Percent of children who are complete/partial from birth for the HBV vaccination, 2000/01–2007/08

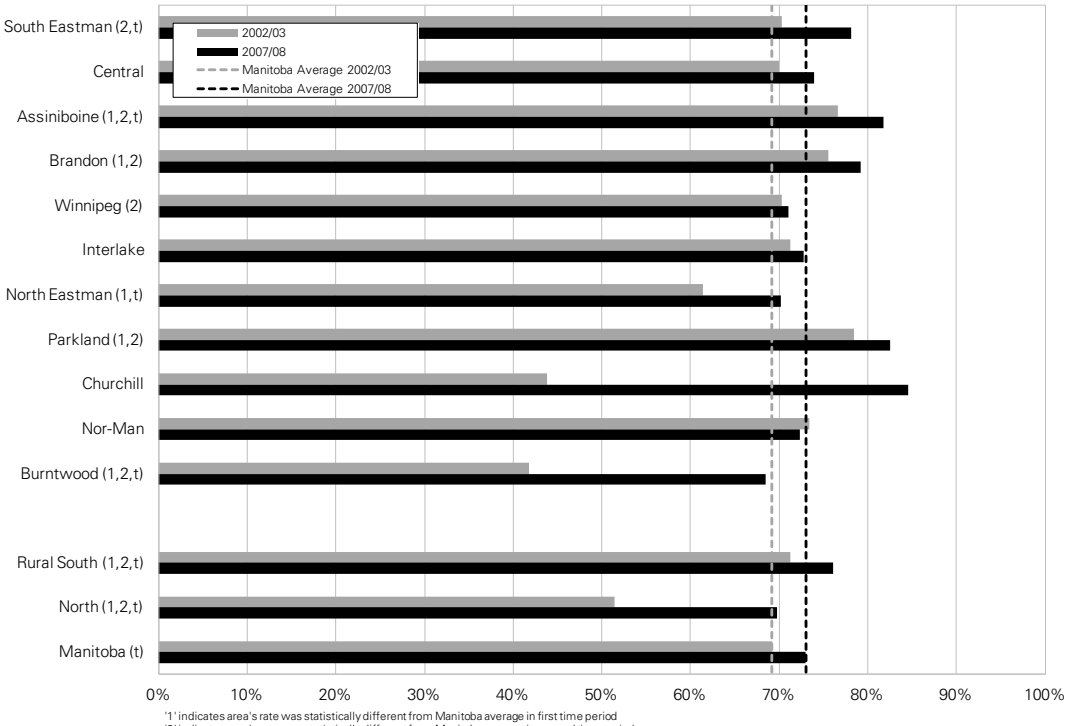


Linear trend test: Complete from birth p<.0001
Complete + partial from birth p<.0001
'c' indicates the complete from birth rate for this fiscal year, was statistically different from the complete from birth rate in 2007/08
'¥' indicates the complete + partial from birth rate for this fiscal year was statistically different from the complete + partial from birth rate in 2007/08

Source: Manitoba Centre for Health Policy, 2011

Figure 2.71: RHA Hepatitis B (HBV) Immunization Rates, Aged 11

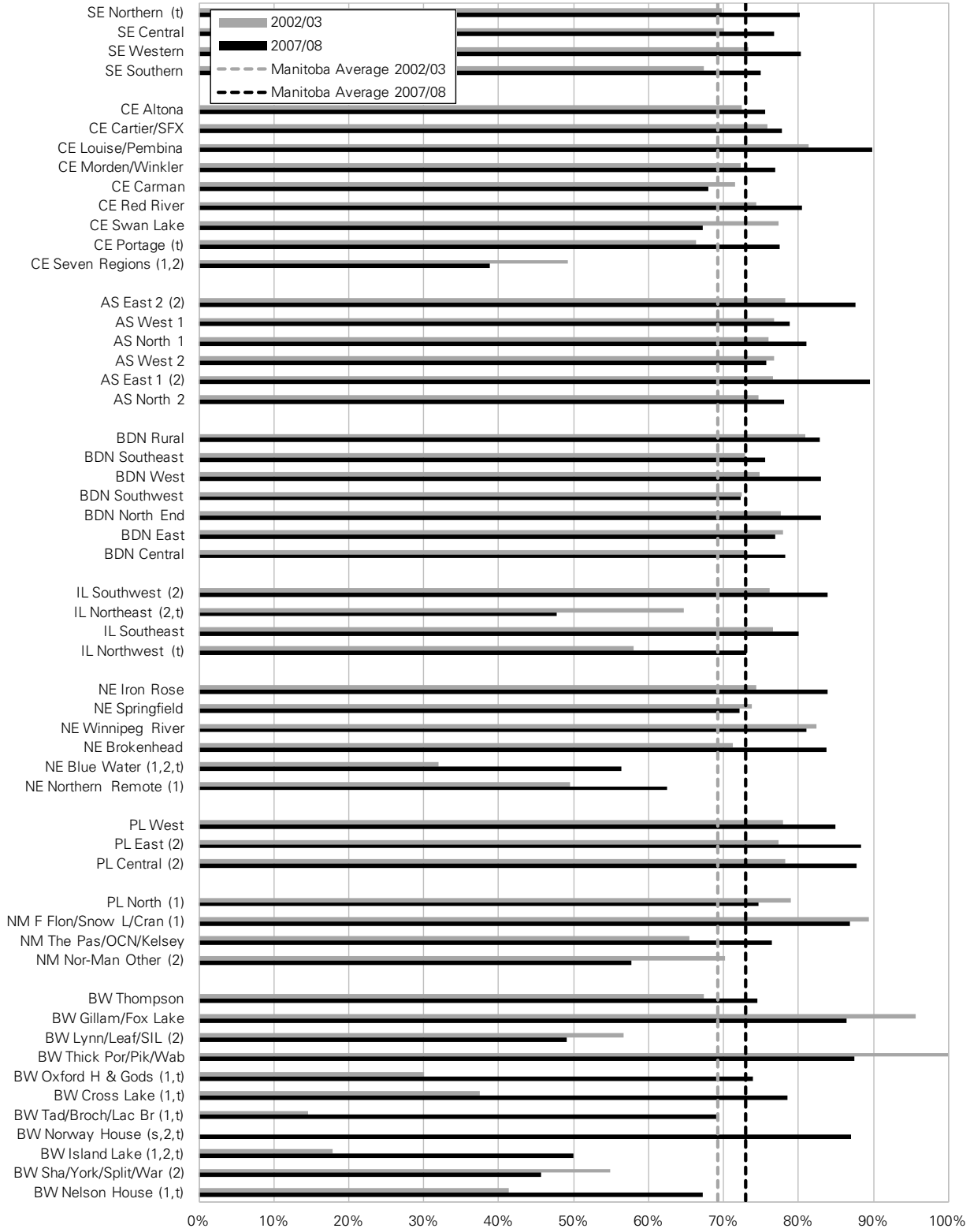
Percent of children who are complete from birth for the HBV vaccination, 2002/03 and 2007/08



'1' indicates area's rate was statistically different from Manitoba average in first time period
'2' indicates area's rate was statistically different from Manitoba average in second time period
't' indicates change over time was statistically significant for that area
's' indicates data suppressed due to small numbers

Source: Manitoba Centre for Health Policy, 2011

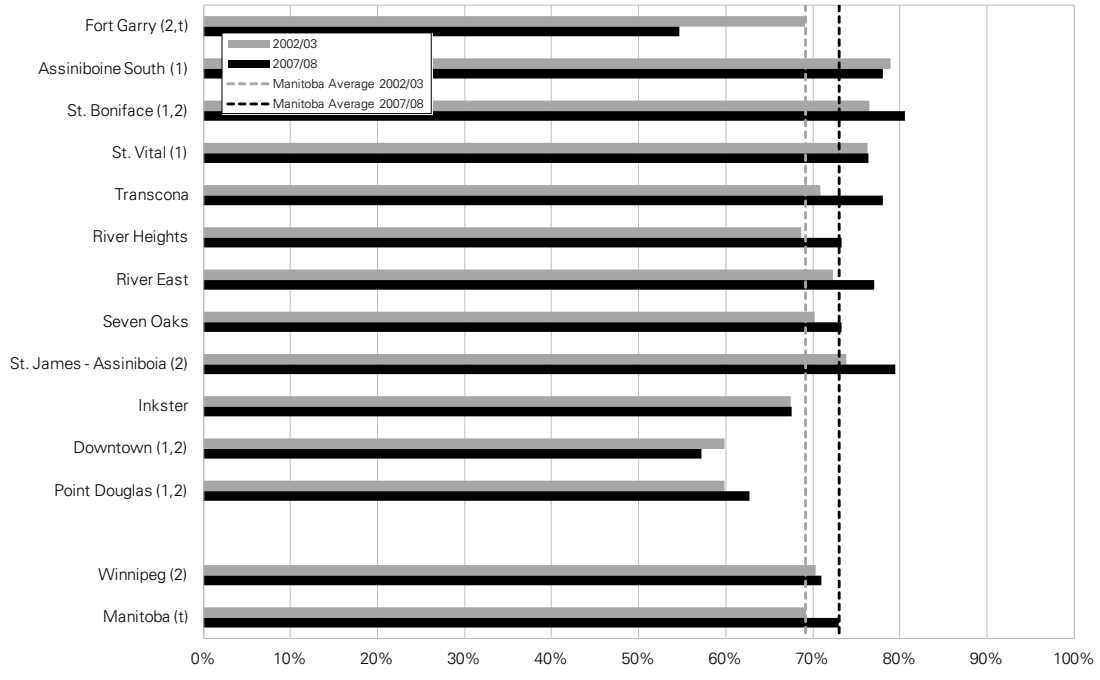
Figure 2.72: RHA District Hepatitis B (HBV) Immunization Rates, Aged 11
Percent of children who are complete from birth for the HBV vaccination, 2002/03 and 2007/08



Source: Manitoba Centre for Health Policy, 2011

Figure 2.73: Winnipeg CA Hepatitis B (HBV) Immunization Rates, Aged 11

Percent of children who are complete from birth for the HBV, 2002/03 and 2007/08

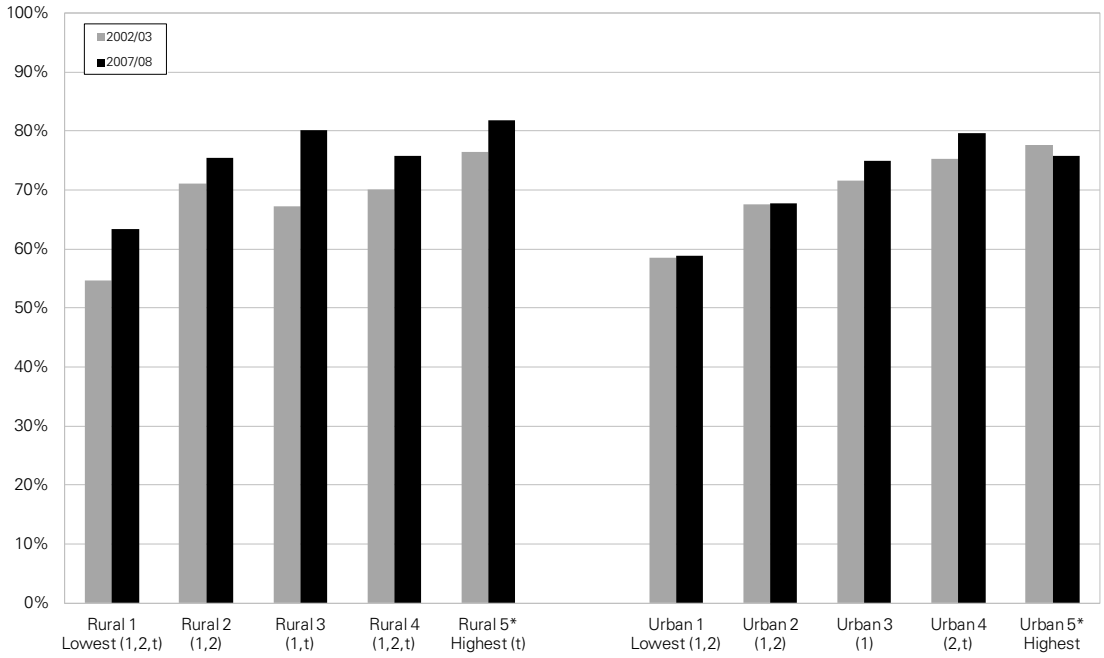


'1' indicates area's rate was statistically different from Manitoba average in first time period
'2' indicates area's rate was statistically different from Manitoba average in second time period
't' indicates change over time was statistically significant for that area
's' indicates data suppressed due to small numbers

Source: Manitoba Centre for Health Policy, 2011

Figure 2.74: Hepatitis B (HBV) Immunization Rates by Income Quintile, Aged 11

Percent of children who are complete from birth for the HBV, 2002/03 and 2007/08



'1' indicates quintile's rate was statistically different from reference group in first time period
'2' indicates quintile's rate was statistically different from reference group in second time period
't' indicates change over time was statistically significant for that quintile
's' indicates data suppressed due to small numbers
'*' indicates the reference group. Rural 5 is the reference group for rural quintiles; Urban 5 is the reference group for urban quintiles

Source: Manitoba Centre for Health Policy, 2011

Table 2.30: Factors Associated with Being Complete from Birth for the Hepatitis B Immunization, Aged 11
Adjusted Odds Ratio (95% Confidence Interval), 2007/08

Factor	Category	Adjusted Odds Ratio (95% CI)	
		Model 1	Model 2
Coverage from Birth	Covered from Birth	***Reference***	***Reference***
	Not Covered from Birth	0.69 (0.62, 0.78)	0.42 (0.39, 0.46)
Income Quintile	Quintile 1 (lowest)	0.54 (0.47, 0.62)	0.53 (0.47, 0.59)
	Quintile 2	0.85 (0.74, 0.99)	0.78 (0.69, 0.88)
	Quintile 3	1.16 (1.00, 1.36)	1.00 (0.88, 1.13)
	Quintile 4	1.06 (0.91, 1.23)	1.01 (0.89, 1.14)
	Quintile 5 (highest)	***Reference***	***Reference***
Mother's Age at Birth	Unknown	0.74 (0.45, 1.22)	0.52 (0.36, 0.74)
	18 and younger	0.56 (0.48, 0.67)	0.63 (0.54, 0.73)
	19-24	0.84 (0.76, 0.93)	0.86 (0.79, 0.94)
	25-34	***Reference***	***Reference***
	35 and older	0.90 (0.78, 1.04)	0.90 (0.80, 1.01)
Continuity of Care	No Continuity of Care	0.77 (0.68, 0.87)	0.91 (0.82, 1.00)
	Less than 3 Physician Visits*	0.83 (0.74, 0.92)	0.76 (0.69, 0.83)
	Continuity of Care	***Reference***	***Reference***
Provider Type	Mixed Providers	43.87 (37.02, 51.99)	
	Regional Health Unit	26.78 (22.06, 32.51)	
	Other/Unspecified	3.85 (2.42, 6.13)	
	Physician	***Reference***	
Region of Residence	Brandon	1.16 (0.91, 1.48)	1.63 (1.33, 2.00)
	North	0.71 (0.60, 0.83)	1.18 (1.03, 1.35)
	Rural South	0.93 (0.84, 1.04)	1.45 (1.34, 1.58)
	Winnipeg	***Reference***	***Reference***
Sex of Child	Male	0.93 (0.85, 1.01)	0.91 (0.85, 0.98)
	Female	***Reference***	***Reference***
Number of Children in the Family	1 Child	0.95 (0.83, 1.08)	0.94 (0.85, 1.04)
	2-3 Children	***Reference***	***Reference***
	4 or more Children	0.56 (0.50, 0.62)	0.57 (0.52, 0.63)

Model 1–children with no immunizations are excluded from the adjusted model

Model 2–children with no immunizations are included in the adjusted model; provider type not included as a covariate

'*' for children with less than 3 physician visits, we were unable to define continuity of care

Source: Manitoba Centre for Health Policy, 2011

The School Based Program—Meningococcal Conjugate Vaccine (Men–C)

Neisseria meningitidis is a bacterium that causes a spectrum of clinical disease, including invasive meningococcal disease which is a serious bacterial infection that presents as fever, headache, stiff neck, nausea, and vomiting. Acute infection may occur without spreading to meninges and should be suspected in those with febrile illness, petechial rash, and leukocytosis. Humans are the only known reservoir, and 10–25% of the population of endemic areas may be nasopharyngeal carriers (Manitoba Health Communicable Disease Control, 2003). Since the introduction of Men–C vaccinations, Manitoba has less than 10 cases annually of invasive meningococcal disease (Julia Ryan, personal communication, June 2010).

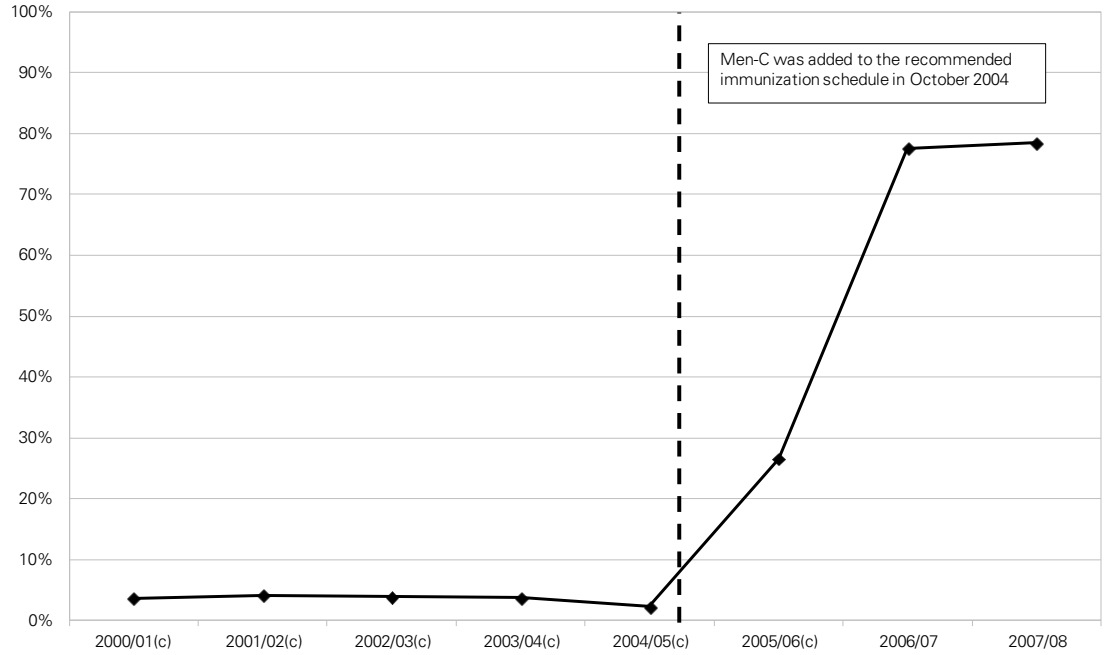
Manitoba introduced its Men–C program in the Grade Four school setting in 2004; and in 2009, primary vaccination with Men–C was introduced to one–year–olds. The meningococcal vaccines licensed in Canada are conjugate vaccines which are created by linking or conjugating the meningococcal C oligosaccharides with a highly immunogenic protein such as CRM197 or tetanus toxoid. For the purposes of this analysis, a single dose of Men–C vaccine is required by age 11 for an individual to be considered complete for age from birth.

In 2007/08, 79% of 11–year–olds in Manitoba were complete for age from birth. Figure 2.75 illustrates the rapid increase in uptake after the provincial program's inception. In 2007/08, Assiniboine, Brandon, and Parkland regions had rates above the provincial average while Winnipeg's rate was lower than the provincial average (Figure 2.76). RHA district, Winnipeg CA, and income quintile rates can be found in Figures 2.77–2.79.

In 2007/08, factors associated with being complete from birth for Men–C vaccine at age 11 were living in a higher income area, continuity of care, female sex, and fewer than four children in the family. A maternal age at birth of less than 25 was associated with lower Men–C immunization rates (Table 2.31). The complete from birth crude Men–C immunization rates by sociodemographic factors can be found at the end of this section in Table 2.34.

Figure 2.75: Manitoba Meningococcal Conjugate (Men-C) Immunization Rates, Aged 11

Percent of children who are complete/partial from birth for the Men-C, 2000/01– 2007/08

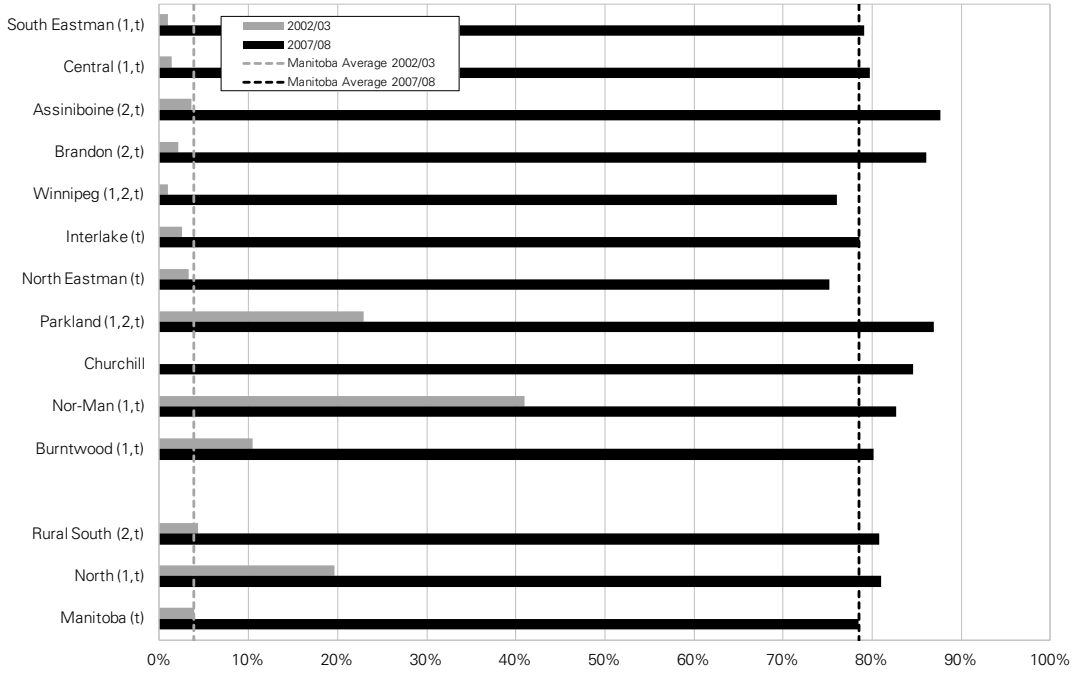


Linear trend test: Complete from birth p<0.0001
'c' Indicates the complete from birth for for this fiscal year, was statistically different from the complete from birth rate in 2007/08.

Source: Manitoba Centre for Health Policy, 2011

Figure 2.76: RHA Meningococcal Conjugate (Men-C) Immunization Rates, Aged 11

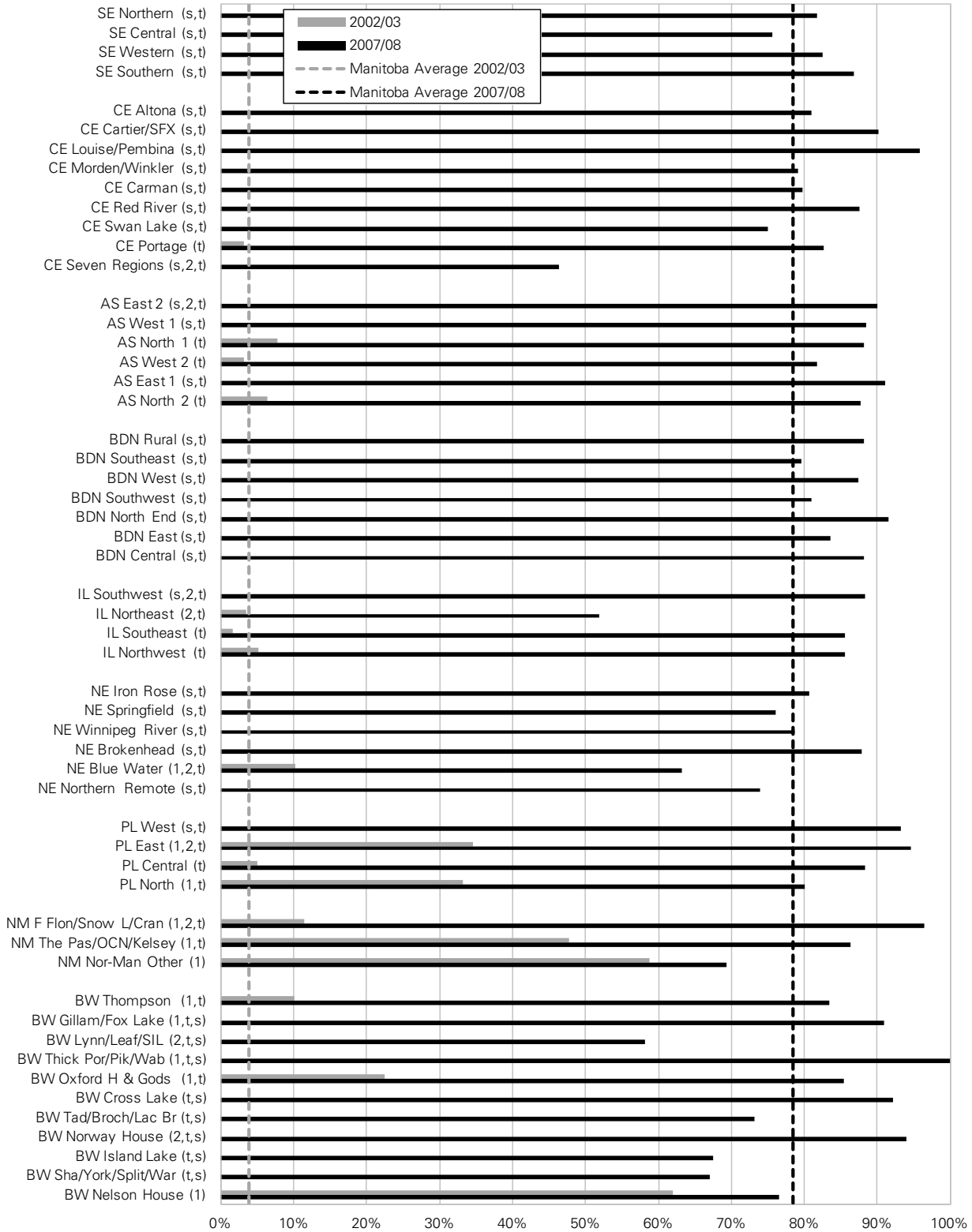
Percent of children who are complete from birth for the Men-C, 2002/03 and 2007/08



'1' indicates area's rate was statistically different from Manitoba average in first time period
'2' indicates area's rate was statistically different from Manitoba average in second time period
't' indicates change over time was statistically significant for that area
's' indicates data suppressed due to small numbers
Men-C was added to the recommended immunization schedule in October 2004

Source: Manitoba Centre for Health Policy, 2011

Figure 2.77: RHA District Meningococcal Conjugate Immunization Rates, Aged 11
Percent of children who are complete from birth for the Men-C , 2002/03 and 2007/08

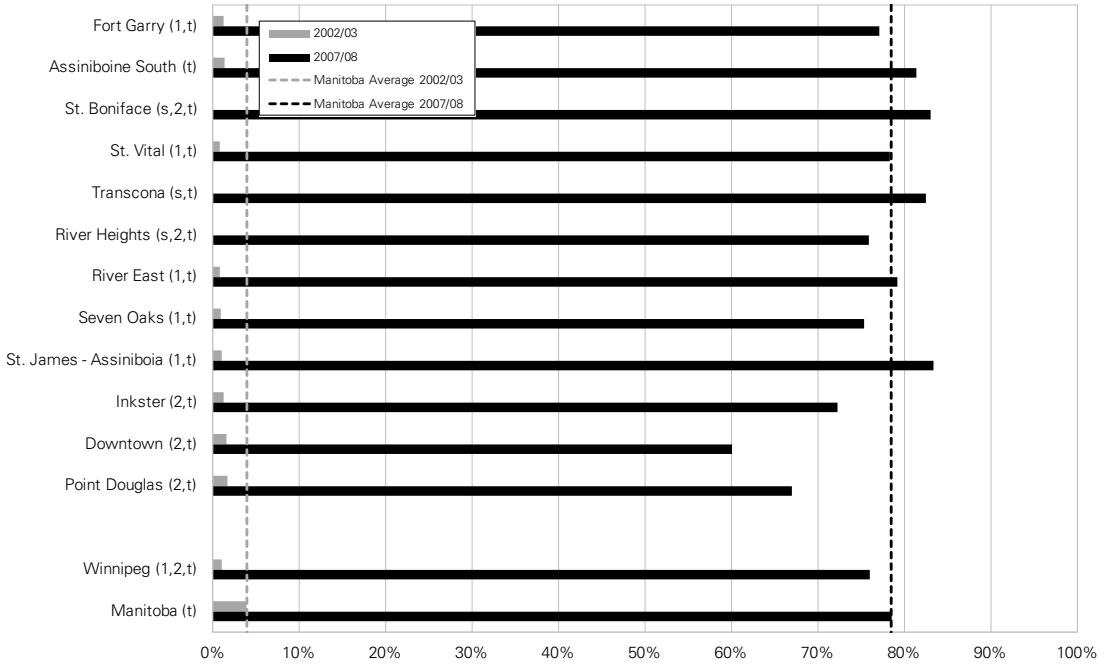


Men-C was added to the provincial immunization schedule in October 2004

Source: Manitoba Centre for Health Policy, 2011

Figure 2.78: Winnipeg CA Meningococcal Conjugate (Men-C) Immunization Rates, Aged 11

Percent of children who are complete from birth for Men-C, 2002/03 and 2007/08

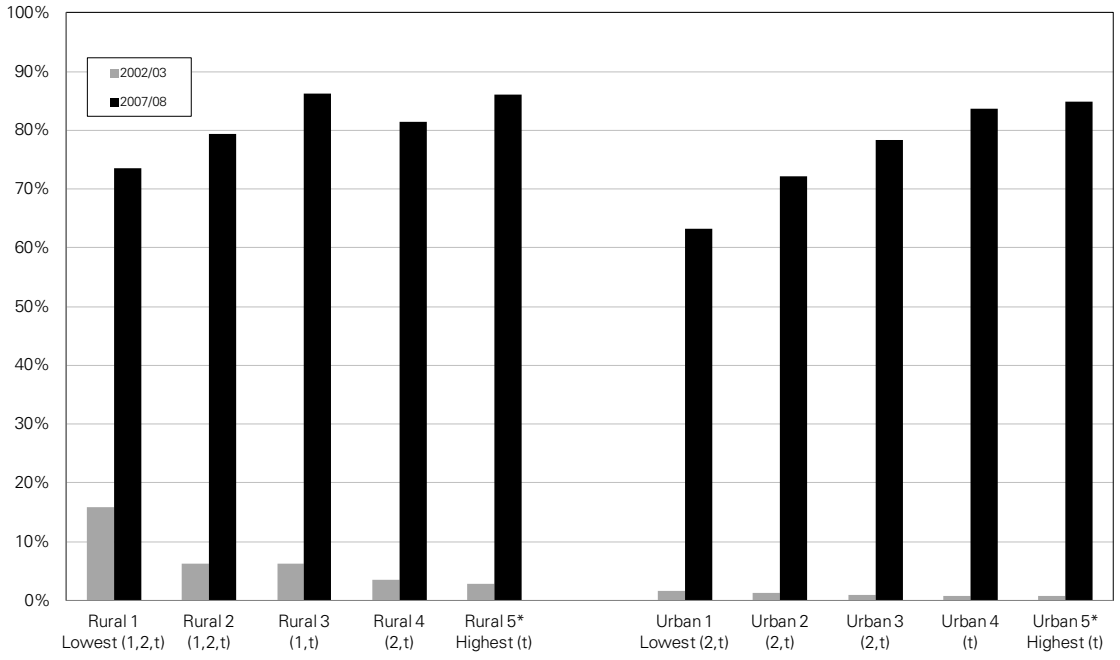


'1' indicates area's rate was statistically different from Manitoba average in first time period
'2' indicates area's rate was statistically different from Manitoba average in second time period
't' indicates change over time was statistically significant for that area
's' indicates data suppressed due to small numbers
Men-C was added to the recommended immunization schedule in October 2004

Source: Manitoba Centre for Health Policy, 2011

Figure 2.79: Meningococcal Conjugate (Men-C) Immunization Rates by Income Quintile, Aged 11

Percent of children who are complete from birth for Men-C, 2002/03 and 2007/08



'1' indicates quintile's rate was statistically different from reference group in first time period
'2' indicates quintile's rate was statistically different from reference group in second time period
't' indicates change over time was statistically significant for that quintile
's' indicates data suppressed due to small numbers
'*' indicates the reference group. Rural 5 is the reference group for rural quintiles; Urban 5 is the reference group for urban quintiles
Men-C was added to the recommended immunization schedule in October 2004

Source: Manitoba Centre for Health Policy, 2011

Table 2.31: Factors Associated with Being Complete from Birth for the Meningococcal Conjugate (Men-C) Immunization, Aged 11
Adjusted Odds Ratio (95% Confidence Interval), 2007/08

Factor	Category	Adjusted Odds Ratio (95% CI)	
		Model 1	Model 2
Coverage from Birth	Covered from Birth	***Reference***	***Reference***
	Not Covered from Birth	0.63 (0.55, 0.72)	0.38 (0.34, 0.41)
Income Quintile	Quintile 1 (lowest)	0.33 (0.28, 0.40)	0.43 (0.38, 0.49)
	Quintile 2	0.49 (0.40, 0.59)	0.59 (0.52, 0.67)
	Quintile 3	0.74 (0.61, 0.91)	0.78 (0.68, 0.89)
	Quintile 4	0.74 (0.61, 0.91)	0.85 (0.74, 0.97)
	Quintile 5 (highest)	***Reference***	***Reference***
Mother's Age at Birth	Unknown	0.87 (0.47, 1.61)	0.53 (0.37, 0.76)
	18 and younger	0.58 (0.47, 0.70)	0.68 (0.58, 0.80)
	19-24	0.76 (0.67, 0.86)	0.83 (0.75, 0.91)
	25-34	***Reference***	***Reference***
	35 and older	0.87 (0.72, 1.05)	0.89 (0.78, 1.01)
Continuity of Care	No Continuity of Care	0.77 (0.66, 0.90)	0.97 (0.86, 1.08)
	Less than 3 Physician Visits*	0.73 (0.63, 0.83)	0.70 (0.63, 0.77)
	Continuity of Care	***Reference***	***Reference***
Provider Type	Mixed Providers	108.10 (89.60, 130.42)	
	Regional Health Unit	58.89 (47.41, 73.16)	
	Other/Unspecified	2.43 (1.38, 4.26)	
	Physician	***Reference***	
Region of Residence	Brandon	1.47 (1.05, 2.04)	2.09 (1.65, 2.64)
	North	0.78 (0.64, 0.95)	1.71 (1.47, 2.00)
	Rural South	0.77 (0.67, 0.87)	1.52 (1.39, 1.66)
	Winnipeg	***Reference***	***Reference***
Sex of Child	Male	0.82 (0.74, 0.91)	0.85 (0.78, 0.92)
	Female	***Reference***	***Reference***
Number of Children in the Family	1 Child	1.00 (0.85, 1.17)	0.97 (0.86, 1.08)
	2-3 Children	***Reference***	***Reference***
	4 or more Children	0.55 (0.48, 0.62)	0.57 (0.52, 0.63)

Model 1–children with no immunizations are excluded from the adjusted model

Model 2–children with no immunizations are included in the adjusted model; provider type not included as a covariate

'*' for children with less than 3 physician visits, we were unable to define continuity of care

Men-C was added to the recommended immunization schedule in October 2004

Source: Manitoba Centre for Health Policy, 2011

The School Based Program—Varicella

Manitoba commenced its varicella program in 2004 for infants 12 months of age, susceptible pre–schoolers, and susceptible Grade Four children. The analysis of 11–year–old children was included with the primary series varicella. (See section entitled "The Primary Series—Varicella", Figures 2.38–2.47, and Tables 2.18 and 2.19.)

The School Based Program—Tetanus and Diphtheria

Six doses of tetanus toxoid are recommended and required before age 17 to be considered complete for age from birth.

Immunization rates for tetanus at 17 years of age over an eight–year period are presented in Figure 2.80. In 2007/08, 96% of 17–year–olds in Manitoba had received one or more tetanus immunizations with 67% receiving the complete six dose series and 29% receiving between one and five doses. It is important to note that, although one–third of 17–year–olds are not complete for age from birth, the vast majority would be considered immune at this age given that three doses plus one booster by age 17 constitutes being up to date—i.e., no further doses would be recommended. This analysis indicates that 5% of children had no record of any tetanus immunizations. The trend over time is relatively stable for both complete as well as complete plus partial for age from birth rates. Most partially immunized 17–year–olds had five of six tetanus toxoid doses (Figure 2.81). Figure 2.82 illustrates that over an eight–year period about 71% of 17–year–olds received their final dose while in school, which suggests that increasing the Grade Eight/Nine booster rates could improve complete from birth rates. A final point concerning MIMS limitations here is the fact that most tetanus vaccinations administered in emergency rooms are not entered into MIMS.

The next analysis looks at the RHA rates of tetanus immunization at age 17 at two different time points, 2002/2003 and 2007/2008 (Figure 2.83). In 2007/08, South Eastman, Central, Assiniboine, Brandon, Interlake, and Parkland RHA rates were significantly above the Manitoba average while Winnipeg and Burntwood regions were below the Manitoba average. Winnipeg, Interlake, and Burntwood saw statistically significant increases over time in the rate of complete from birth tetanus immunization of their 17–year–old populations.

Figures 2.84 and 2.85 illustrate RHA district and Winnipeg CA differences. Using the Assiniboine RHA (AS) as an example, we see that complete from birth immunization rates for tetanus in 2007/08 in the Assiniboine East 2 district (85%) are higher than those observed in the Assiniboine North 2 district (70%). In 2007/08, the Winnipeg RHA analysis of its 12 CAs shows differences as well, with Assiniboine South at 72% and Point Douglas at 44%. River Heights, Inkster, Downtown, and Point Douglas had statistically significant increases in their rates from 2002/03 to 2007/08.

In order to better understand the factors that are associated with receiving six doses of tetanus antigen by age 17, logistic regression models were developed (Table 2.32). The relationship between socioeconomic status and immunization status in both rural and urban settings is illustrated in Figure 2.86. Seventeen–year–olds from lower income quintiles were once again less likely to have six doses of tetanus toxoid administered than those in higher income quintiles.

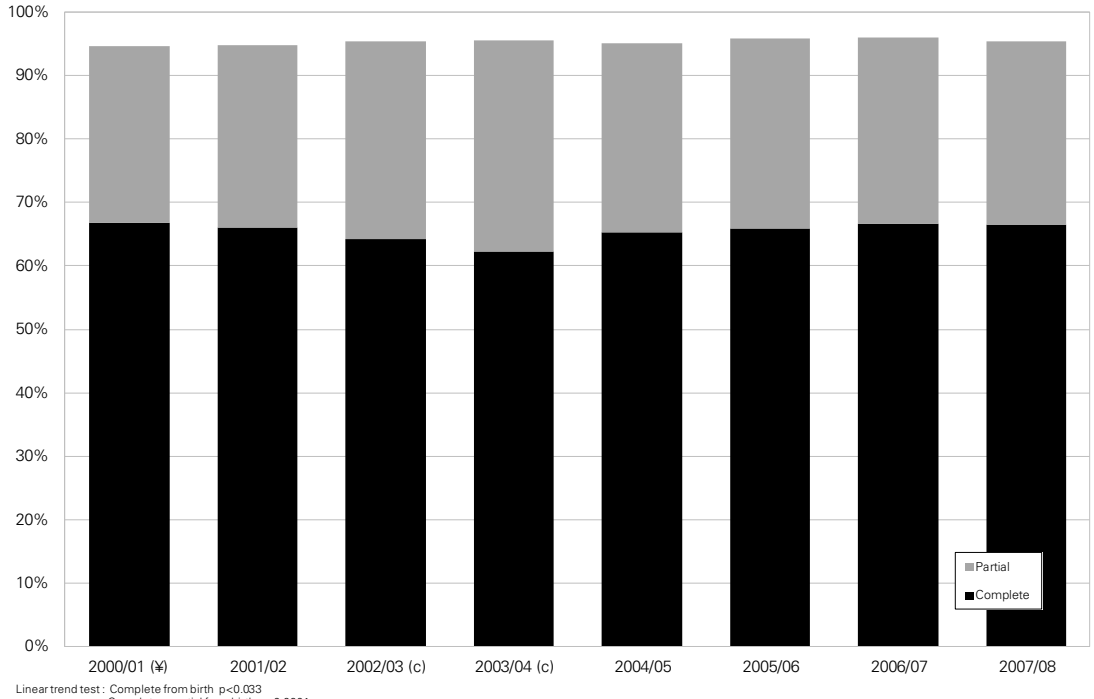
Children who were not continuously registered with Manitoba Health from birth were significantly less likely to have six doses of tetanus than those who were continuously registered. For example, in 2007/08, only 39% of those children who were not continuously registered had received all recommended doses according to their MIMS record compared to 75% of those who were continuously registered from birth (Table 2.35).

Maternal age at birth once again plays a role in complete from birth immunization rates. Children born to mothers aged 24 and younger were less likely to receive all five tetanus doses by age 17 (Table 2.32). This finding is not surprising and has been noted elsewhere in the literature (Wiecha & Gann, 1994;

Luman, McCauley, Shefer, & Chu, 2003). Children in families with four or more children or one child only were less likely to be completely immunized when compared to children in families with two or three children.

Seventeen–year–olds who had mixed providers or regional health unit administered vaccine were once again more likely to be complete from birth at age 17. This is expected due to the school based delivery setting. Continuity of care was not significantly associated with complete from birth tetanus immunization at age 17.

Figure 2.80: Manitoba Tetanus Immunization Rates, Aged 17
Percent of children who are complete/partial from birth for the tetanus vaccination, 2000/01–2007/08

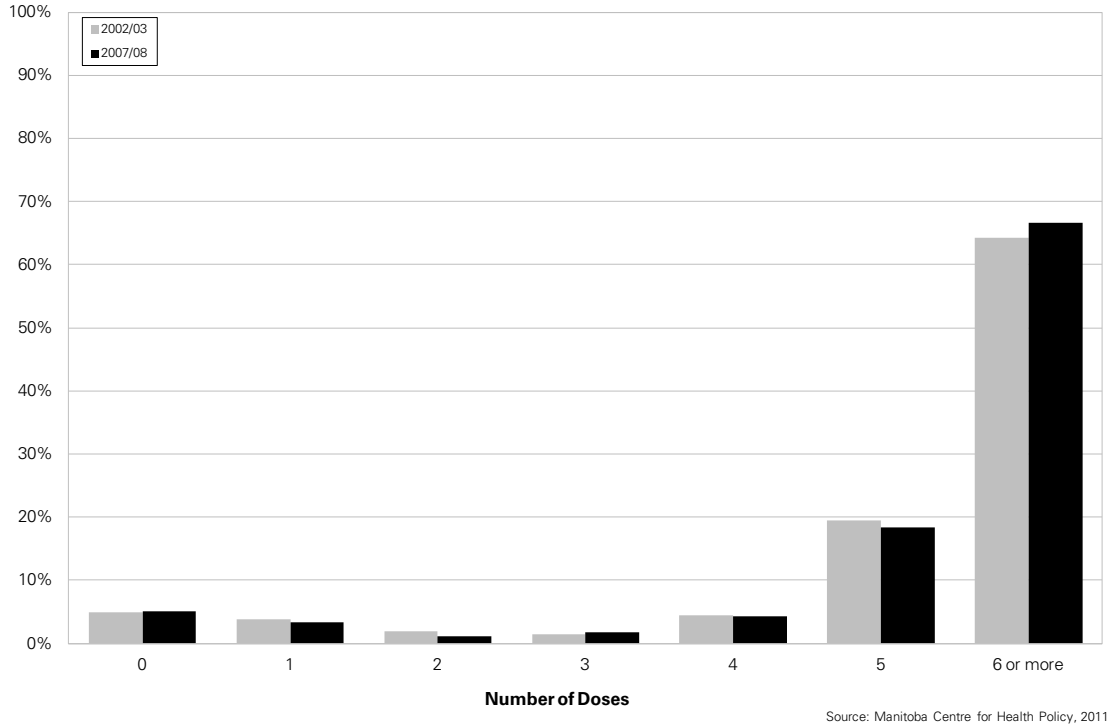


Linear trend test : Complete from birth p<0.033
Complete + partial from birth p= 0.0001

'c' indicates the complete from birth rate for this fiscal year, was statistically different from the complete from birth rate in 2007/08
'¥' indicates the complete + partial from birth rate for this fiscal year was statistically different from the complete + partial from birth rate in 2007/08

Source: Manitoba Centre for Health Policy, 2011

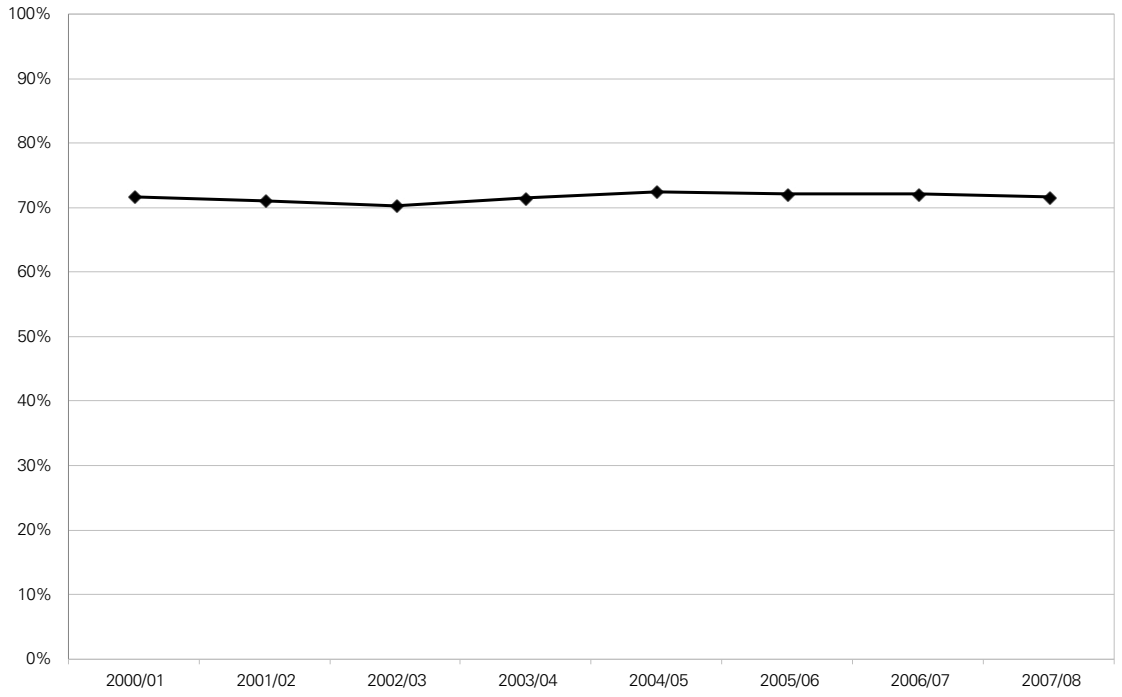
Figure 2.81: Tetanus Immunization by the Number of Doses Received, Aged 17, 2007/08



Source: Manitoba Centre for Health Policy, 2011

Figure 2.82: Tetanus Booster Rates, Aged 17

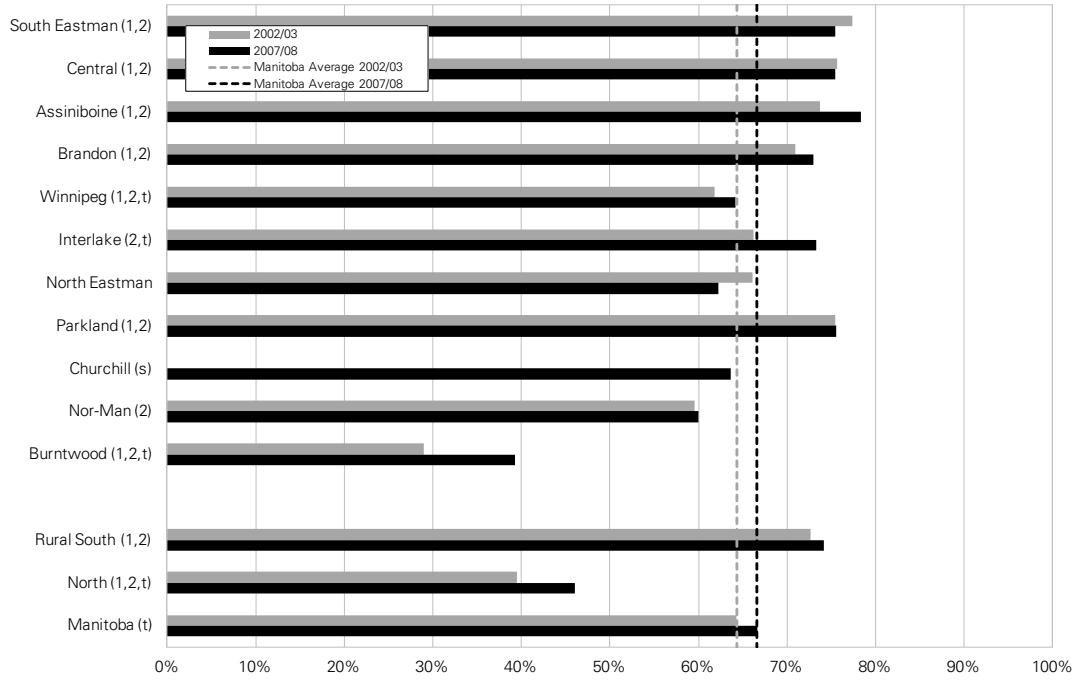
Percent of children who received a tetanus immunization after 12 and by 17



Source: Manitoba Centre for Health Policy, 2011

Figure 2.83: RHA Tetanus Immunization Rates, Aged 17

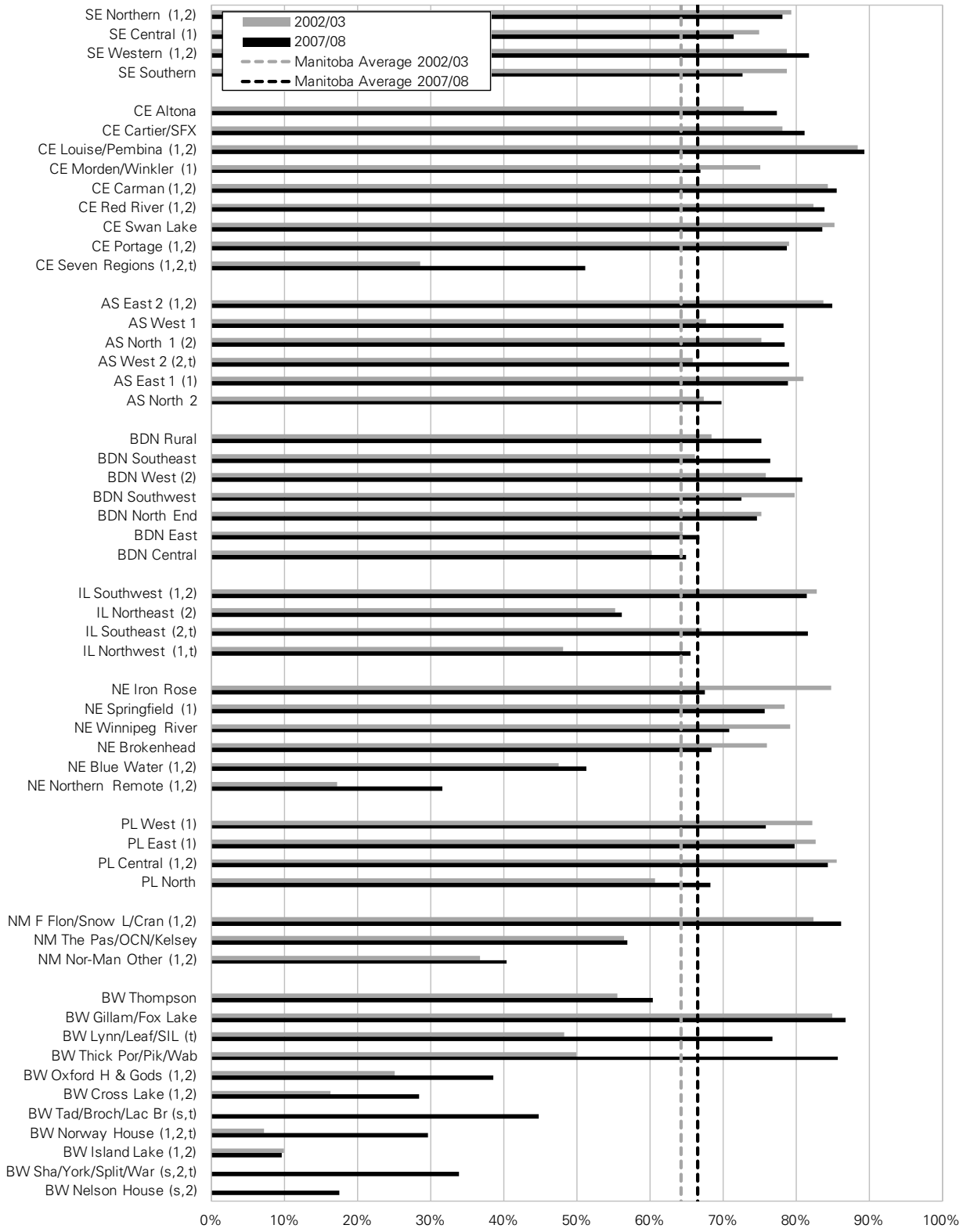
Percent of children who are complete from birth for the tetanus vaccination, 2002/03 and 2007/08



'1' indicates area's rate was statistically different from Manitoba average in first time period
'2' indicates area's rate was statistically different from Manitoba average in second time period
't' indicates change over time was statistically significant for that area
's' indicates data suppressed due to small numbers

Source: Manitoba Centre for Health Policy, 2011

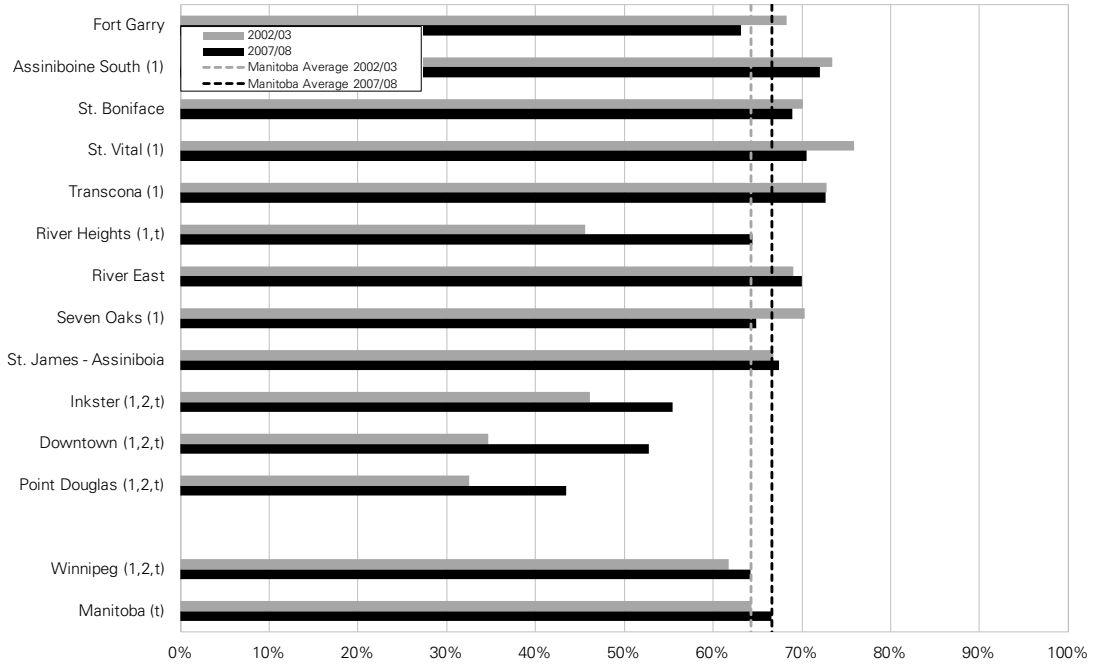
Figure 2.84: RHA District Tetanus Immunization Rates, Aged 17
Percent of children who are complete from birth for the tetanus vaccination, 2002/03 and 2007/08



Source: Manitoba Centre for Health Policy, 2011

Figure 2.85: Winnipeg CA Tetanus Immunization Rates, Aged 17

Percent of children who are complete from birth for the tetanus vaccination, 2002/03 and 2007/08

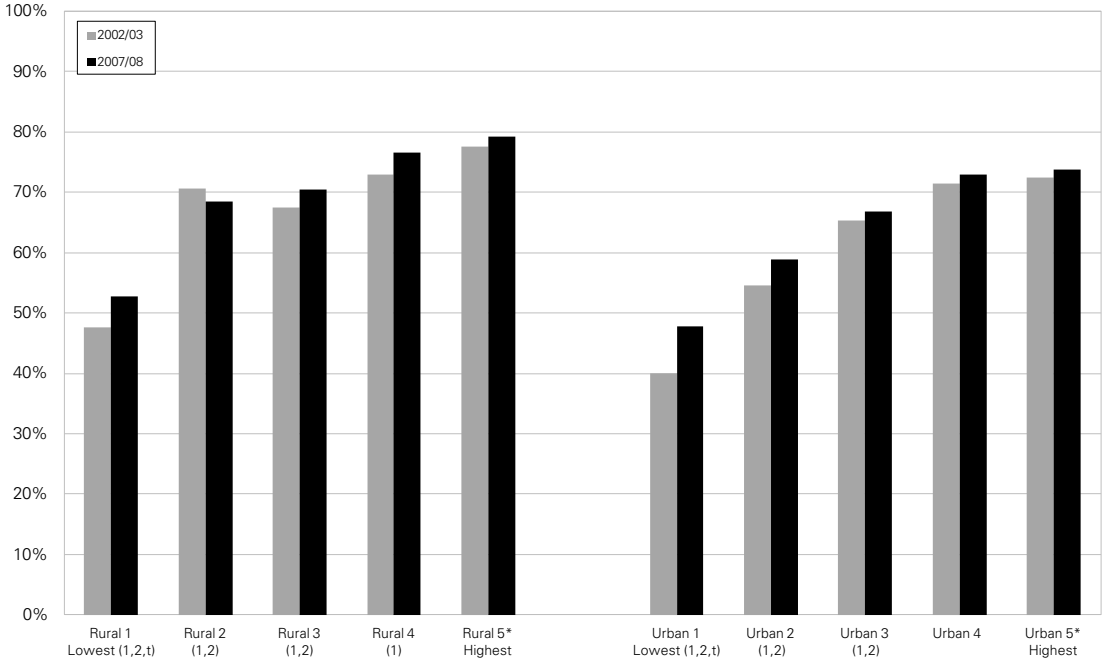


'1' indicates area's rate was statistically different from Manitoba average in first time period
'2' indicates area's rate was statistically different from Manitoba average in second time period
't' indicates change over time was statistically significant for that area
's' indicates data suppressed due to small numbers

Source: Manitoba Centre for Health Policy, 2011

Figure 2.86: Tetanus Immunization Rates by Income Quintile, Aged 17

Percent of children who are complete from birth for the tetanus vaccination, 2002/03 and 2007/08



'1' indicates quintile's rate was statistically different from reference group in first time period
'2' indicates quintile's rate was statistically different from reference group in second time period
't' indicates change over time was statistically significant for that quintile
's' indicates data suppressed due to small numbers
'*' indicates the reference group. Rural 5 is the reference group for rural quintiles; Urban 5 is the reference group for urban quintiles

Source: Manitoba Centre for Health Policy, 2011

Table 2.32: Factors Associated with Being Complete from Birth for the Tetanus Immunization, Aged 17
Adjusted Odds Ratio (95% Confidence Interval), 2007/08

Factor	Category	Adjusted Odds Ratio (95% CI)	
		Model 1	Model 2
Coverage from Birth	Covered from Birth	***Reference***	***Reference***
	Not Covered from Birth	0.31 (0.28,0.34)	0.19 (0.18,0.21)
Income Quintile	Quintile 1 (lowest)	0.43 (0.38,0.48)	0.36 (0.33,0.41)
	Quintile 2	0.67 (0.59,0.75)	0.59 (0.53,0.66)
	Quintile 3	0.79 (0.70,0.89)	0.72 (0.64,0.80)
	Quintile 4	0.94 (0.84,1.07)	0.92 (0.82,1.03)
	Quintile 5 (highest)	***Reference***	***Reference***
Mother's Age at Birth	Unknown	0.75 (0.56,1.01)	0.70 (0.54,0.91)
	18 or younger	0.56 (0.48,0.66)	0.59 (0.50,0.68)
	19-24	0.70 (0.64,0.77)	0.74 (0.68,0.80)
	25-34	***Reference***	***Reference***
	35 or older	1.00 (0.87,1.15)	1.02 (0.90,1.17)
Continuity of Care	No Continuity of Care	0.94 (0.85,1.03)	0.98 (0.89,1.08)
	Less than 3 Physician Visits*	0.64 (0.59,0.71)	0.58 (0.53,0.63)
	Continuity of Care	***Reference***	***Reference***
Provider Type	Mixed Providers	6.88 (5.68,8.34)	
	Regional Health Unit	2.93 (2.38,3.61)	
	Other/Unspecified	0.78 (0.39,1.55)	
	Physician	***Reference***	
Region of Residence	Brandon	1.92 (1.56,2.37)	1.92 (1.58,2.34)
	North	0.64 (0.56,0.73)	0.52 (0.46,0.59)
	Rural South	1.92 (1.76,2.10)	1.80 (1.66,1.94)
	Winnipeg	***Reference***	***Reference***
Sex of Child	Male	0.99 (0.92,1.07)	1.00 (0.93,1.07)
	Female	***Reference***	***Reference***
Number of Children in the Family	1 Child	0.90 (0.83,0.97)	0.91 (0.84,0.99)
	2-3 Children	***Reference***	***Reference***
	4 or more Children	0.61 (0.53,0.68)	0.57 (0.50,0.64)

Model 1–children with no immunizations are excluded from the adjusted model

Model 2–children with no immunizations are included in the adjusted model; provider type not included as a covariate

'*' for children with less than 3 physician visits, we were unable to define continuity of care

Source: Manitoba Centre for Health Policy, 2011

Table 2.33: Complete from Birth Crude Rates for Hepatitis B Immunization by Sociodemographic Factors, Aged 11, 2002/03 and 2007/08

Factor	Category	% Complete from Birth	
		2002/03	2007/08
Coverage from Birth	Covered from Birth (l) ***Reference***	71.10	76.80
	Not Covered from Birth (1,2,l)	60.60	58.30
Income Quintile	Rural 1 (lowest) (1,2,t,l)	54.60	63.40
	Rural 2 (1,2,l)	71.10	75.40
	Rural 3 (1,t,l)	67.20	80.10
	Rural 4 (1,2,t,l)	70.10	75.80
	Rural 5 (highest) (t,l) ***Reference***	76.50	81.80
	Urban 1 (lowest) (1,2,l)	58.60	58.90
	Urban 2 (1,2,l)	67.50	67.80
	Urban 3 (1,l)	71.60	74.90
	Urban 4 (2,t,l)	75.20	79.70
	Urban 5 (highest) (l) ***Reference***	77.70	75.80
Mother's Age at Birth	Unknown (1,2,l)	48.90	50.00
	18 and younger (1,2,l)	58.20	63.00
	19-24 (1,2,t,l)	63.90	69.50
	25-34 (t,l) ***Reference***	72.70	75.90
	35 and older (l)	70.00	73.50
Continuity of Care	No Continuity of Care (1,t,l)	71.40	75.20
	Less than 3 Physician Visits* (1,2,t,l)	63.30	69.40
	Continuity of Care (t,l) ***Reference***	74.40	76.90
Provider Type	Mixed Providers (1,2,l)	85.70	86.50
	Regional Health Unit (1,2,t,l)	63.70	72.40
	Other/Unspecified (1,2,l)	16.70	27.90
	Physician (t,l) ***Reference***	8.10	13.70
Region of Residence	Brandon (1,2,l)	75.60	79.20
	North (1,2,t,l)	51.40	69.80
	Rural South(1,2,t,l)	71.30	76.10
	Winnipeg (2,l)	70.20	70.90
	Manitoba (t,l) ***Reference***	69.20	73.00
Number of Children in the Family	1 Child (1,2,t,l)	74.90	73.80
	2-3 Children (t,l) ***Reference***	77.10	76.10
	4 or more Children (1,2,t,l)	57.10	61.40

'1' indicates quintile's rate was statistically different from reference group in first time period

'2' indicates quintile's rate was statistically different from reference group in second time period

't' indicates change over time was statistically significant

's' indicates data suppressed due to small numbers

'l' indicates a significant linear trend over time

*for children with less than 3 physician visits, we were unable to define continuity of care

Source: Manitoba Centre for Health Policy, 2011

Table 2.34: Complete from Birth Crude Rates for Meningococcal Conjugate (Men-C) Immunization by Sociodemographic Factors, Aged 11, 2002/03 and 2007/08

Factor	Category	% Complete from Birth	
		2002/03	2007/08
Coverage from Birth	Covered from Birth (t,l) ***Reference***	4.00	82.50
	Not Covered from Birth (2,t,l)	3.40	63.20
Income Quintile	Rural 1 (Lowest) (1,2,t,l)	15.90	73.50
	Rural 2 (1,2,t,l)	6.20	79.30
	Rural 3 (1,t,l)	6.30	86.20
	Rural 4 (2,t,l)	3.50	81.50
	Rural 5 (highest) (t,l) ***Reference***	2.90	86.10
	Urban 1 (lowest) (2,t,l)	1.60	63.20
	Urban 2 (2,t,l)	1.20	72.20
	Urban 3 (2,t,l)	1.00	78.30
	Urban 4 (t,l)	0.80	83.70
	Urban 5 (highest) (t,l)	0.80	84.90
Mother's Age at Birth	Unknown (2,t,l)	s	55.20
	18 and younger (1,2,t,l)	10.20	72.20
	19-24 (1,2,t,l)	5.50	75.00
	25-34 (t,l) ***Reference***	2.70	81.10
	35 and older (t,l)	2.50	79.00
Continuity of Care	No Continuity of Care (1,t,l)	4.30	81.70
	Less than 3 Physician Visits* (2,t,l)	3.90	74.60
	Continuity of Care (t,l) ***Reference***	3.20	82.10
Provider Type	Mixed Providers (1,2,t,l)	2.70	92.60
	Regional Health Unit (1,2,t,l)	10.70	80.30
	Other/Unspecified (1,l)	s	15.30
	Physician (t,l) ***Reference***	s	12.70
Region of Residence	Brandon (2,t,l)	2.20	86.10
	North (1,t,l)	19.60	81.00
	Rural South(2,t,l)	4.30	80.80
	Winnipeg (1,2,t,l)	1.00	76.00
	Manitoba (t,l) ***Reference***	3.90	78.50
Sex of Child	Male(t,l)	3.70	77.20
	Female (2,t,l) ***Reference***	4.00	80.00
Number of Children in the Family	1 Child (t,l)	3.60	79.70
	2-3 Children (t,l) ***Reference***	3.00	81.10
	4 or more Children (1,2,t,l)	7.20	68.40

'1' indicates quintile's rate was statistically different from reference group in first time period

'2' indicates quintile's rate was statistically different from reference group in second time period

't' indicates change over time was statistically significant

's' indicates data suppressed due to small numbers

'l' indicates a significant linear trend over time

'*' for children with less than 3 physician visits, we were unable to define Continuity of Care

Men-C was added to the recommended immunization schedule in October 2004

Source: Manitoba Centre for Health Policy, 2011

Table 2.35: Complete from Birth Crude Rates for Tetanus Immunization by Sociodemographic Factors, Aged 17, 2002/03 and 2007/08

Factor	Category	% Complete from Birth	
		2002/03	2007/08
Coverage from Birth	Covered from Birth (t,l) ***Reference***	70.90	75.10
	Not Covered from Birth (1,2,l)	41.40	38.90
Income Quintile	Rural 1 (lowest) (1,2,t,l)	47.70	52.80
	Rural 2 (1,2,l)	70.60	68.40
	Rural 3 (1,2,l)	67.50	70.40
	Rural 4 (1)	73.00	76.60
	Rural 5 (highest) (l) ***Reference***	77.50	79.30
	Urban 1 (lowest) (1,2,t,l)	40.00	47.80
	Urban 2 (1,2,l)	54.60	58.80
	Urban 3 (1,2)	65.40	66.80
	Urban 4 (l)	71.40	72.90
	Urban 5 (highest) ***Reference***	72.50	73.70
Mother's Age at Birth	Unknown (1,2,l)	27.40	32.30
	18 and younger (1,2,t,l)	40.10	50.50
	19-24 (1,2)	60.10	59.20
	25-34 (t) ***Reference***	70.00	71.80
	35+ (1,t,l)	64.00	71.00
Continuity of Care	No Continuity of Care (1,t,l)	66.50	72.20
	Less than 3 Physician Visits* (1,2)	57.80	57.90
	Continuity of Care (t,l) ***Reference***	69.60	73.40
Provider Type	Mixed Providers (1,2,t)	72.10	76.90
	Regional Health Unit (1,2,l)	51.50	50.00
	Other/Unspecified (2)	12.50	14.50
	Physician (t,l) ***Reference***	21.20	28.90
Region of Residence	Brandon (1,2)	70.90	73.00
	North (1,2,t,l)	39.50	46.00
	Rural South(1,2)	72.70	74.20
	Winnipeg (1,2,t)	61.50	64.10
	Manitoba (t,l) ***Reference***	64.30	66.60
Number of Children in the Family	1 Child (t,l)	66.00	69.40
	2-3 Children ***Reference***	66.60	68.40
	4 or more Children (1,2)	45.80	46.50

'1' indicates quintile's rate was statistically different from reference group in first time period

'2' indicates quintile's rate was statistically different from reference group in second time period

't' indicates change over time was statistically significant

's' indicates data suppressed due to small numbers

'l' indicates a significant linear trend over time

*' for children with less than 3 physician visits, we were unable to define continuity of care

Source: Manitoba Centre for Health Policy, 2011

The Overall Picture

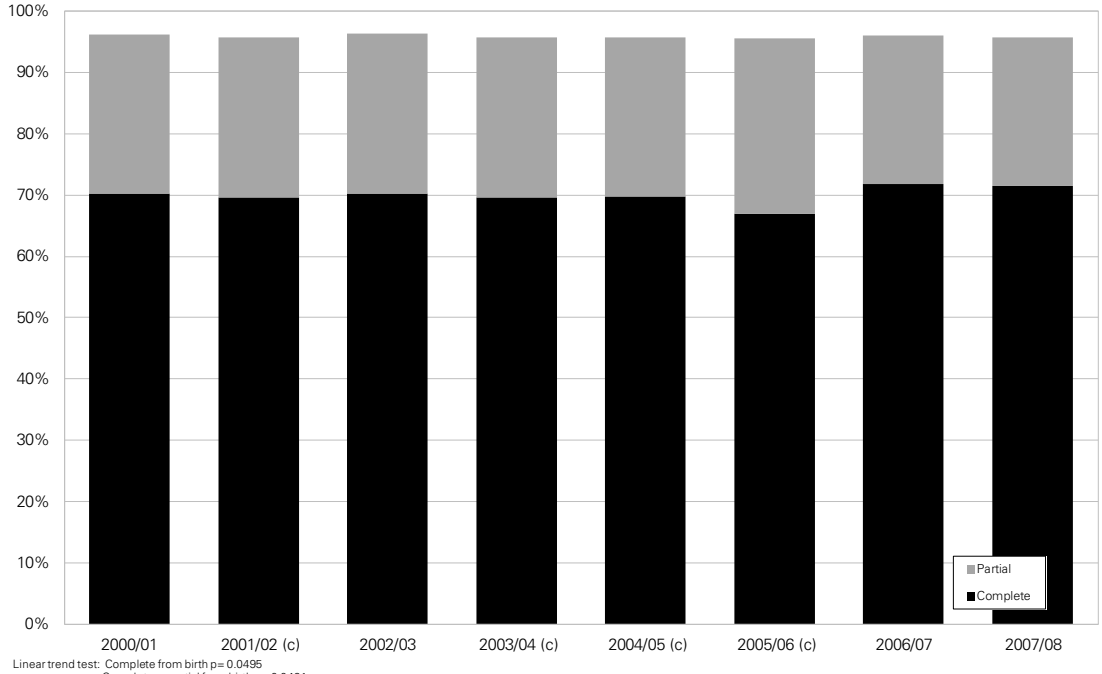
To assess the overall "completeness" of immunizations, we looked at how many children were complete from birth for a composite of antigens at age two, seven, 11, and 17. Due to changes in immunization policy during the study, measles, HBV, varicella, Men–C, and PCV–7 were excluded from these analyses. Tetanus, diphtheria, pertussis, polio, mumps, rubella, and Hib were included in the analyses.

Complete at Age Two for All Indicated Antigens

Figure 2.87 illustrates the remarkable stability of complete from birth immunization rates over the eight–year period from 2000/01 to 2007/08. Small but statistically significant increases in immunization rates were seen in 2006/07 and 2007/08. Rates increased in those continuously registered from 73% to 75% over this period (Table 2.39). Figure 2.88 shows increases in complete from birth at age two across virtually all RHAs with South Eastman, Assiniboine, and Parkland having rates higher than the provincial average. Figures 2.89 and 2.90 illustrates the within region variability in complete from birth for age two while Figure 2.91 once again illustrates the impact of income on complete for age from birth. Logistic regression modeling suggests that living in lower income areas, non–continuous registration, a maternal age at birth of less than 25, and children in families with four or more children were all associated with lower rates of complete for age from birth; while one child families, regional health unit delivered immunizations, and living in higher income areas were associated with higher rates of complete from birth for age two (Table 2.36).

Figure 2.87: Manitoba Tetanus, Diphtheria, Pertussis, Polio, Mumps, Rubella, and *Haemophilus influenzae* type B Immunization Rates, Aged 2

Percent of children who are complete/partial from birth for the tetanus, diphtheria, pertussis, polio, mumps, rubella, and Hib vaccinations, 2000/01–2007/08



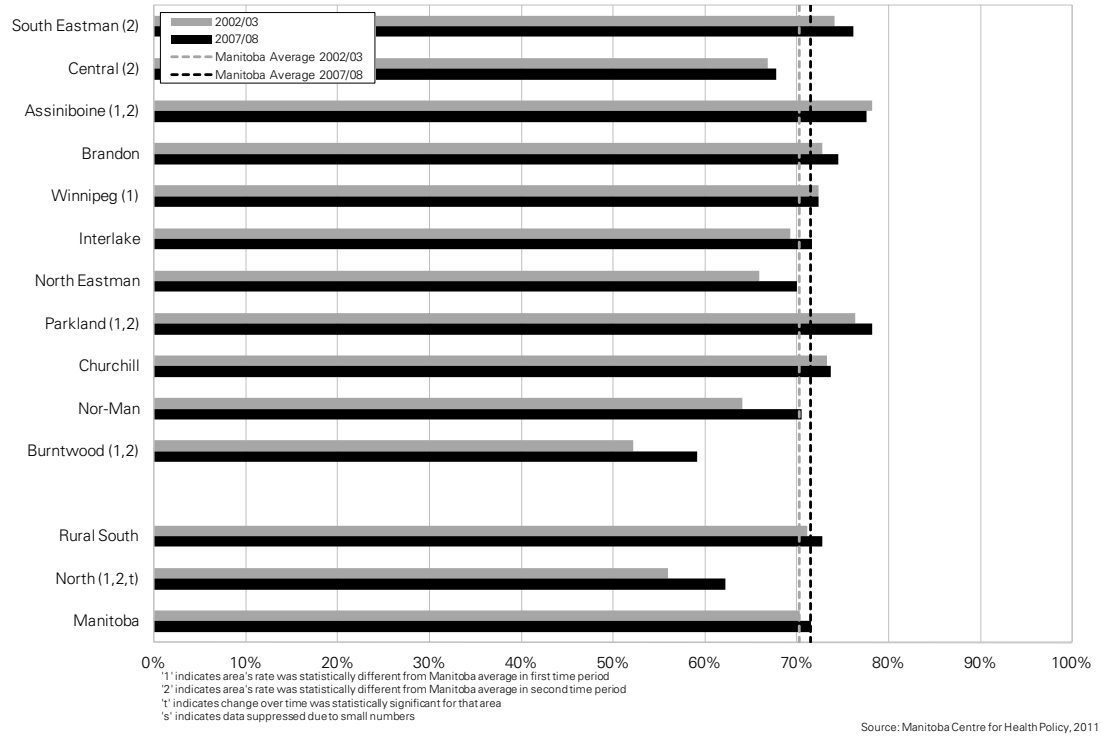
Linear trend test: Complete from birth p= 0.0495
Complete + partial from birth p= 0.0421

'c' indicates the complete from birth was statistically different from the complete from birth rate in 2007/08
'x' indicates the complete + partial from birth rate was statistically different from the complete + partial from birth rate in 2007/08

Source: Manitoba Centre for Health Policy, 2011

Figure 2.88: RHA Tetanus, Diphtheria, Pertussis, Polio, Mumps, Rubella, and *Haemophilus influenzae* type B Immunization Rates, Aged 2

Percent of children who are complete from birth for the tetanus, diphtheria, pertussis, polio, mumps, rubella, and Hib vaccinations, 2002/03 and 2007/08

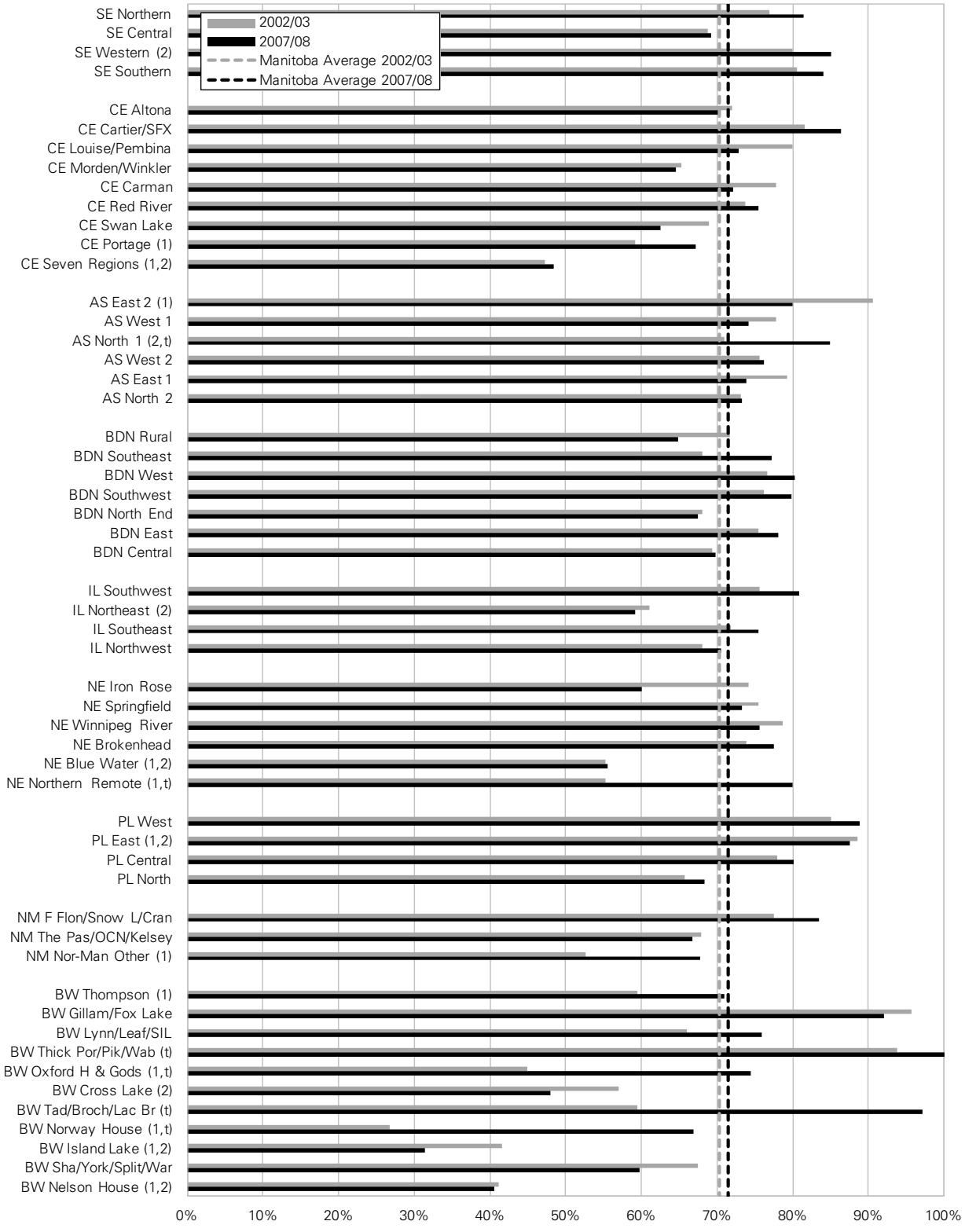


'1' indicates area's rate was statistically different from Manitoba average in first time period
'2' indicates area's rate was statistically different from Manitoba average in second time period
't' indicates change over time was statistically significant for that area
's' indicates data suppressed due to small numbers

Source: Manitoba Centre for Health Policy, 2011

Figure 2.89: RHA District Tetanus, Diphtheria, Pertussis, Polio, Mumps, Rubella, and *Haemophilus influenzae* type B Immunization Rates, Aged 2

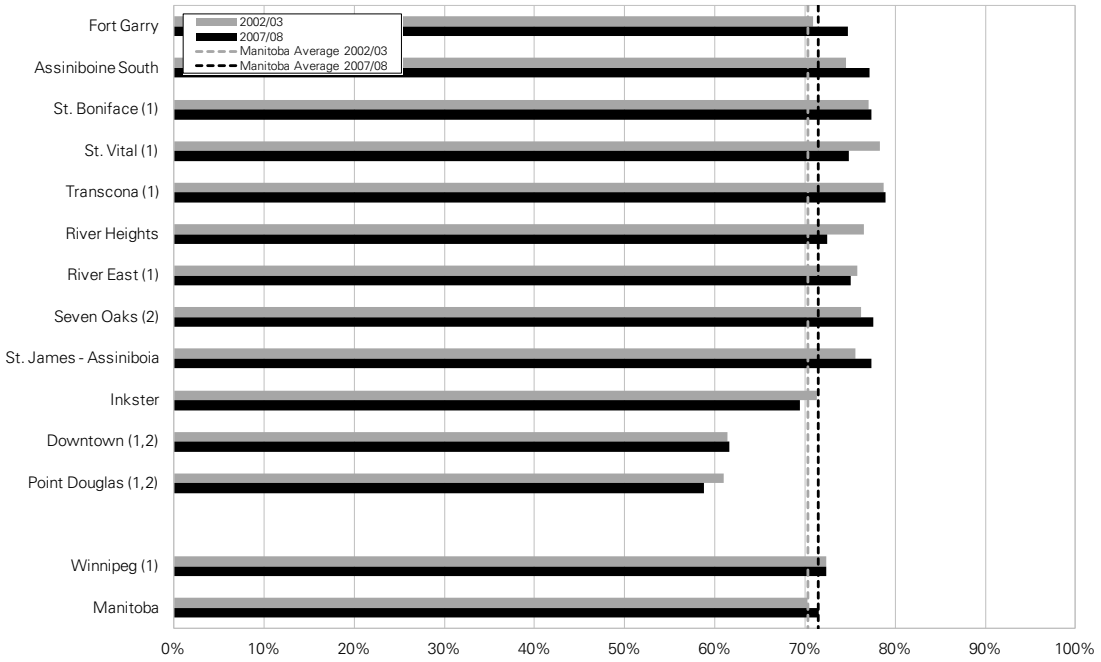
Percent of children who are complete from birth for the tetanus, diphtheria, pertussis, polio, mumps, rubella, and Hib vaccinations, 2002/03 and 2007/08



Source: Manitoba Centre for Health Policy, 2011

Figure 2.90: Winnipeg CA Tetanus, Diphtheria, Pertussis, Polio, Mumps, Rubella, and *Haemophilus influenzae* type B Immunization Rates, Aged 2

Percent of children who are complete from birth for the tetanus, diphtheria, pertussis, polio, mumps, rubella, and Hib vaccinations, 2002/03 and 2007/08

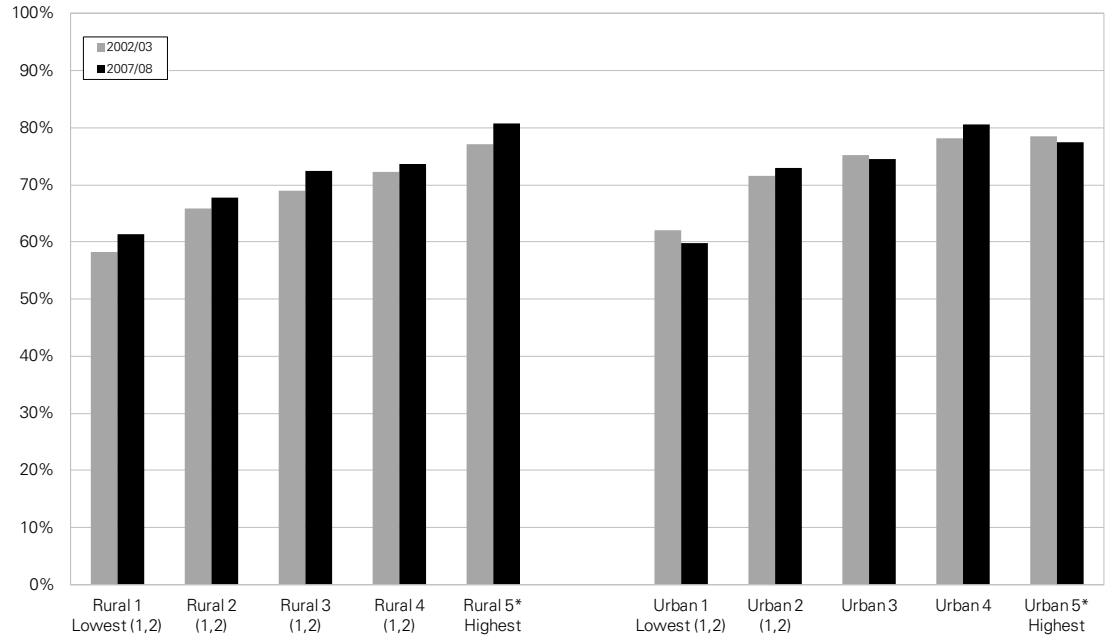


'1' indicates area's rate was statistically different from Manitoba average in first time period
'2' indicates area's rate was statistically different from Manitoba average in second time period
't' indicates change over time was statistically significant for that area
's' indicates data suppressed due to small numbers

Source: Manitoba Centre for Health Policy, 2011

Figure 2.91: Tetanus, Diphtheria, Pertussis, Polio, Mumps, Rubella, and *Haemophilus influenzae* type B Immunization Rates by Income Quintile, Aged 2

Percent of children who are complete from birth for the tetanus, diphtheria, pertussis, polio, mumps, rubella, and Hib vaccinations, 2002/03 and 2007/08



'1' indicates quintile's rate was statistically different from reference group in first time period
'2' indicates quintile's rate was statistically different from reference group in second time period
't' indicates change over time was statistically significant for that quintile
's' indicates data suppressed due to small numbers
'*' indicates the reference group. Rural 5 is the reference group for rural quintiles; Urban 5 is the reference group for urban quintiles

Source: Manitoba Centre for Health Policy, 2011

Table 2.36: Factors Associated with Being Complete from Birth for the Tetanus, Diphtheria, Pertussis, Polio, Mumps, Rubella and *Haemophilus influenzae* type B Immunizations, Aged 2
Adjusted Odds Ratio (95% Confidence Interval), 2007/08

Factor	Category	Adjusted Odds Ratio (95% CI)	
		Model 1	Model 2
Coverage from Birth	Covered from Birth	***Reference***	***Reference***
	Not Covered from Birth	0.16 (0.14,0.19)	0.13 (0.11,0.15)
Income Quintile	Quintile 1 (lowest)	0.51 (0.44,0.59)	0.58 (0.51,0.67)
	Quintile 2	0.70 (0.61,0.82)	0.78 (0.68,0.90)
	Quintile 3	0.78 (0.67,0.91)	0.85 (0.74,0.98)
	Quintile 4	0.87 (0.74,1.01)	0.95 (0.82,1.10)
	Quintile 5 (highest)	***Reference***	***Reference***
Mother's Age at Birth	Unknown	1.01 (0.53,1.91)	0.90 (0.51,1.58)
	18 and younger	0.58 (0.48,0.69)	0.64 (0.54,0.76)
	19-24	0.67 (0.60,0.74)	0.70 (0.64,0.78)
	25-34	***Reference***	***Reference***
	35 and older	1.07 (0.94,1.22)	1.07 (0.95,1.21)
Continuity of Care	No Continuity of Care	0.63 (0.58,0.69)	0.64 (0.58,0.70)
	Less than 3 Physician Visits*	0.52 (0.45,0.60)	0.36 (0.32,0.41)
	Continuity of Care	***Reference***	***Reference***
Provider Type	Mixed Providers	1.41 (1.24,1.61)	
	Regional Health Unit	1.21 (1.06,1.40)	
	Other/Unspecified	0.79 (0.59,1.07)	
	Physician	***Reference***	
Region of Residence	Brandon	1.21 (0.97,1.50)	1.37 (1.11,1.68)
	North	0.83 (0.70,0.99)	1.18 (1.02,1.35)
	Rural South	1.26 (1.12,1.41)	1.36 (1.24,1.49)
	Winnipeg	***Reference***	***Reference***
Sex of Child	Male	0.98 (0.91,1.07)	0.97 (0.90,1.05)
	Female	***Reference***	***Reference***
Number of Children in the Family	1 Child	1.26 (1.14,1.39)	1.27 (1.16,1.40)
	2-3 Children	***Reference***	***Reference***
	4 or more Children	0.42 (0.38,0.47)	0.42 (0.38,0.47)

Model 1–children with no immunizations are excluded from the adjusted model

Model 2–children with no immunizations are included in the adjusted model; provider type not included as a covariate

'*' for children with less than 3 physician visits, we were unable to define continuity of care

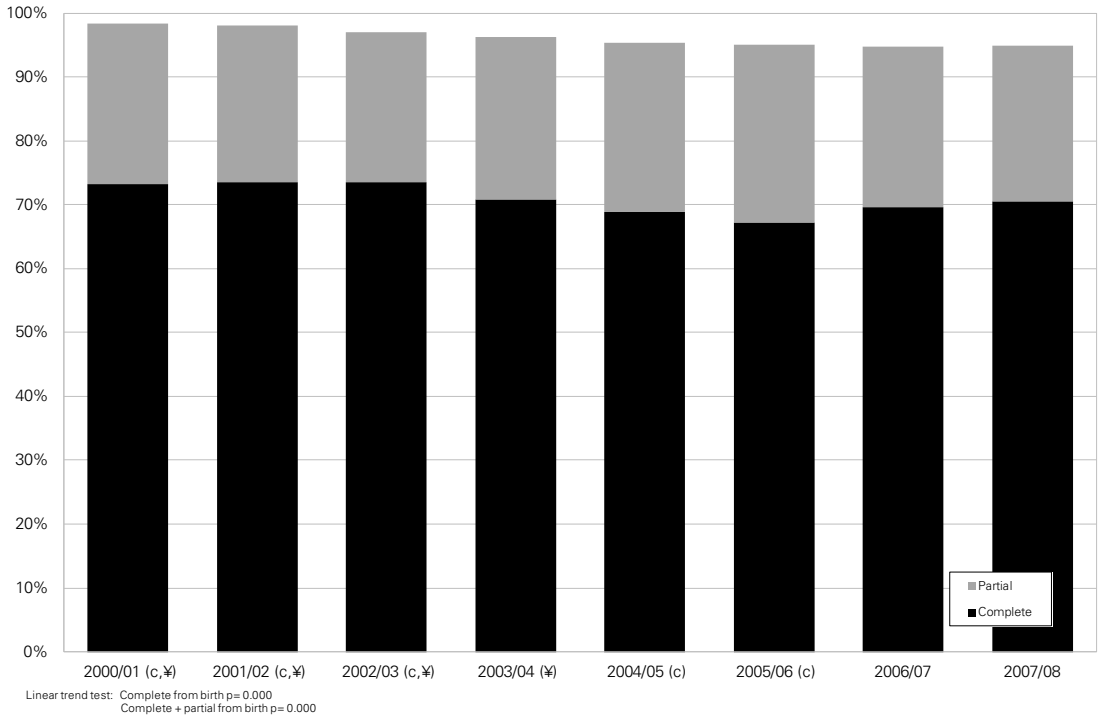
Source: Manitoba Centre for Health Policy, 2011

Complete at Age Seven for All Indicated Antigens

Figure 2.92 illustrates the stability of complete from birth immunization rates at age seven with a small but statistically significant increase in 2007/08 compared to 2004/05 and 2005/06. However, rates were significantly lower compared to the three years from 2000/01–2002/03. Seventy-nine percent of seven–year–olds continuously registered with Manitoba Health had all antigens in 2002/03, and this was essentially unchanged at 79% in 2007/08 (Table 2.40). Interestingly, complete from birth for age seven dropped significantly from 39% to 31% in those not continuously registered from birth over the same period. We cannot tell if the low rates in this group are due to true low and declining rates of immunization or due to inadequate updating of MIMS post registration with Manitoba Health. At the regional level, South Eastman and Winnipeg had statistically significant declines, but North Eastman had a statistically significant increase in immunization rates in 2007/08 versus 2002/03 (Figure 2.93). RHA district, Winnipeg CA, and income quintile rates can be seen in Figures 2.94–2.96. Results of logistic regression analyses can be found in Table 2.37.

Figure 2.92: Manitoba Tetanus, Diphtheria, Pertussis, Polio, Mumps, Rubella, and *Haemophilus influenzae* type B Immunization Rates, Aged 7

Percent of children who are complete/partial from birth for the tetanus, diphtheria, pertussis, polio, mumps, rubella, and Hib vaccinations, 2000/01–2007/08



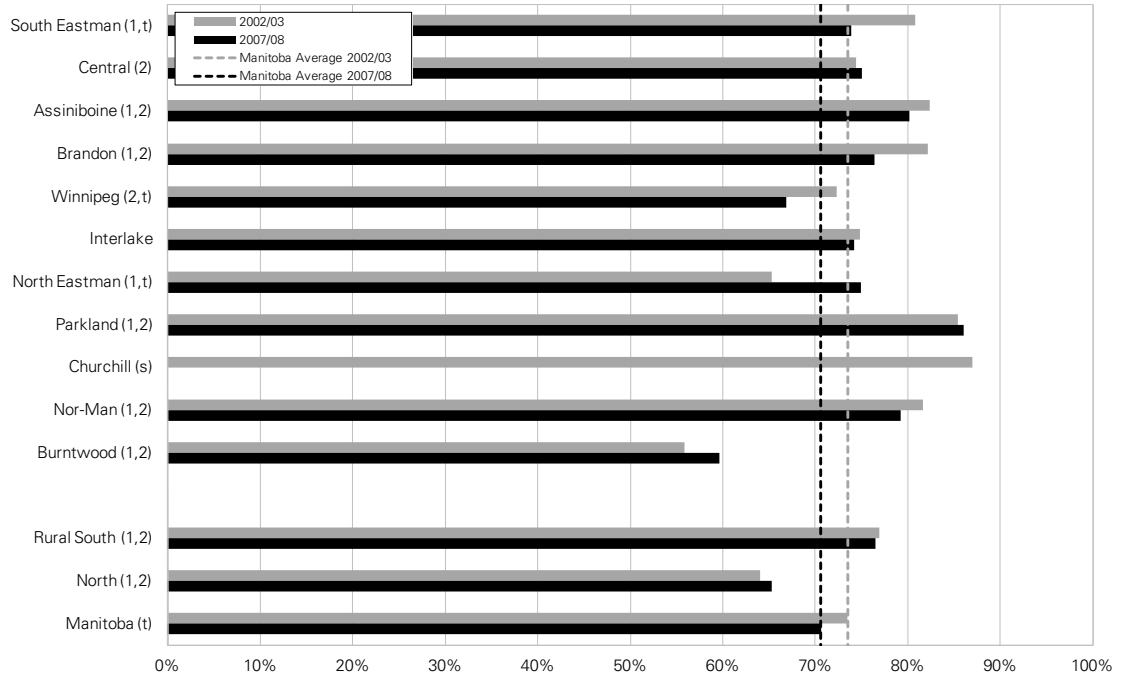
Linear trend test: Complete from birth p= 0.000
Complete + partial from birth p= 0.000

'c' indicates the complete from birth rate was statistically different from the complete from birth rate in 2007/08
'¥' indicates the complete + partial from birth rate was statistically different from the complete + partial from birth rate in 2007/08

Source: Manitoba Centre for Health Policy, 2011

Figure 2.93: RHA Tetanus, Diphtheria, Pertussis, Polio, Mumps, Rubella, and *Haemophilus influenzae* type B Immunization Rates, Aged 7

Percent of children who are complete from birth for the tetanus, diphtheria, pertussis, polio, mumps, rubella, and Hib vaccinations, 2002/03 and 2007/08

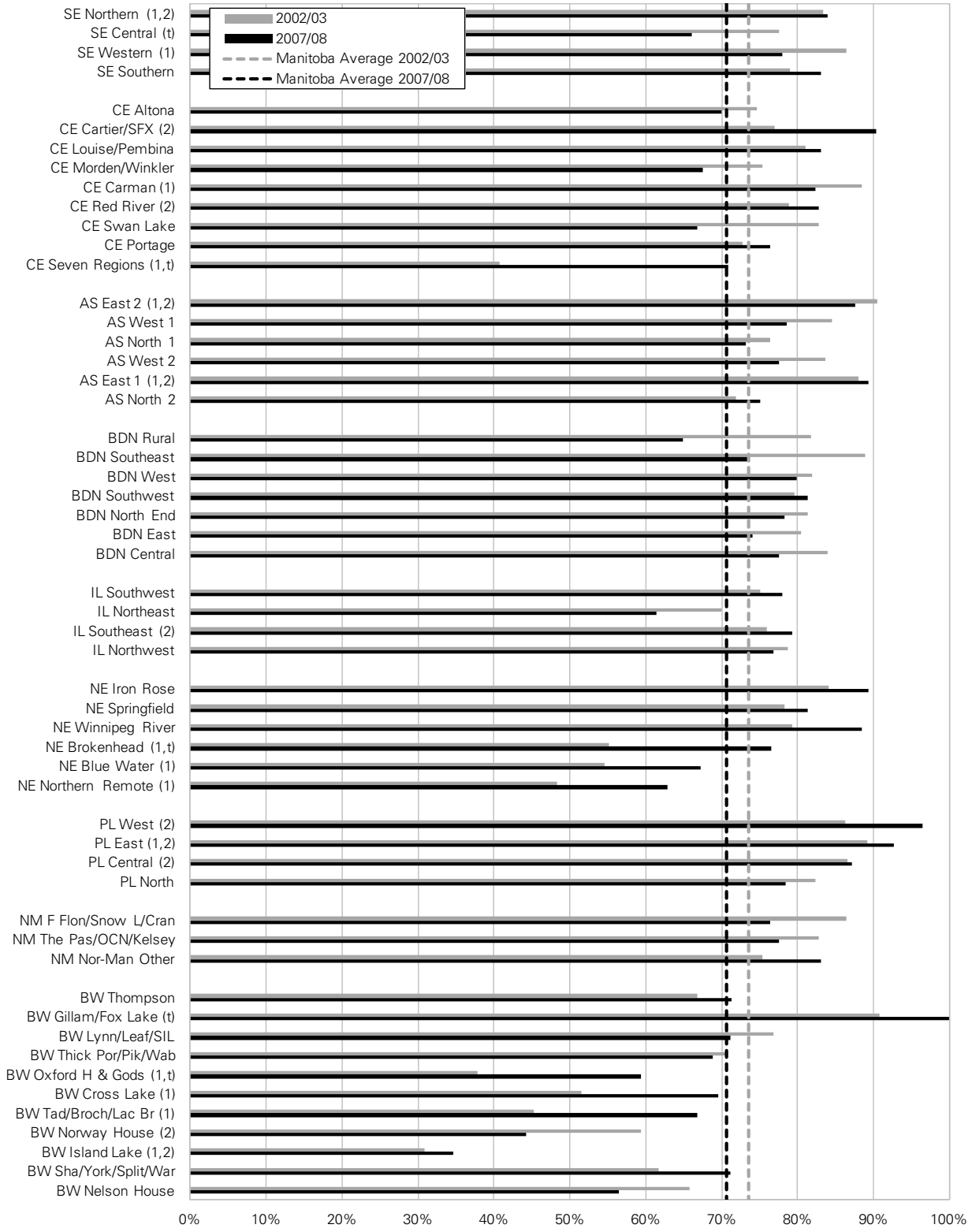


'1' indicates area's rate was statistically different from Manitoba average in first time period
'2' indicates area's rate was statistically different from Manitoba average in second time period
't' indicates change over time was statistically significant for that area
's' indicates data suppressed due to small numbers

Source: Manitoba Centre for Health Policy, 2011

Figure 2.94: RHA District Tetanus, Diphtheria, Pertussis, Polio, Mumps, Rubella, and *Haemophilus influenzae* type B Immunization Rates, Aged 7

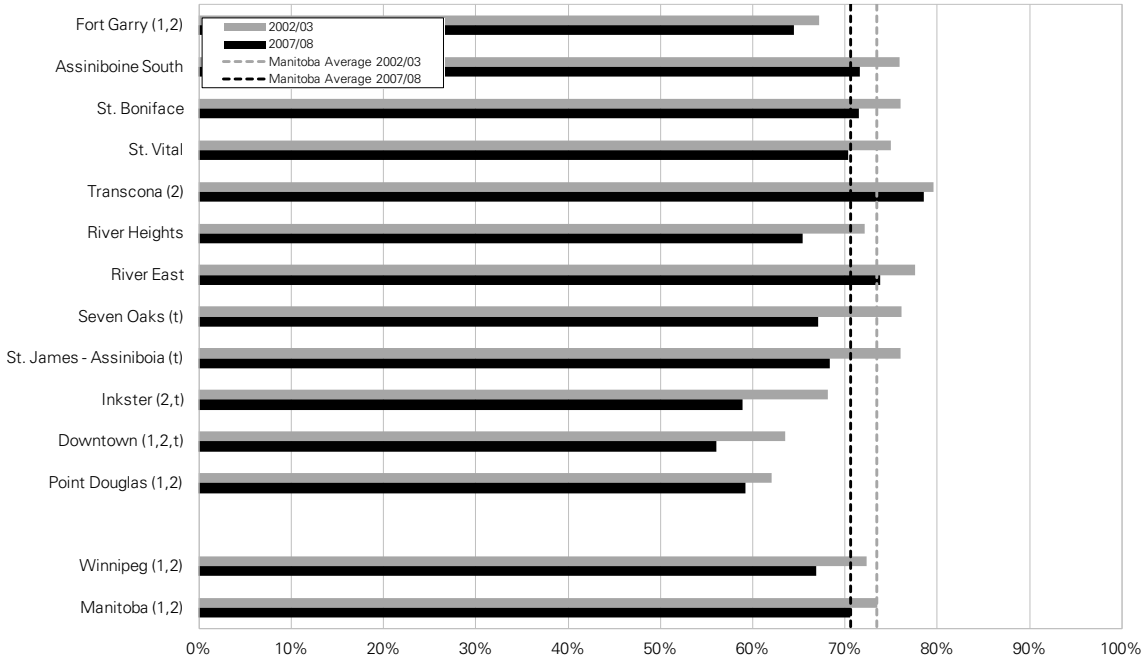
Percent of children who are complete from birth for the tetanus, diphtheria, pertussis, polio, mumps, rubella, and Hib vaccinations, 2002/03 and 2007/08



Source: Manitoba Centre for Health Policy, 2011

Figure 2.95: Winnipeg CA Tetanus, Diphtheria, Pertussis, Polio, Mumps, Rubella, and *Haemophilus influenzae* type B Immunization Rates, Aged 7

Percent of children who are complete from birth for the tetanus, diphtheria, pertussis, polio, mumps, rubella, and Hib vaccinations, 2002/03 and 2007/08

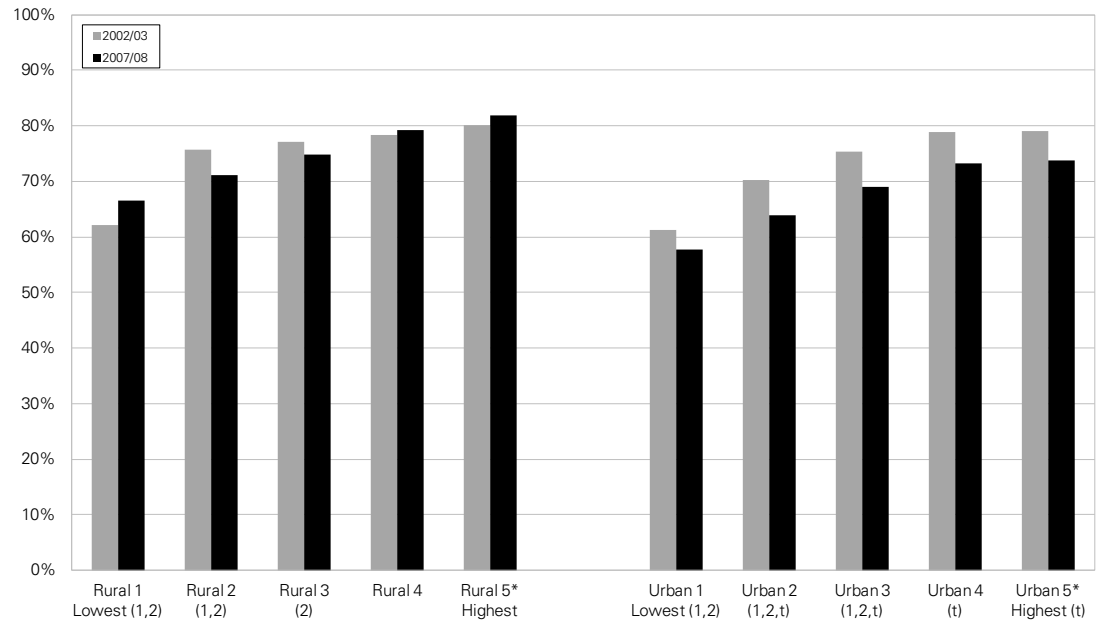


'1' indicates area's rate was statistically different from Manitoba average in first time period
'2' indicates area's rate was statistically different from Manitoba average in second time period
't' indicates change over time was statistically significant for that area
's' indicates data suppressed due to small numbers

Source: Manitoba Centre for Health Policy, 2011

Figure 2.96: Tetanus, Diphtheria, Pertussis, Polio, Mumps, Rubella, and *Haemophilus influenzae* type B Immunization Rates by Income Quintile, Aged 7

Percent of children who are complete from birth for the tetanus, diphtheria, pertussis, polio, mumps, rubella, and Hib vaccinations, 2002/03 and 2007/08



'1' indicates quintile's rate was statistically different from reference group in first time period
'2' indicates quintile's rate was statistically different from reference group in second time period
't' indicates change over time was statistically significant for that quintile
's' indicates data suppressed due to small numbers
'*' indicates the reference group. Rural 5 is the reference group for rural quintiles; Urban 5 is the reference group for urban quintiles

Source: Manitoba Centre for Health Policy, 2011

Table 2.37: Factors Associated with Being Complete from Birth for the Tetanus, Diphtheria, Pertussis, Polio, Mumps, Rubella and *Haemophilus influenzae* type B Immunizations, Aged 7
Adjusted Odds Ratio (95% Confidence Interval), 2007/08

Factor	Category	Adjusted Odds Ratio (95% CI)	
		Model 1	Model 2
Coverage from Birth	Covered from Birth	***Reference***	***Reference***
	Not Covered from Birth	0.13 (0.12,0.15)	0.11 (0.10,0.12)
Income Quintile	Quintile 1 (lowest)	0.49 (0.43,0.56)	0.51 (0.45,0.58)
	Quintile 2	0.67 (0.58,0.77)	0.69 (0.60,0.78)
	Quintile 3	0.76 (0.66,0.88)	0.76 (0.66,0.87)
	Quintile 4	0.92 (0.80,1.07)	0.95 (0.82,1.09)
	Quintile 5 (highest)	***Reference***	***Reference***
Mother's Age at Birth	Unknown	0.32 (0.16,0.62)	0.28 (0.15,0.52)
	18 and younger	0.80 (0.67,0.96)	0.88 (0.74,1.05)
	19-24	0.85 (0.77,0.94)	0.87 (0.79,0.96)
	25-34	***Reference***	***Reference***
	35 and older	1.02 (0.90,1.17)	0.95 (0.84,1.08)
Continuity of Care	No Continuity of Care	0.84 (0.75,0.94)	0.86 (0.77,0.96)
	Less than 3 Physician Visits*	0.56 (0.51,0.63)	0.49 (0.44,0.54)
	Continuity of Care	***Reference***	***Reference***
Provider Type	Mixed Providers	1.45 (1.28,1.64)	
	Regional Health Unit	1.03 (0.89,1.20)	
	Other/Unspecified	0.41 (0.30,0.57)	
	Physician	***Reference***	
Region of Residence	Brandon	1.72 (1.35,2.19)	2.02 (1.61,2.54)
	North	0.99 (0.82,1.18)	1.19 (1.03,1.36)
	Rural South	1.95 (1.73,2.19)	2.14 (1.95,2.36)
	Winnipeg	***Reference***	***Reference***
Sex of Child	Male	0.92 (0.84,1.00)	0.95 (0.88,1.03)
	Female	***Reference***	***Reference***
Number of Children in the Family	1 Child	0.88 (0.78,1.00)	0.87 (0.77,0.98)
	2-3 Children	***Reference***	***Reference***
	4 or more Children	0.54 (0.49,0.60)	0.52 (0.47,0.58)

Model 1–children with no immunizations are excluded from the adjusted model

Model 2–children with no immunizations are included in the adjusted model; provider type not included as a covariate
'*' for children with less than 3 physician visits, we were unable to define continuity of care

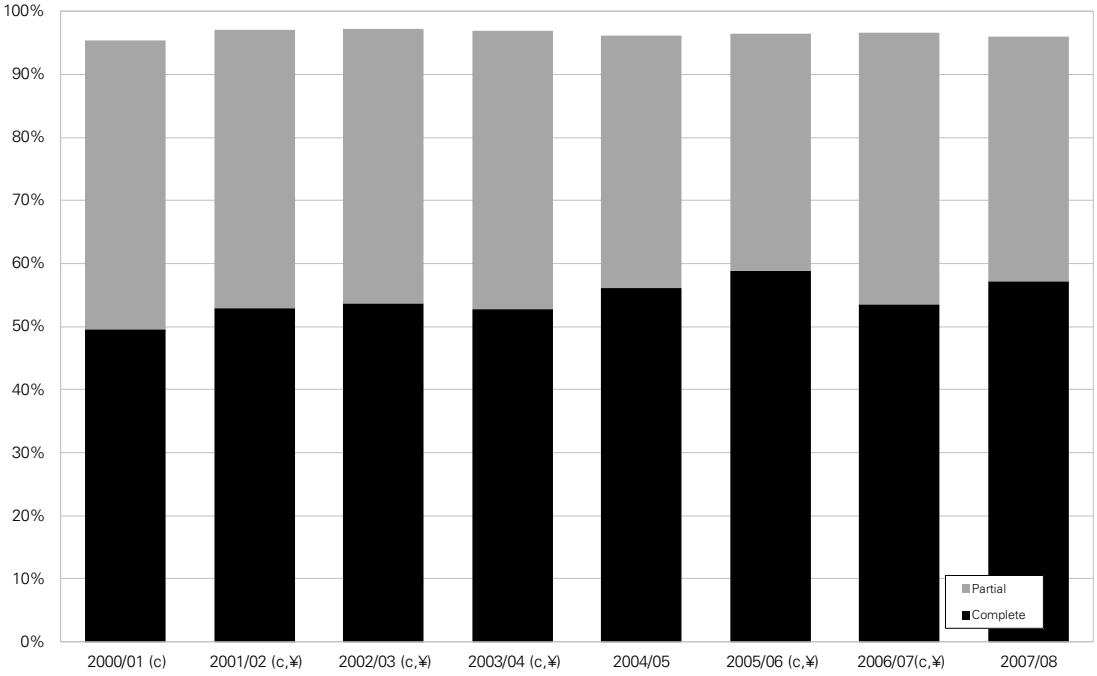
Source: Manitoba Centre for Health Policy, 2011

Complete at Age Seventeen for All Indicated Antigens

The proportion of continuously covered Manitoba 17–year–olds who received all vaccinations increased from 60% in 2000/01 to 66% in 2007/08 (Table 2.41). The declining rates in non–continuously registered Manitobans is once again evident. Provincial rates can be seen in Figure 2.97. The provincial average for complete from birth immunization rates increased from 2002/03 to 2007/08. Central, Assiniboine, Brandon, Interlake, and Parkland had rates above the provincial average while Winnipeg, North Eastman, and Burntwood had rates below the provincial average (Figure 2.98). RHA district rates can be seen in Figure 2.99. Four Winnipeg CAs—River Heights, Inkster, Downtown, and Point Douglas—had statistically significant increases in their rates (Figure 2.100). The impact of income is illustrated in Figure 2.101 and results of the logistic regressions are presented in Table 2.38.

Figure 2.97: Manitoba Tetanus, Diphtheria, Pertussis, Polio, Mumps, Rubella, and *Haemophilus influenzae* type B Immunization Rates, Aged 17

Percent of children who are complete/partial from birth for the tetanus, diphtheria, pertussis, polio, mumps, rubella, and Hib vaccinations, 2000/01–2007/08



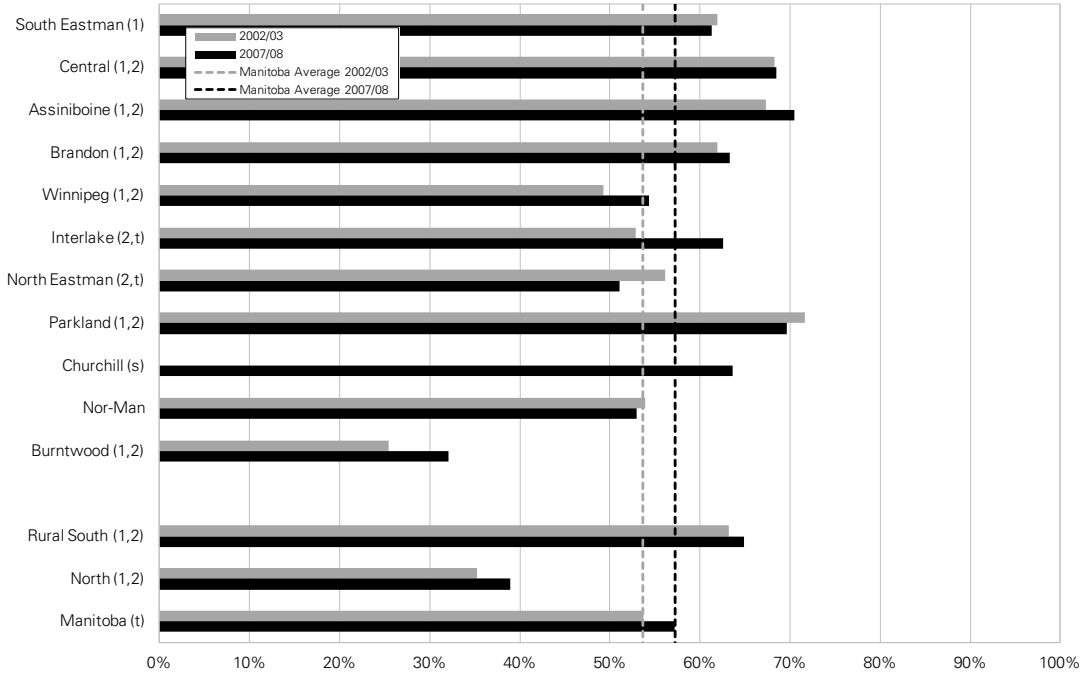
Linear trend test: Complete from birth p=0.000
Complete + partial from birth p=0.2247

'c' indicates the complete from birth rate was statistically different from the complete from birth rate in 2007/08
'¥' indicates the complete + partial from birth rate was statistically different from the complete + partial from birth rate in 2007/08

Source: Manitoba Centre for Health Policy, 2011

Figure 2.98: RHA Tetanus, Diphtheria, Pertussis, Polio, Mumps, Rubella, and *Haemophilus influenzae* type B Immunization Rates, Aged 17

Percent of children who are complete from birth for the tetanus, diphtheria, pertussis, polio, mumps, rubella, and Hib vaccinations, 2002/03 and 2007/08

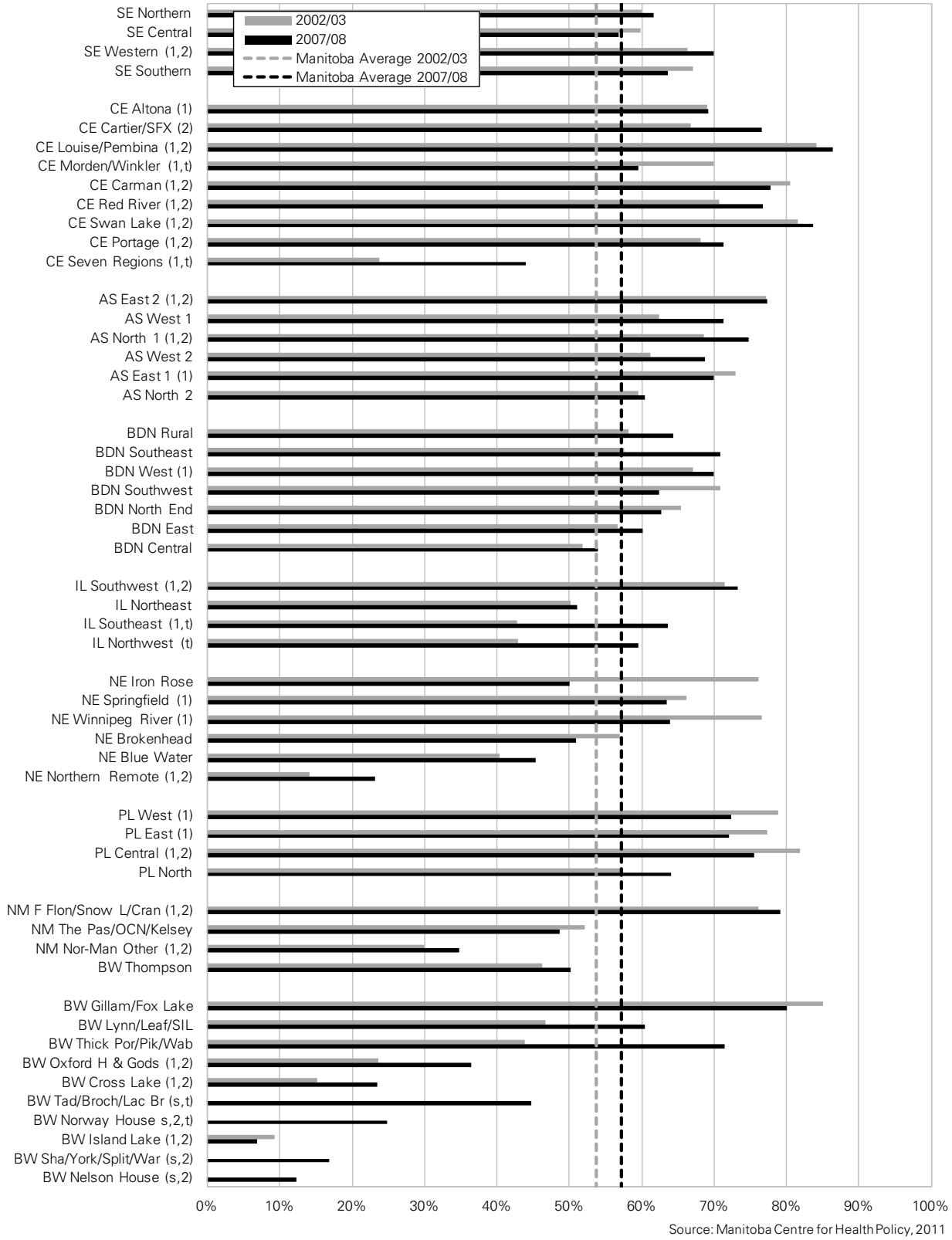


'1' indicates area's rate was statistically different from Manitoba average in first time period
'2' indicates area's rate was statistically different from Manitoba average in second time period
't' indicates change over time was statistically significant for that area
's' indicates data suppressed due to small numbers

Source: Manitoba Centre for Health Policy, 2011

Figure 2.99: RHA District Tetanus, Diphtheria, Pertussis, Polio, Mumps, Rubella, and *Haemophilus influenzae* type B Immunization Rates, Aged 17

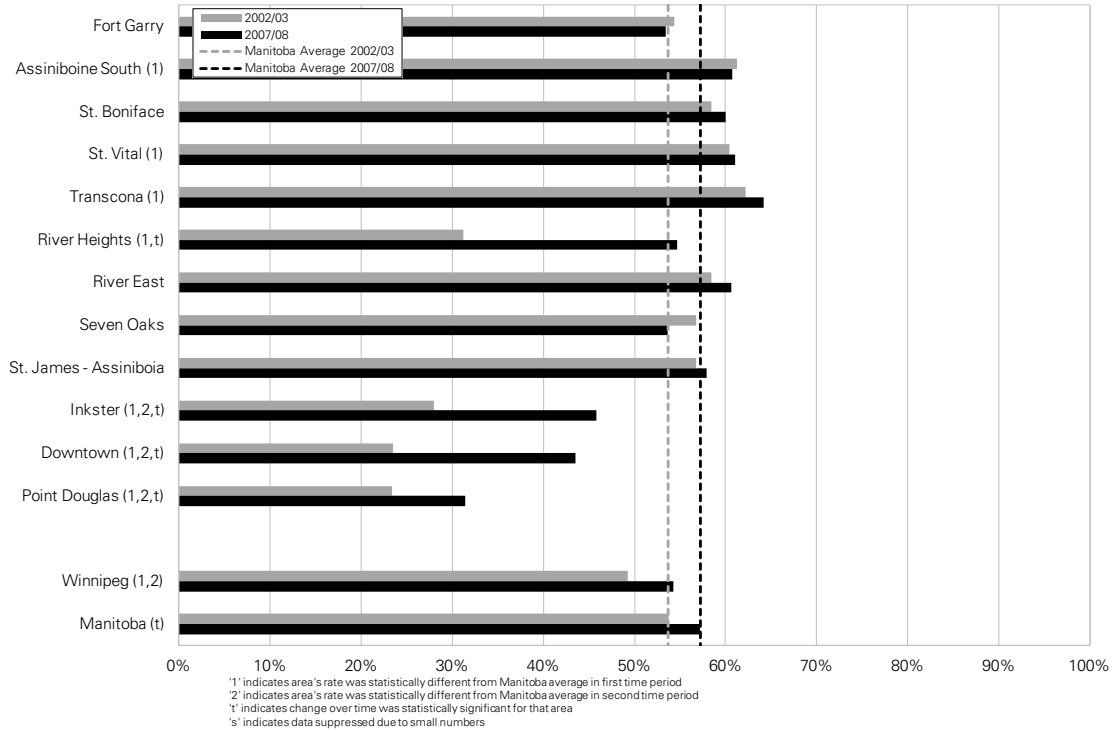
Percent of children who are complete from birth for the tetanus, diphtheria, pertussis, polio, mumps, rubella, and Hib vaccinations, 2002/03 and 2007/08



Source: Manitoba Centre for Health Policy, 2011

Figure 2.100: Winnipeg CA Tetanus, Diphtheria, Pertussis, Polio, Mumps, Rubella, and *Haemophilus influenzae* type B Immunization Rates, Aged 17

Percent of children who are complete from birth for the tetanus, diphtheria, pertussis, polio, mumps, rubella, and Hib vaccinations, 2002/03 and 2007/08

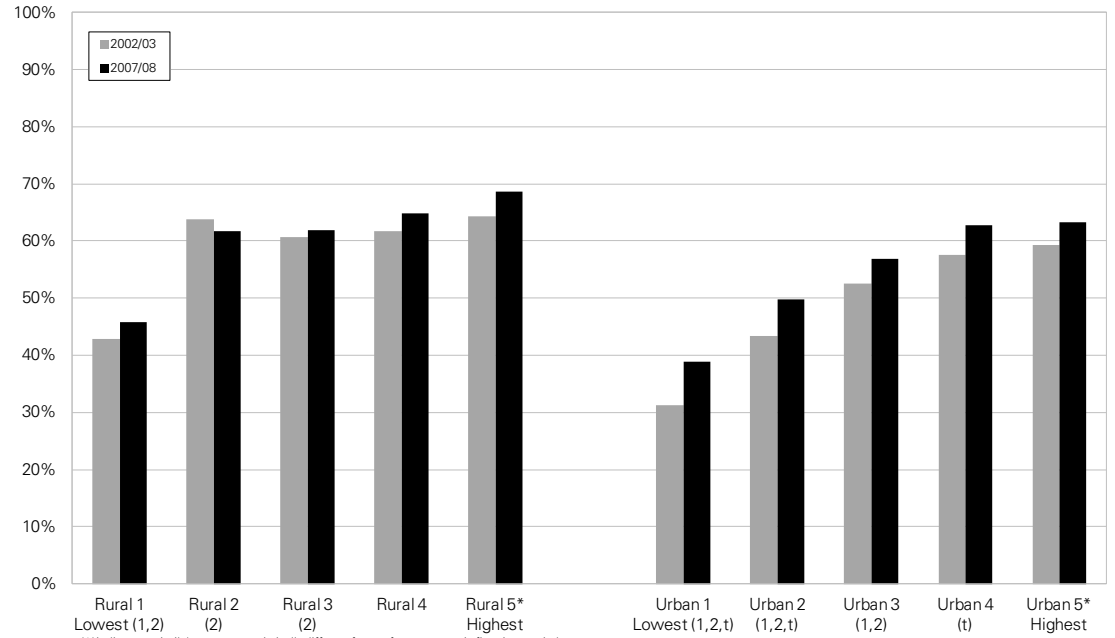


'1' indicates area's rate was statistically different from Manitoba average in first time period
'2' indicates area's rate was statistically different from Manitoba average in second time period
't' indicates change over time was statistically significant for that area
's' indicates data suppressed due to small numbers

Source: Manitoba Centre for Health Policy, 2011

Figure 2.101: Tetanus, Diphtheria, Pertussis, Polio, Mumps, Rubella, and *Haemophilus influenzae* type B Immunization Rates by Income Quintile, Aged 17

Percent of children who are complete from birth for the tetanus, diphtheria, pertussis, polio, mumps, rubella, and Hib vaccinations, 2002/03 and 2007/08



'1' indicates quintile's rate was statistically different from reference group in first time period
'2' indicates quintile's rate was statistically different from reference group in second time period
't' indicates change over time was statistically significant for that quintile
's' indicates data suppressed due to small numbers
'*' indicates the reference group. Rural 5 is the reference group for rural quintiles; Urban 5 is the reference group for urban quintiles

Source: Manitoba Centre for Health Policy, 2011

Table 2.38: Factors Associated with Being Complete from Birth for the Tetanus, Diphtheria, Pertussis, Polio, Mumps, Rubella and *Haemophilus influenzae* type B Immunizations, Aged 17

Adjusted Odds Ratio (95% Confidence Interval), 2007/08

Factor	Category	Odds Ratio (95% CI)	
		Model 1	Model 2
Coverage from Birth	Covered from Birth	***Reference***	***Reference***
	Not Covered from Birth	0.31 (0.29,0.34)	0.21 (0.20,0.23)
Income Quintile	Quintile 1 (lowest)	0.51 (0.46,0.57)	0.45 (0.41,0.50)
	Quintile 2	0.79 (0.71,0.88)	0.72 (0.65,0.80)
	Quintile 3	0.86 (0.78,0.96)	0.81 (0.73,0.90)
	Quintile 4	0.95 (0.85,1.05)	0.93 (0.84,1.03)
	Quintile 5 (highest)	***Reference***	***Reference***
Mother's Age at Birth	Unknown	0.85 (0.63,1.15)	0.77 (0.58,1.02)
	18 and younger	0.61 (0.53,0.71)	0.62 (0.54,0.72)
	19-24	0.72 (0.66,0.78)	0.74 (0.68,0.80)
	25-34	***Reference***	***Reference***
	35 and younger	1.05 (0.92,1.18)	1.06 (0.94,1.20)
Continuity of Care	No Continuity of Care	0.98 (0.89,1.07)	1.01 (0.92,1.10)
	Less than 3 Physician Visits*	0.75 (0.69,0.82)	0.69 (0.64,0.75)
	Continuity of Care	***Reference***	***Reference***
Provider Type	Mixed Providers	6.03 (4.90,7.42)	
	Regional Health Unit	3.63 (2.90,4.53)	
	Other/Unspecified	0.41 (0.14,1.15)	
	Physician	***Reference***	
Region of Residence	Brandon	1.68 (1.39,2.02)	1.74 (1.45,2.08)
	North	0.65 (0.57,0.74)	0.60 (0.53,0.67)
	Rural South	1.70 (1.57,1.84)	1.69 (1.57,1.82)
	Winnipeg	***Reference***	***Reference***
Sex of Child	Male	0.92 (0.86,0.98)	0.92 (0.86,0.98)
	Female	***Reference***	***Reference***
Number of Children in the Family	1 Child	0.90 (0.84,0.97)	0.91 (0.84,0.97)
	2-3 Children	***Reference***	***Reference***
	4 or more Children	0.59 (0.53,0.67)	0.56 (0.50,0.63)

Model 1–children with no immunizations are excluded from the adjusted model

Model 2–children with no immunizations are included in the adjusted model; provider type not included as a covariate

'*' for children with less than 3 physician visits, we were unable to define continuity of care

Source: Manitoba Centre for Health Policy, 2011

Table 2.39: Complete from Birth Crude Rates for Tetanus, Diphtheria, Pertussis, Polio, Mumps, Rubella and *Haemophilus influenzae* type B Immunization by Sociodemographic Factors, Aged 2, 2002/03 and 2007/08

Factor	Category	% Complete from Birth	
		2002/03	2007/08
Coverage from Birth	Covered from Birth(t,l) ***Reference***	72.50	75.00
	Not Covered from Birth(1,2,t,l)	37.50	29.50
Income Quintile	Rural 1 (Lowest)(1,2)	58.20	61.40
	Rural 2 (1,2)	65.80	67.70
	Rural 3 (1,2)	68.90	72.40
	Rural 4(1,2)	72.30	73.60
	Rural 5 (highest)	77.10	80.80
	Urban 1 (lowest)(1,2)	62.10	59.80
	Urban 2(1,2)	71.60	73.00
	Urban 3	75.20	74.50
	Urban 4	78.20	80.50
	Urban 5 (highest)	78.50	77.50
Mother's Age at Birth	Unknown(l)	66.70	62.90
	18 and younger(1,2)	63.00	62.90
	19-24(1,2,l)	64.70	66.80
	25-34	73.30	74.00
	35 and older	72.20	73.10
Continuity of Care	No Continuity of Care (1,2,t,l)	64.90	68.50
	Less than 3 Physician Visits*(1,2,l)	40.90	45.60
	Continuity of Care (l)	78.80	79.70
Provider Type	Mixed Providers(1,t,l)	72.70	77.10
	Regional Health Unit(1,2,t)	66.20	69.50
	Other/Unspecified(1,2)	51.50	53.50
	Physician	77.00	78.10
Region of Residence	Brandon	72.80	74.50
	North(1,2,t,l)	56.00	62.20
	Rural South	71.10	72.80
	Winnipeg(1)	72.40	72.40
	Manitoba	70.30	71.50
Number of Children in the Family	1 Child(1,2)	78.90	77.20
	2-3 Children(t,l)	70.50	73.90
	4 or more Children(1,2)	50.90	52.40

'1' indicates quintile's rate was statistically different from reference group in first time period

'2' indicates quintile's rate was statistically different from reference group in second time period

't' indicates change over time was statistically significant

's' indicates data suppressed due to small numbers

'l' indicates a significant linear trend over time

'*' for children with less than 3 physician visits, we were unable to define continuity of care

Source: Manitoba Centre for Health Policy, 2011

Table 2.40: Complete from Birth Crude Rates for Tetanus, Diphtheria, Pertussis, Polio, Mumps, Rubella and *Haemophilus influenzae* type B Immunization by Sociodemographic Factors, Aged 7, 2002/03 and 2007/08

Factor	Category	% Complete from Birth	
		2002/03	2007/08
Coverage from Birth	Covered from Birth (l) ***Reference***	79.10	78.50
	Not Covered from Birth (1,2,t,l)	38.70	30.70
Income Quintile	Rural 1 (lowest) (1,2,l)	62.20	66.60
	Rural 2 (1,2)	75.70	71.10
	Rural 3 (2)	77.10	74.80
	Rural 4	78.30	79.30
	Rural 5 (highest) (l) ***Reference***	80.10	81.90
	Urban 1 (lowest) (1,2,l)	61.20	57.80
	Urban 2 (1,2,t,l)	70.30	63.90
	Urban 3 (1,2,t,l)	75.40	69.00
	Urban 4 (t,l)	78.90	73.20
	Urban 5 (highest) (t,l) ***Reference***	79.10	73.80
Mother's Age at Birth	Unknown (1,2,t,l)	36.80	17.60
	18 and younger (1)	69.10	69.60
	19-24 (1,2,l)	70.00	68.40
	25-34 (t,l) ***Reference***	76.10	71.90
	35 and older (1,l)	72.50	71.80
Continuity of Care	No Continuity of Care (1,l)	74.80	75.40
	Less than 3 Physician Visits* (1,2,t,l)	64.30	61.20
	Continuity of Care (t,l) ***Reference***	79.80	77.40
Provider Type	Mixed Providers (1,t,l)	74.80	78.20
	Regional Health Unit (1,2)	69.80	69.50
	Other/Unspecified (1,2,t,l)	55.40	34.80
	Physician (t,l) ***Reference***	79.90	76.80
Region or Residence	Brandon (1,2,l)	82.10	76.40
	North (1,2,l)	64.00	65.30
	Rural South(1,2)	76.90	76.50
	Winnipeg (2,t,l)	72.20	66.90
	Manitoba (t,l) ***Reference***	73.50	70.60
Number of Children in the Family	1 Child (2,l)	74.10	70.90
	2-3 Children (t,l) ***Reference***	76.30	74.20
	4 or more Children (1,2,l)	62.10	59.10

'1' indicates quintile's rate was statistically different from reference group in first time period

'2' indicates quintile's rate was statistically different from reference group in second time period

't' indicates change over time was statistically significant

's' indicates data suppressed due to small numbers

'l' indicates a significant linear trend over time

*' for children with less than 3 physician visits, we were unable to define continuity of care

Source: Manitoba Centre for Health Policy, 2011

Table 2.41: Complete from Birth Crude Rates for Tetanus, Diphtheria, Pertussis, Polio, Mumps, Rubella and *Haemophilus Influenzae* type B by Sociodemographic Factors, Aged 17, 2002/03 and 2007/08

Factor	Category	% Complete from Birth	
		2002/03	2007/08
Coverage from Birth	Covered from Birth (t,l) ***Reference***	59.60	65.50
	Not Covered from Birth (1,2,t,l)	33.50	30.00
Income Quintile	Rural 1 (Lowest) (1,2,l)	42.80	45.80
	Rural 2 (2,l)	63.80	61.70
	Rural 3 (2,l)	60.60	61.90
	Rural 4 (l)	61.80	64.80
	Rural 5 (highest) (l) ***Reference***	64.40	68.60
	Urban 1 (lowest) (1,2,t,l)	31.20	38.80
	Urban 2 (1.2.t,l)	43.40	49.70
	Urban 3 (1,2,l)	52.50	56.80
	Urban 4 (t,l)	57.50	62.70
	Urban 5 (highest) (l) ***Reference***	59.30	63.20
Mother's Age at Birth	Unknown (1,2)	20.30	26.10
	18 and younger(1,2,t,l)	33.70	42.20
	19-24(1,2)	50.90	49.40
	25-34(t,l) ***Reference***	58.20	62.30
	35 and younger(1,t,l)	52.70	62.00
Continuity of Care	No Continuity of Care(1,t,l)	55.30	62.10
	Less than 3 Physician Visits*(1,2,l)	48.20	49.70
	Continuity of Care(t,l) ***Reference***	58.40	62.80
Provider Type	Mixed Providers (1,2,t,l)	59.10	65.80
	Regional Health Unit (1,2,l)	47.50	44.80
	Other/Unspecified (2)	8.30	s
	Physician (l) ***Reference***	16.60	21.00
Region of Residence	Brandon (1,2,l)	61.90	63.30
	North (1,2,l)	35.20	38.90
	Rural South(1,2,l)	63.20	64.90
	Winnipeg (1,2,t,l)	49.10	54.30
	Manitoba (t,l) ***Reference***	53.70	57.20
Number of Children in the Family	1 Child (t,l)	54.80	59.70
	2-3 Children (t,l) ***Reference***	55.60	59.10
	4 or more Children (1,2)	39.20	37.70

'1' indicates quintile's rate was statistically different from reference group in first time period

'2' indicates quintile's rate was statistically different from reference group in second time period

't' indicates change over time was statistically significant

's' indicates data suppressed due to small numbers

'l' indicates a significant linear trend over time

*' for children with less than 3 physician visits, we were unable to define continuity of care

Source: Manitoba Centre for Health Policy, 2011

Chapter 3: Influenza Immunization Program

Background

Influenza is an acute viral disease of the respiratory tract characterized by fever, cough, headache, myalgia, prostration, coryza, and sore throat (*Control of Communicable Diseases Manual*, 2008). Gastro–intestinal manifestations (nausea, vomiting, and diarrhea) are uncommon in adults but may accompany respiratory symptoms in up to 25% of children. Influenza is caused by influenza A and B viruses and occurs in Canada every year, generally during late fall and the winter months. Influenza A viruses are the most common cause of annual influenza **epidemics**. Outbreaks of influenza B are generally more localized and, in any one year, may be restricted to one region of the country (Public Health Agency of Canada, 2006). Yearly epidemics affect all age groups but demonstrate the highest complication risk in children less than two, adults older than 64, and people of any age with other medical conditions (including chronic cardiovascular, pulmonary, renal, hepatic, hematologic, or metabolic disorders; immunosuppression; pregnancy; and neurologic/neuromuscular conditions). Complications of influenza include co–infection with bacterial pneumonia, febrile seizures, encephalitis/encephalopathy, myositis, Reye syndrome, and death.

The antigens comprising the seasonal influenza vaccine are selected by the World Health Organization based on global epidemiology and currently include one strain of influenza A/H3N2, one strain of influenza A/H1N1 and one strain of influenza B. The virus strains chosen for inclusion in influenza vaccine are reviewed annually to ensure that they include antigens that are expected to provide the best protection during the following influenza season. One dose (0.5 mL) of influenza vaccine contains 15 µg of hemagglutinin of each of three antigens (Public Health Agency of Canada, 2006).

Manitoba Program

Manitoba introduced the influenza vaccine as a publicly funded program in 1999. At that time, it was introduced for healthcare workers and high–risk individuals, which included people aged 65 and older, those whose immune systems were weakened by disease or medication, and those with chronic conditions such as heart and kidney disease or asthma (Manitoba Government, 1999). In 2004, this program was expanded to include children aged six to 23 months and their household contacts. This category included pregnant women who would be delivering during the influenza season as they would then become household contacts of their newborn children. In the following year the program was expanded again, this time to broaden eligibility to those with any condition that reduces ability to breathe or increases risk of choking. The most recent change to the influenza vaccine occurred in 2007 when the pregnancy criteria expanded to include all pregnant women regardless of delivery date. The influenza pandemic of 2009 and the associated pandemic vaccine are not included in this analysis.

Manitoba recommended and funded the influenza vaccination for the following people:

- People at high risk of influenza–related complications or those more likely to require hospitalization:
    - Adults (including pregnant women) and children with the following chronic health conditions:
        - cardiac or pulmonary disorders (including bronchopulmonary dysplasia, cystic fibrosis, and **asthma**)
        - **diabetes** mellitus and other metabolic diseases
        - cancer, **immunodeficiency**, or immunosuppression (due to underlying disease and/or therapy)
        - renal disease
        - anaemia or haemoglobinopathy

        - conditions that compromise the management of respiratory secretions and are associated with an increased risk of aspiration
        - children and adolescents with conditions treated for long periods with acetylsalicylic acid
    - People of any age who are residents of nursing homes and other chronic care facilities
    - People 65 years of age and older
    - Healthy children six to 23 months of age
    - Healthy pregnant women (the risk of influenza–related hospitalization increases with length of gestation, i.e., it is higher in the third than in the second trimester)
- People capable of transmitting influenza to those at high risk
    - Healthcare and other care providers in facilities and community settings who, through their activities, are capable of transmitting influenza to those at high risk of influenza complications
    - Household contacts (adults and children) of individuals at high risk of influenza–related complications (whether or not the individual at high risk has been immunized):
        - household contacts of individuals at high risk, as listed in the section above
        - household contacts of infants less than six months of age who are at high risk of complications from influenza but for whom the influenza vaccine is not approved
        - members of a household expecting a newborn during the influenza season
    - Those providing regular child care to children less than 24 months of age, whether in or out of the home
    - Those who provide services within closed or relatively closed settings to persons at high risk (e.g., the crew on a ship)
- Others
    - People who provide essential community services
    - People in direct contact during culling operations with poultry infected with avian influenza

Although not publicly funded, healthy persons aged two to 64 without contraindication are also encouraged to receive influenza vaccine even if they are not in one of the aforementioned priority groups (National Advisory Committee on Immunization, 2009).

Influenza Vaccination in those 65 and older

Methods

We looked at eight fiscal years of data, from April 1, 2000 to March 31, 2008, for influenza immunizations. Data for all eight years are presented only at the provincial level and is compared to the most current year (2007/08). For RHA, RHA district, Winnipeg CA, and covariate analyses, two years of data were examined and compared—2002/03 and 2007/08.

Individuals who had the tariff code 8791, 8792, or 8799 in the fiscal year of interest were considered to have received an influenza immunization.

Logistic Regression Models were used to better understand the characteristics of those who were immunized using the most recent year of available data 2007/08. Three different models were used. All three included sex, age group, continuity of care, region of residence, income quintile, number of inpatient hospitalizations, whether they lived in a personal care home (PCH), and marital status. The first model used the number of major **Aggregated Diagnostic Groups (ADGs)** to measure comorbidities, while the second used the total number of ADGs to measure comorbidities. The third model did not include any measure of comorbidities.

Age Group: Age was calculated for the fiscal year of interest. Three age groups were studied: 65–74, 75–84, and 85 and older, with 65–74 as the reference category.

Income Quintile: Income quintiles were developed by assigning average household income from the 2006 Statistics Canada Census to dissemination areas and ranking these from highest to lowest. Dissemination areas were then grouped into five groups or quintiles (one being poorest and five being wealthiest); each contains approximately 20% of the total population. The average household income of the dissemination area is attributed to each person, so this is not an individual income but rather an area–level income measure. Income quintiles are often used as a proxy measure of socio–economic status. Rates were calculated (and reported) separately for urban and rural quintiles. For the logistic regression analyses, we did not separate the quintiles into rural and urban quintiles because we included a separate covariate for region.

Number of Inpatient Hospitalizations: We looked at the number of inpatient hospital episodes in the two previous fiscal years. An episode is a single, continuous stay in the hospital system, irrespective of transfers between hospitals. Day surgeries were excluded from the analysis. We grouped inpatient hospitalizations into two categories: zero to one inpatient hospitalization and two or more inpatient hospitalizations.

Personal Care Home: People were considered a resident of a PCH if, according to the Long Term Care Database, they were living in a PCH at any time in the fiscal year.

Aggregated Diagnostic Groups (ADGs): Formerly known as Ambulatory Diagnostic Groups, ADGs continue to be part of the Johns Hopkins Adjusted Clinical Group (ACG) case–mix system. The ACG system is risk adjustment tool developed to measure the illness burden (morbidity) of individual patients by grouping individuals based on their age, sex, and all known medical diagnoses assigned by their healthcare providers over a defined time period (typically one year). Every **ICD–9–CM** and **ICD–10–CA** diagnosis code assigned to a patient is grouped into one of 32 different ADGs based on five clinical and expected utilization criteria: 1) duration of the condition (acute, recurrent, or chronic); 2) severity of the condition (e.g., minor and stable versus major and unstable); 3) diagnostic certainty (symptoms focusing on diagnostic evaluation versus documented disease focusing on treatment services); 4) etiology of the condition (infectious, injury, or other); and 5) specialty care involvement (medical, surgical, obstetric, haematology, etc.). Based on the number of ADGs that a patient falls into, two measures of morbidity were created:

Total number of ADGs: To determine the total number of ADGs, the number of ADGs was summed. Individuals were then assigned to one of three categories: 0–2, 3–5, and 6 or more ADGs.

Number of Major ADGs: To determine the number of Major ADGs, the ADGs of the ACG system were used to count the number of conditions and to define conditions as major or minor on the basis of resource use and clinical outcomes. Individuals were then assigned to one of four categories: 0, 1, 2, or 3 or more Major ADGs. Major ADGs included the following: ADG3 (time limited: major), ADG4 (time limited: major–primary infections), ADG9 (likely to recur: progressive), ADG11 (chronic medical: unstable), ADG16 (chronic specialty: unstable–orthopedic), ADG22 (injuries/adverse effects: major), ADG25 (psychosocial: recurrent or persistent, unstable), and ADG32 (malignancy).

Marital Status: Marital status was determined from the Registry data. A person was defined as married if there was a spouse or a common–law spouse present in the registration number of the family. A person was defined as other if there was no spouse present. Because the registry can only identify marriages if the family reports their status to Manitoba Health and from a family registration number, the other group likely also includes some people who are actually married.

Continuity of Care: Continuity of care is the extent to which individuals see a given healthcare provider (versus two or more other providers) over a specified period of time. Individuals with a regular family physician (or specialist) may have improved health outcomes as a result of one physician managing their healthcare needs over an extended period of time. An individual was considered to have continuity of care if they had three or more visits over a two–year period and at least 50% of their ambulatory visits from the same physician. This physician could be either a general practitioner/family physician or an internal medicine specialist. A separate category was created for individuals who had less than three visits as we did not want to exclude them from the analysis and we felt they were different from individuals who did not have continuity of care.

Region of Residence: Region of Residence was defined according to the individual's residency on December 31, 2007. Winnipeg RHA, Brandon RHA, the North (Churchill, NOR–MAN, and Burntwood RHAs), and Rural South (South Eastman, Central, Assiniboine, Interlake, North Eastman, and Parkland RHAs) were compared to Manitoba to look for regional difference.

To provide additional information to the logistic regressions, rates were also calculated for 2002/03 and 2007/08 for each of the covariates. Rates were calculated separately for the rural and urban income quintiles. Rates were calculated for the regions of residence (Brandon, Winnipeg, Rural South, and North) and compared to the Manitoba average.

Rates

Figure 3.1 examines overall influenza immunization rates in the 65 and older population over time—from 2000/01 until 2007/08. Rates peaked in 2003/04–2005/06 and appear to have declined in recent years. Figure 3.2 looks at influenza immunization rates in people aged 65 and older in 2002/03 compared to 2007/08 and is broken down by RHA. The Manitoba average in 2002/03 was 56% and in 2007/08 was 62%. This figure demonstrates the variation in immunization rates around the province with urban (Brandon and Winnipeg) RHAs showing significantly higher rates than the Manitoba average while South Eastman, Central, Assiniboine, Interlake, North Eastman, Parkland, and Burntwood were lower than the Manitoba average.

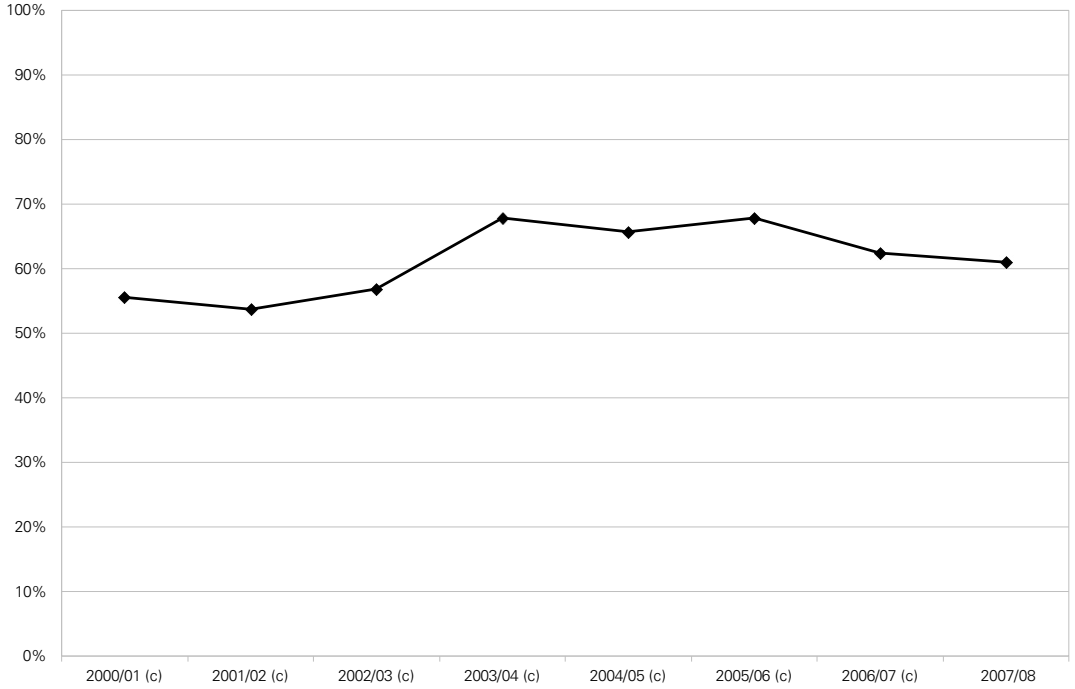
These rates are broken down into RHA districts in Figure 3.3. Most RHAs tended to have consistent numbers across their districts; however, there were some notable exceptions. Within the Central RHA (CE), Swan Lake (64%) and Louise/Pembina (65%) have above average rates while Altona (49%) shows a substantially lower rate. Within the North Eastman region, the Northern Remote area had the lowest immunization rate of all RHA districts in Manitoba at 13% (down from 26% in 2002/03). Variation is also evident in Burntwood RHA (BW) where Gillam/Fox Lake demonstrates one of the highest vaccination rates at 70% while other RHA districts such as Island Lake and Shamattawa/York Factory/Split Lake/War Lake have rates in the mid–teens.

In 2007/08, all of the areas of Winnipeg show rates at or above the Manitoba average except Inkster, Downtown and Point Douglas, which have statistically significantly lower rates (Figure 3.4).

Figure 3.5 presents influenza immunization rates by income quintile. Unlike the association seen repeatedly with the childhood immunizations, income did not appear to have any effect on urban influenza rates in those 65 or older. In the rural areas, however, the lower income quintiles did demonstrate statistically significantly lower immunization rates.

Figure 3.1: Manitoba Influenza Immunization Rates, Aged 65+

Percent of people who received the influenza vaccination, 2000/01–2007/08

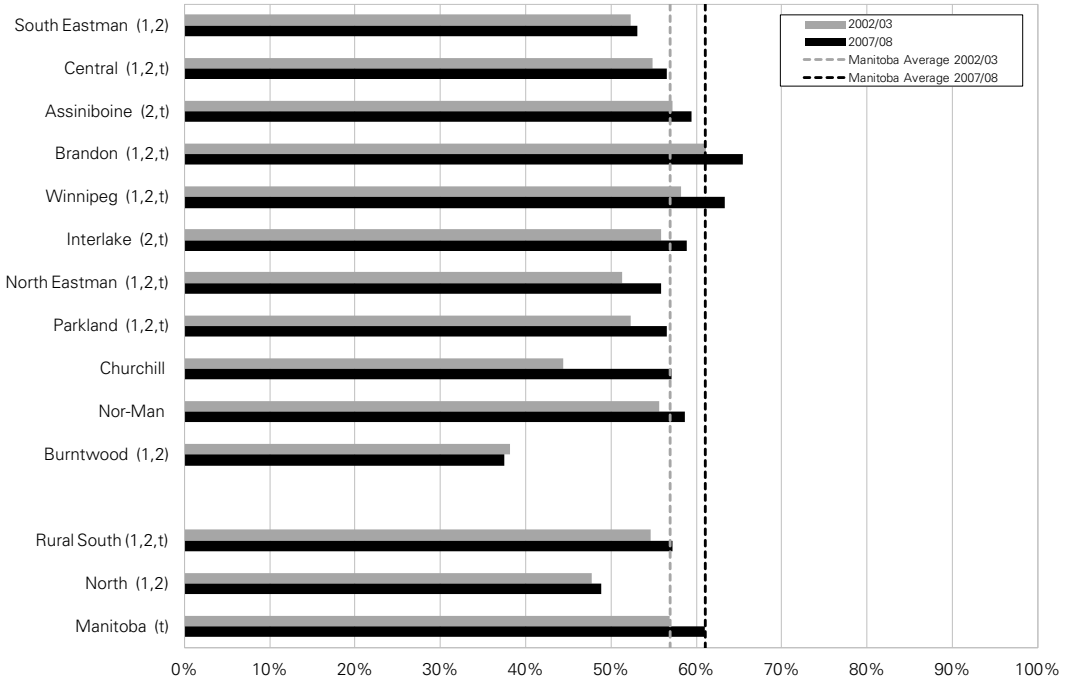


Linear trend test: Complete for age p<.0001
'c' indicates the immunization rate for this fiscal year was statistically different from the immunization rate in 2007/08

Source: Manitoba Centre for Health Policy, 2011

Figure 3.2: RHA Influenza Immunization Rates, Aged 65+

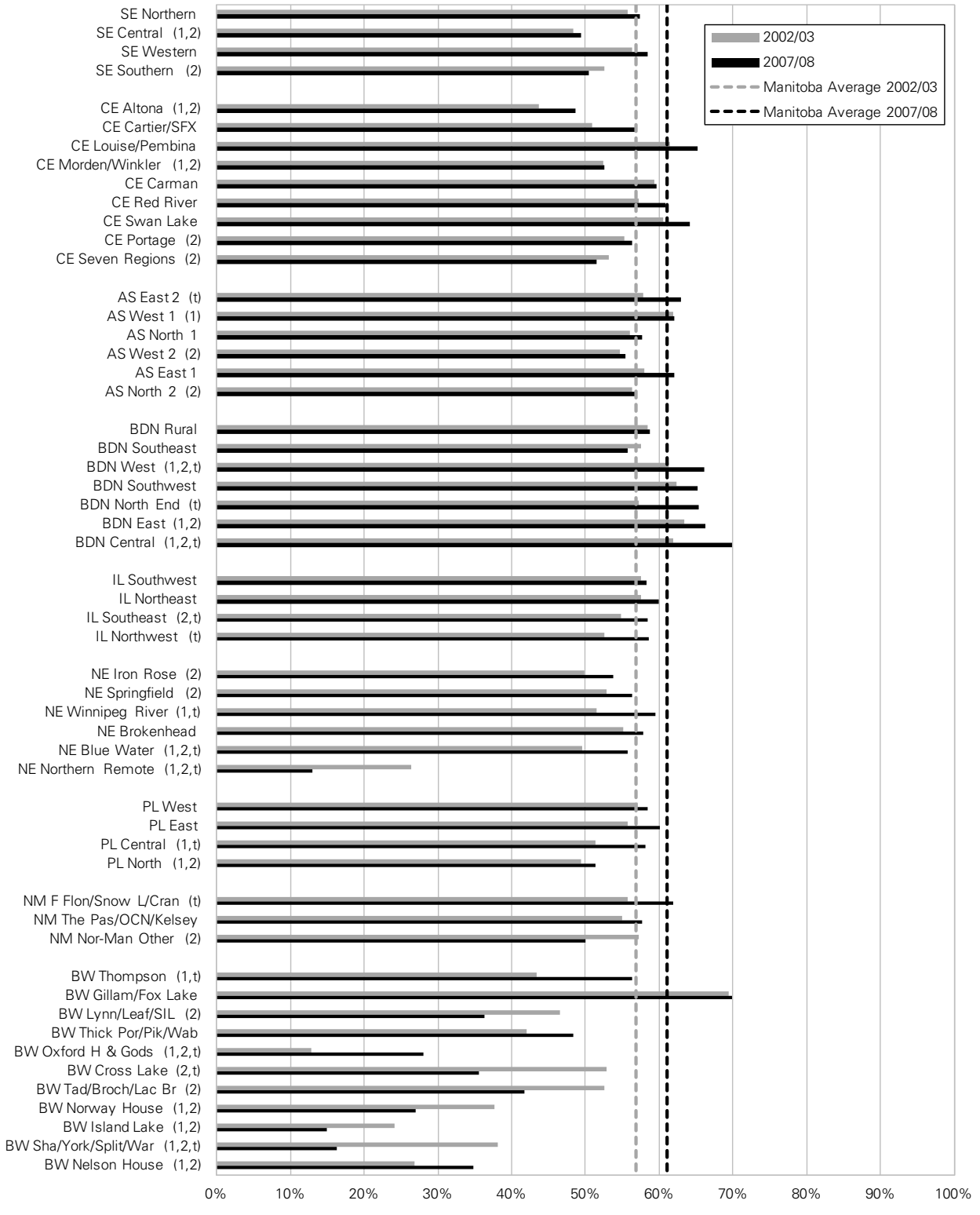
Percent of people who received the influenza vaccination, 2002/03 and 2007/08



'1' indicates area's rate was statistically different from Manitoba average in first time period
'2' indicates area's rate was statistically different from Manitoba average in second time period
't' indicates change over time was statistically significant for that area
's' indicates data suppressed due to small numbers

Source: Manitoba Centre for Health Policy, 2011

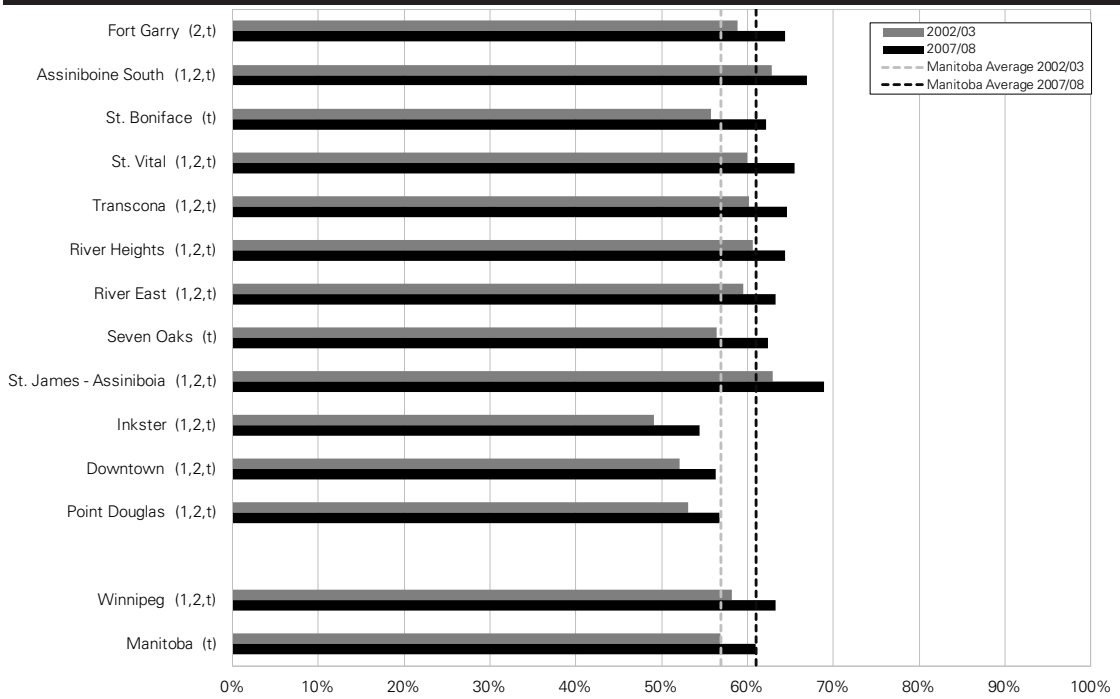
Figure 3.3: RHA District Influenza Immunization Rates, Aged 65+
Percent of people who received the influenza vaccination, 2002/03 and 2007/08



Source: Manitoba Centre for Health Policy, 2011

Figure 3.4: Winnipeg CA Influenza Immunization Rates, Aged 65+

Percent of people who received the influenza vaccination, 2002/03 and 2007/08

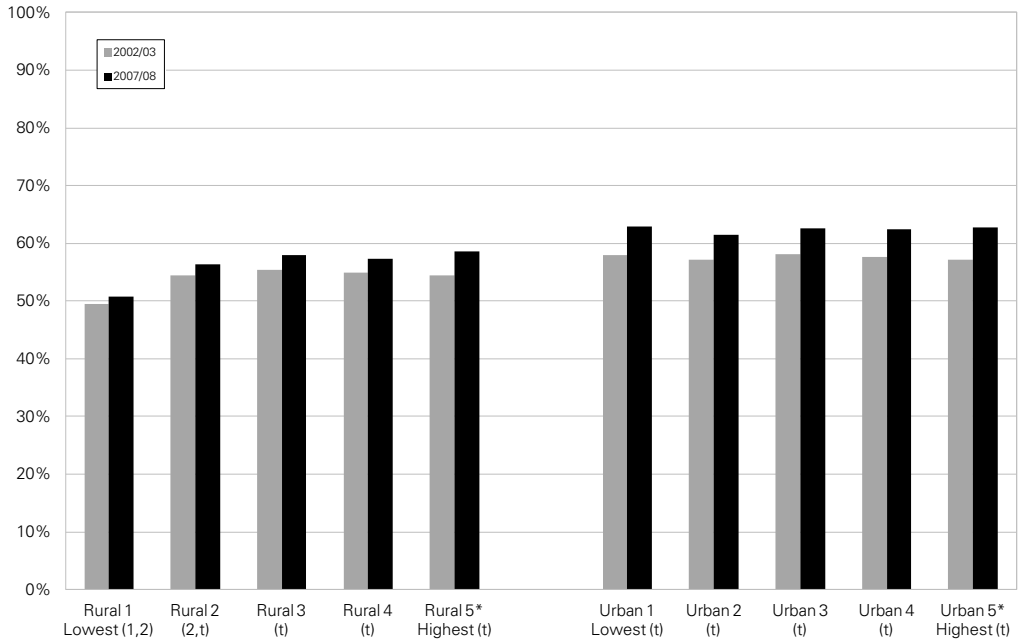


'1' indicates area's rate was statistically different from Manitoba average in first time period
'2' indicates area's rate was statistically different from Manitoba average in second time period
't' indicates change over time was statistically significant for that area
's' indicates data suppressed due to small numbers

Source: Manitoba Centre for Health Policy, 2011

Figure 3.5: Influenza Immunization Rates by Income Quintile, Aged 65+

Percent of people who received the influenza vaccination, 2002/03 and 2007/08



'1' indicates quintile's rate was statistically different from reference group in first time period
'2' indicates quintile's rate was statistically different from reference group in second time period
't' indicates change over time was statistically significant for that quintile
's' indicates data suppressed due to small numbers
'*' indicates the reference group. Rural 5 is the reference group for rural quintiles; Urban 5 is the reference group for urban quintiles

Source: Manitoba Centre for Health Policy, 2011

Logistic Regressions

Results of the logistic regression models can be seen in Table 3.1. Crude immunization rates by sociodemographic factors are listed for 2002/03 and 2007/08 in Table 3.2.

Model 1

After controlling for the other variables in the model, people 75–84 and 85 and older were more likely to receive the influenza immunization than those who were 65–74. Those living in lower income quintiles (quintile 1, 2, 3 and 4) were less likely to receive the influenza vaccine compared to those in living in the higher income quintile (quintile 5). Those who had zero or one inpatient hospitalization in the previous two years were more likely to receive the influenza immunization than those with two or more inpatient hospitalizations. Residents of PCHs were more likely to receive the influenza vaccination compared to those who lived in the community. This large difference is more than likely due to the routine seasonal programs that run in the vast majority of long–term care settings. People with no major ADGs were less likely to receive the influenza immunization than those with one major ADGs, while those with two major ADGs were even more likely to receive the influenza immunization. Increasing rates of immunization in those over 65 with increasing ADGs suggests that those with greater comorbidity are more likely to be immunized. Married Manitobans over 65 were more likely to have received an influenza vaccination compared to those who were classified as other. Those who had fewer than three ambulatory visits and those with no continuity of care were less likely to receive the influenza vaccination than those who had continuity of care, which demonstrates the importance of healthcare provider contact as a predictor of immunization. Individuals living in rural areas were less likely to receive the influenza vaccination compared to those living in urban areas. Males were less likely to receive the influenza vaccination than women.

Models 2 and 3

The covariates in Model 2 are similar to those in Model 1, except that a different measure of comorbidity was included—total number of ADGs. Again, those with more ADGs were more likely to have received the influenza immunization compared to those who had fewer ADGs. Model 3 does not include any measure of comorbidity and the number of hospitalizations is no longer significant.

Table 3.1: Factors Associated with Receiving the Influenza Vaccination, Aged 65+
Adjusted Odds Ratio (95% Confidence Interval), 2007/08

Factor	Category	Adjusted Odds Ratio (95% CI)		
		Model 1	Model 2	Model 3
Age Group	65-74	***Reference***	***Reference***	***Reference***
	75-84	1.62 (1.59, 1.66)	1.63 (1.59, 1.67)	1.67 (1.63, 1.71)
	85 and older	1.73 (1.67, 1.79)	1.76 (1.70, 1.82)	1.80 (1.74, 1.86)
Income Quintile	Quintile 1 (lowest)	0.87 (0.84, 0.90)	0.88 (0.85, 0.91)	0.87 (0.84, 0.90)
	Quintile 2	0.89 (0.86, 0.92)	0.90 (0.87, 0.94)	0.89 (0.86, 0.92)
	Quintile 3	0.95 (0.91, 0.98)	0.96 (0.92, 0.99)	0.95 (0.91, 0.98)
	Quintile 4	0.95 (0.91, 0.98)	0.95 (0.92, 0.98)	0.94 (0.91, 0.98)
	Quintile 5 (highest)	***Reference***	***Reference***	***Reference***
Number of Inpatient Hospitalizations	0-1	1.16 (1.11, 1.21)	1.23 (1.18, 1.28)	1.02 (0.98, 1.06)
	2 or more	***Reference***	***Reference***	***Reference***
Residency	Does not reside in a PCH	0.39 (0.37, 0.42)	0.38 (0.35, 0.40)	0.37 (0.34, 0.39)
	Resides in a PCH	***Reference***	***Reference***	***Reference***
Marital Status	Other	0.75 (0.73, 0.77)	0.76 (0.74, 0.77)	0.75 (0.73, 0.77)
	Married	***Reference***	***Reference***	***Reference***
Continuity of Care	No Continuity of Care	0.80 (0.78, 0.82)	0.77 (0.75, 0.79)	0.82 (0.80, 0.84)
	Less than 3 Physician Visits*	0.23 (0.22, 0.24)	0.27 (0.26, 0.28)	0.20 (0.19, 0.21)
	Continuity of Care	***Reference***	***Reference***	***Reference***
Region of Residence	Winnipeg	***Reference***	***Reference***	***Reference***
	Brandon	1.02 (0.97, 1.08)	1.01 (0.95, 1.06)	1.02 (0.97, 1.08)
	Rural South	0.78 (0.77, 0.80)	0.80 (0.79, 0.82)	0.77 (0.76, 0.79)
	North	0.66 (0.61, 0.70)	0.69 (0.65, 0.74)	0.65 (0.61, 0.70)
Sex	Female	***Reference***	***Reference***	***Reference***
	Male	0.89 (0.87, 0.91)	0.92 (0.90, 0.94)	0.91 (0.89, 0.93)
Major Aggregated Diagnostic Groups (ADGs)	0	0.73 (0.71, 0.75)		
	1	***Reference***		
	2	1.08 (1.04, 1.12)		
	3 or more	1.02 (0.97, 1.07)		
Total Aggregated Diagnostic Groups (ADGs)	0-2		***Reference***	
	3-5		1.57 (1.53, 1.61)	
	6 or more		1.89 (1.84, 1.95)	

*' for people with less than 3 physician visits, we were unable to define continuity of care

Model 1 includes the number of major ADGs as a measure of comorbidity; Model 2 includes the number of total ADGs as a measure of comorbidity; Model 3 contains no measure of comorbidity.

Source: Manitoba Centre for Health Policy, 2011

Table 3.2: Influenza Immunization Crude Rates by Sociodemographic Factors, Aged 65+, 2002/03 and 2007/08

Factor	Category	% Immunized	
		2002/03	2007/08
Age Group	65-74 (t,l) ***Reference***	50.10	53.50
	75-84 (1,2,t,l)	62.80	66.80
	85 and older (1,2,t,l)	65.40	70.90
Income Quintile	Rural 1 (Lowest) (1,2,l)	49.50	50.70
	Rural 2 (2,t,l)	54.40	56.40
	Rural 3 (t,l)	55.40	58.00
	Rural 4 (t,l)	54.90	57.40
	Rural 5 (highest) (t,l)	54.50	58.60
	Urban 1 (lowest) (t,l)	58.00	62.90
	Urban 2 (t,l)	57.20	61.50
	Urban 3 (t,l)	58.20	62.60
	Urban 4 (t,l)	57.60	62.50
	Urban 5 (highest) (t,l)	57.10	62.70
Number of Inpatient Hospitalizations	0-1 (1,2,t,l)	56.20	60.50
	2 or more (t,l)	63.60	66.00
Residency	Does not reside in a PCH (1,2,t,l)	55.40	59.40
	Resides in a PCH (t,l)	80.60	86.70
Marital Status	Other (1,2,t,l)	56.10	60.40
	Married (t,l)	57.70	61.50
Continuity of Care	No Continuity of Care (1,2,t,l)	56.00	60.40
	Less than 3 Physician Visits* (1,2,t,l)	20.80	25.80
	Continuity of Care (t,l)	62.20	65.60
Region of Residence	Brandon (1,2,t,l)	61.10	65.50
	Winnipeg (1,2,t,l)	58.40	63.50
	Rural South (1,2,t,l)	54.70	57.20
	North (1,2,l)	47.70	48.90
	Manitoba (t,l)	56.90	61.00
Sex	Male (t,l)	55.90	59.30
	Female (1,2,t,l)	57.70	62.30
Major Aggregated Diagnostic Groups (ADGs)	0 (1,2,t,l)	47.70	52.80
	1 (t,l)	63.10	66.70
	2 (1,2,t,l)	67.00	70.50
	3 or more (1,2,t,l)	67.40	71.00
Total Aggregated Diagnostic Groups (ADGs)	0-2 (t,l)	40.50	46.20
	3-5 (1,2,t,l)	61.40	65.30
	6 or more (1,2,t,l)	67.60	70.80

'1' indicates quintile's rate was statistically different from reference group in first time period

'2' indicates quintile's rate was statistically different from reference group in second time period

't' indicates change over time was statistically significant

's' indicates data suppressed due to small numbers

'l' indicates a significant linear trend over time

'*' for people with less than 3 physician visits, we were unable to define continuity of care

Source: Manitoba Centre for Health Policy, 2011

Influenza Vaccination in those with Respiratory Illness

People with a respiratory illness are eligible for funded influenza vaccination. **Total respiratory morbidity (TRM)** is a cumulative measure of the burden of respiratory illnesses in the population and includes the following diseases: asthma, chronic or acute **bronchitis**, **emphysema**, and chronic airway obstruction. TRM is often used in studies of this nature because of the challenge in separating these conditions from each other using the administrative claims data. People were considered to have TRM if they met one of the following conditions:

- one or more hospitalizations with a diagnosis of asthma, chronic or acute bronchitis, emphysema, or chronic airway obstruction: ICD–9–CM codes 466, 490, 491, 492, 493, or 496; ICD–10–CA codes J20, J21, J40–J45 **OR**
- one or more physician visits with a diagnosis of asthma, chronic or acute bronchitis, emphysema, or chronic airway obstruction (ICD–9–CM codes as above)

Given the low incidence of chronic bronchitis, emphysema, or chronic airway obstruction in those younger than 45 years of age, respiratory morbidity was examined using only asthma in those under the age of 45. For those 45 and older, TRM was used. For both age groups, individuals were considered to have asthma if they met at least one of the following conditions:

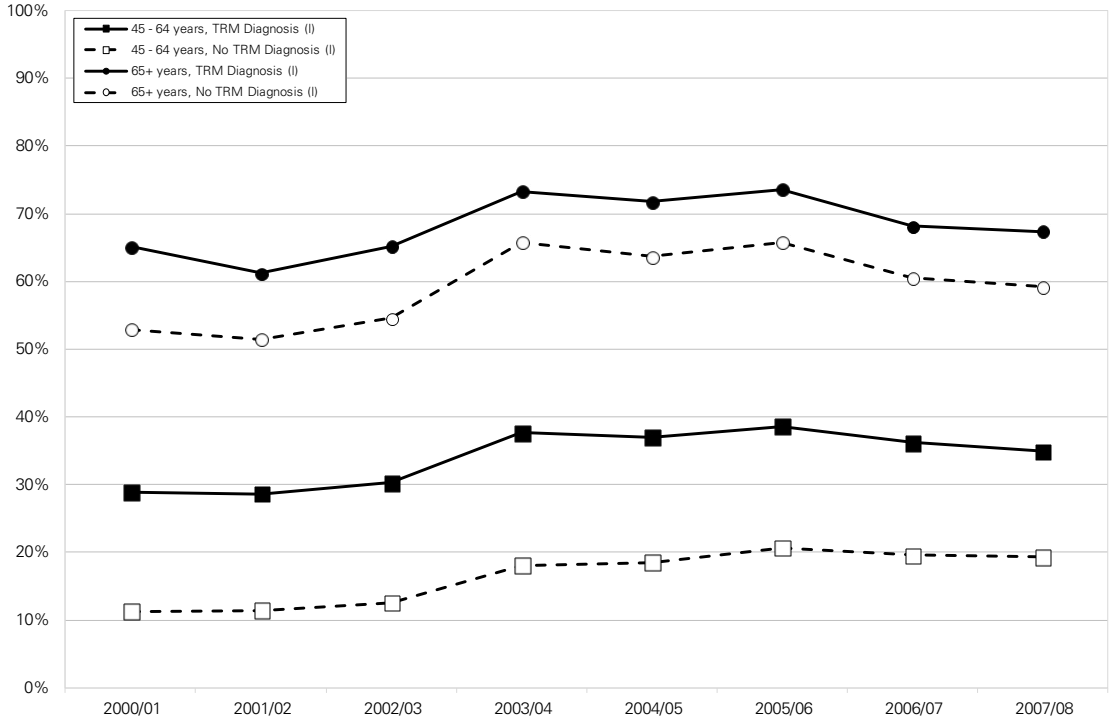
- one or more hospitalizations with primary diagnosis of 493 (ICD–9–CM) or J45 (ICD–10–CA) in a fiscal year **OR**
- two or more physician visits with diagnosis of 493 in a fiscal year **OR**
- two or more prescriptions for medications used to treat asthma in a fiscal year

Influenza Immunization in those with Total Respiratory Morbidity (TRM)

Figure 3.6 demonstrates the increased immunization rates among people with TRM compared to those without regardless of age group. It should be noted that despite the recommendations and public funding for immunization for people with respiratory illness, less than 40% of those with respiratory illness in the 45–64 age group are vaccinated in any given year. This number, while much less than ideal, is similar to rates for other medical illnesses such as congestive heart failure (CHF) (Figure 3.9) but higher than rates for some conditions such as cancer (Figure 3.8).

Figure 3.6: Manitoba Influenza Immunization Rates by Total Respiratory Morbidity (TRM) Diagnosis, Aged 45+

Percent of people who received the influenza vaccination, 2000/01–2007/08



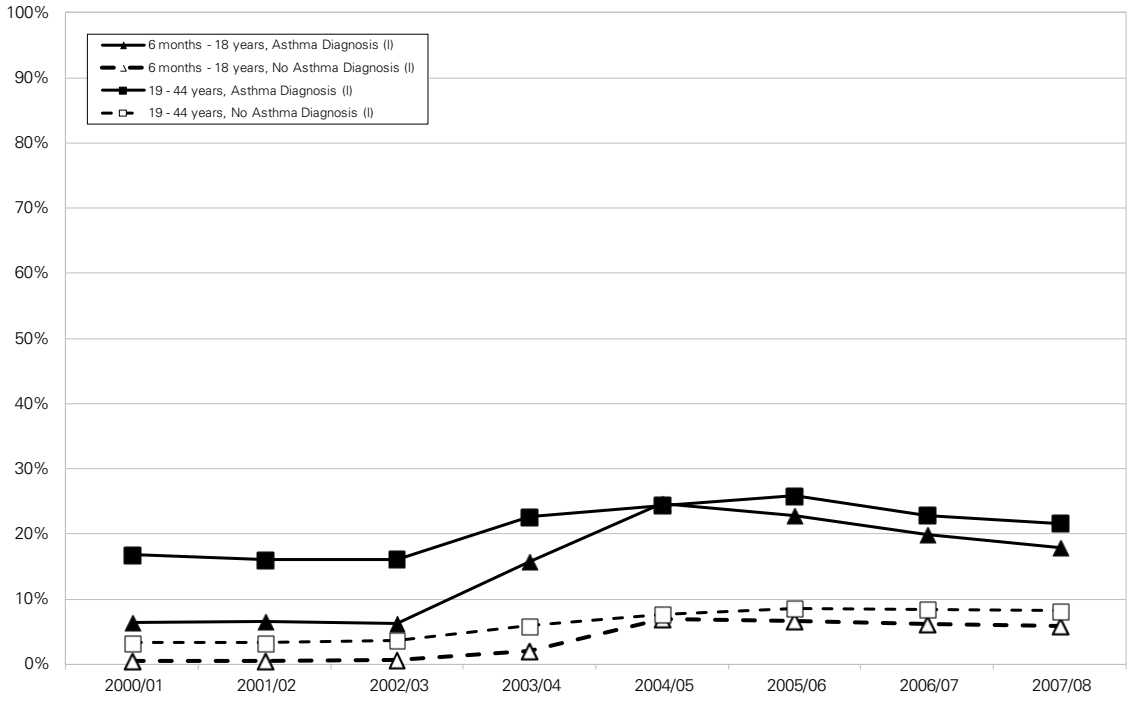
'I' indicates that the linear trend over time is significant at p<0.05

Source: Manitoba Centre for Health Policy, 2011

Influenza Immunization in those with Asthma

Rates of immunization in asthmatics six months to 18 years of age and 19–44 years of age are presented in Figure 3.7. As expected, immunization rates for people with asthma were higher than the non–asthmatic population peaking at 25% in 2005/06. There was a significant increase in immunization rates among the younger population with asthma between 2002/03 and 2004/05, which corresponds to the addition of all children aged six to 23 months to the provincial immunization program.

Figure 3.7: Manitoba Influenza Immunization Rates by Asthma Diagnosis, Aged 6 months to 44 years
Percent of people who received the influenza vaccination, 2000/01–2007/08



'I' indicates that the linear trend over time is significant at p<0.05

Source: Manitoba Centre for Health Policy, 2011

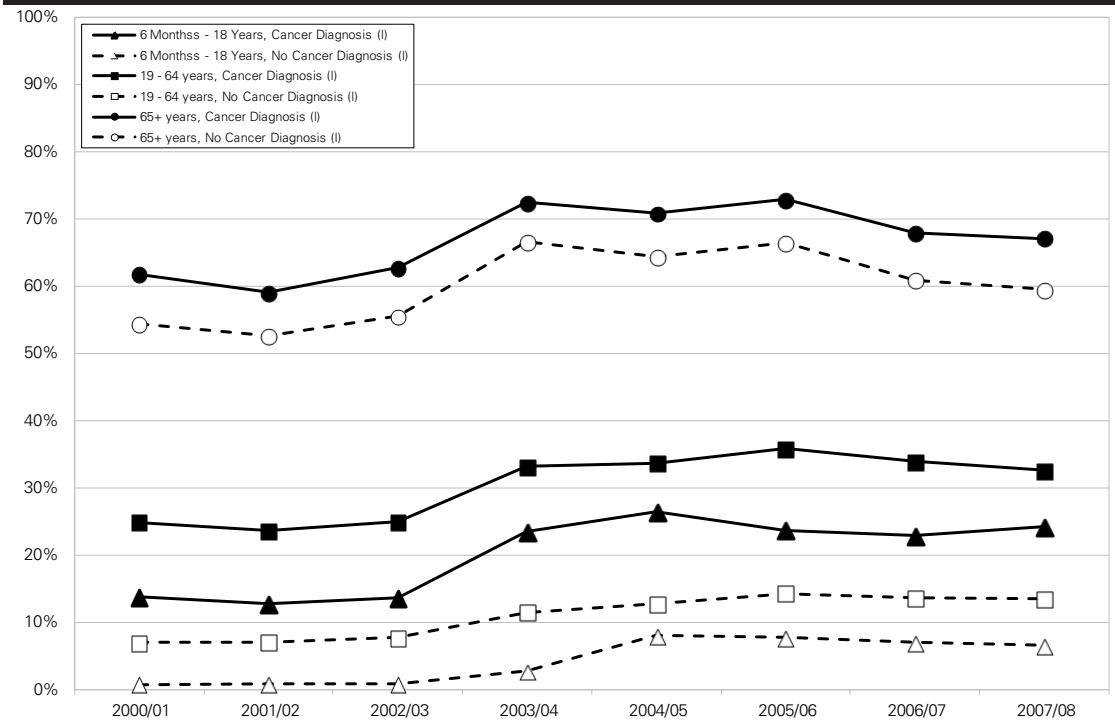
Influenza Immunization in those with a Cancer Diagnosis

In Manitoba's targeted program, individuals with a cancer diagnosis are eligible to receive influenza vaccination. CancerCare Manitoba provided MCHP with data on all invasive cancer patients diagnosed from 1983 to 2008. This definition of cancer encompasses all cancer diagnoses regardless of location or severity. We looked at three age groups: six months–18 years, 19–65 years, and 65 years and older. We compared the rates of those who had a previous cancer diagnosis to those who had not had a cancer diagnosis in the past 25 years.

Figure 3.8 demonstrates a similar pattern to other analyses in that a cancer diagnosis increases immunization rates across all age ranges with increases also noted from 2002/03 to 2005/06. The 65 and older category, although having the highest rates, shows a decline in vaccination rates after 2005/06 which is consistent with most other subgroup analyses. Interestingly, the decrease after 2005/06 is not seen in the aged 19–64 cancer population.

Overall, receiving a cancer diagnosis appears to be associated with a slightly lower immunization rate compared to other comorbidities with a peak between 2004/05 and 2006/07 of 73% for those 65 and older, 36% for those 19–65, and 26% for those six months to 18 years.

Figure 3.8: Manitoba Influenza Immunization Rates by Cancer Diagnosis
Percent of people who received the influenza vaccination, 2000/01–2007/08



'I' indicates that the linear trend over time is significant at p<0.05

Source: Manitoba Centre for Health Policy, 2011

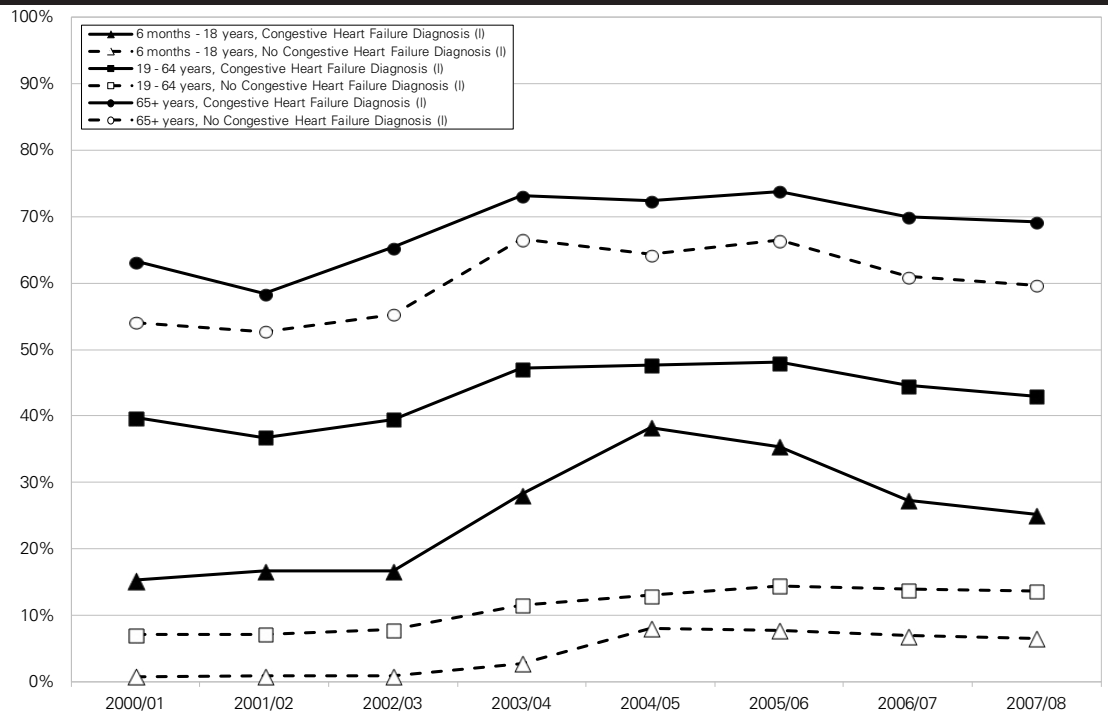
Influenza Immunization in those with Congestive Heart Failure (CHF)

People who have **congestive heart failure (CHF)** are considered at higher risk for complications of influenza and as such are included in the Manitoba high risk eligibility criteria. CHF was defined as:

- one or more hospitalizations with diagnosis code 428 (ICD–9 CM) or I50.0, I50.1, I50.9, I13.0, I13.2 (ICD–10–CA) in any diagnosis field over three years of data **OR**
- one or more physician claims with diagnosis code 428 over three years of data

A pattern of peak rates of influenza immunization appears from 2003/04 to 2005/06 in this patient group; and as expected, the 19–64 age group shows the most impressive difference between those with and without CHF (Figure 3.9). The baseline rate for that age group with no CHF peaks at 15% in 2005/06 compared to the CHF rate which peaks at 48% in that same year. Both groups decline after that with rates of 13% and 43% respectively by 2007/08. Similarly, the six months to 18 years and 65 and older age groups show higher rates for those with CHF compared to those without.

Figure 3.9: Manitoba Influenza Immunization Rates by Congestive Heart Failure Diagnosis
Percent of people who received the influenza vaccination, 2000/01–2007/08



'I' indicates that the linear trend over time is significant at p<0.05

Source: Manitoba Centre for Health Policy, 2011

Influenza Immunization in those with Diabetes

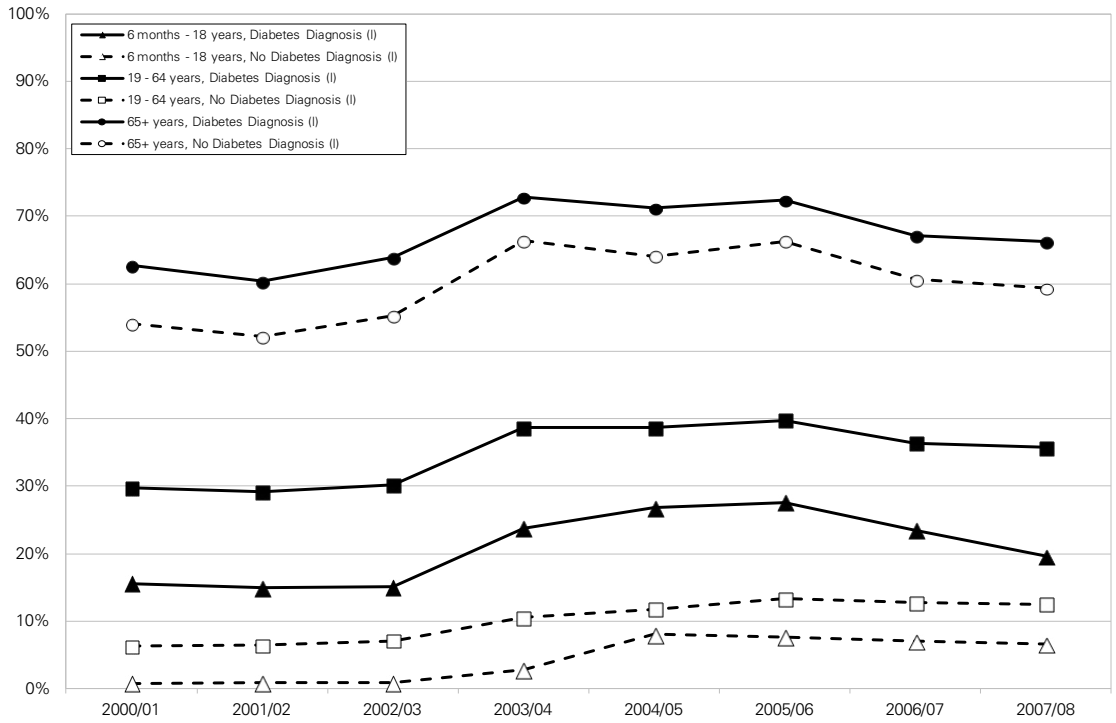
For the purpose of this analysis, diabetes is defined as one of:

- one or more hospitalizations with diagnosis codes 250 (ICD–9 CM) or E10–E14 (ICD–10–CA) in any diagnosis field over three years of data **OR**
- two or more physician claims with diagnosis code 250 over three years of data **OR**
- one or more prescriptions for diabetic drugs over three years of data

As with other comorbidities, the rates of immunization increase with age and with a diagnosis of diabetes (Figure 3.10). The 2003/04 rates for those with diabetes were once again the beginning of an overall increase in rates with rates of 24% (six months to 18 years), 39% (19–64 years), and 73% (65 years and older). This is compared to rates of 15%, 30%, and 64%, respectively, one year earlier. As seen previously, the immunization rates peaked in 2005/06 and declined after that. The 2007/08 rates dropped to 20%, 36% and 66% respectively, but were still higher than the rates from 2002/03.

The difference between immunization rates among diabetics compared to non–diabetic people was comparable to rate differences for other comorbidities and was consistently statistically significant.

Figure 3.10: Manitoba Influenza Immunization Rates by Diabetes Diagnosis
Percent of people who received the influenza vaccination, 2000/01–2007/08



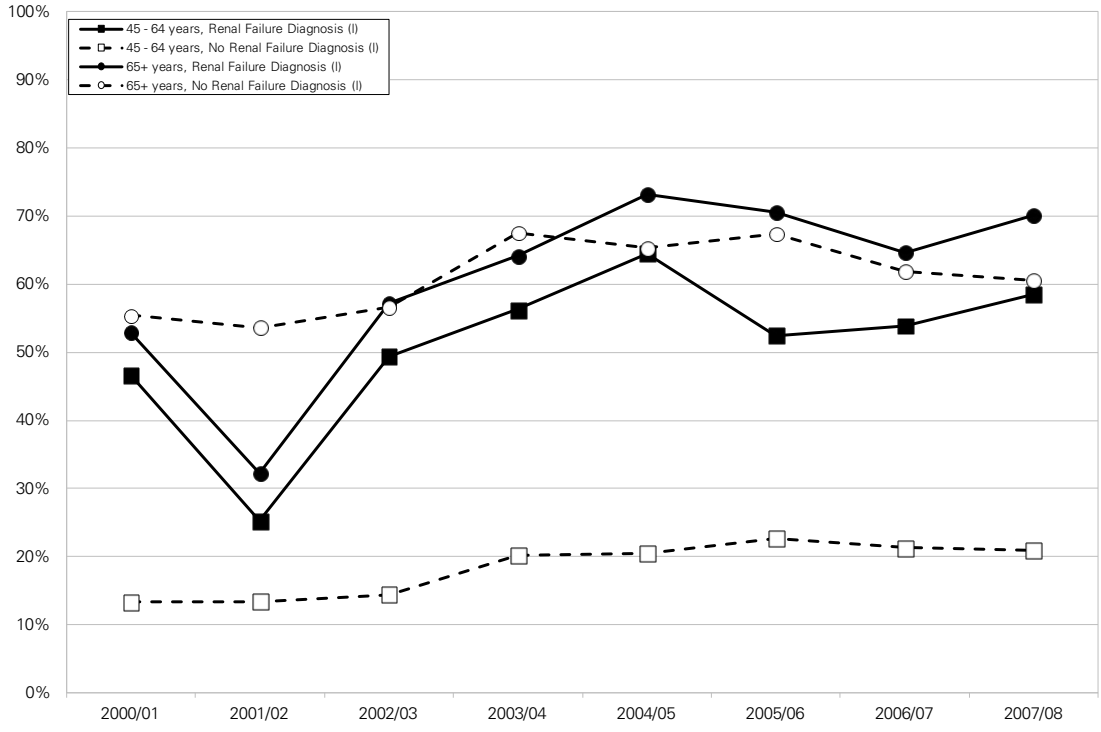
'I' indicates that the linear trend over time is significant at p<0.05

Source: Manitoba Centre for Health Policy, 2011

Influenza Immunization in those with Renal Failure

Patients with renal failure are considered to be at high risk for complications of influenza and are eligible for influenza vaccination under the provincial program. **Chronic renal failure** is defined for the purposes of this report as a medical claim (ICD–9–CM 9801, 9802, 9806, 9819, 9821, 9610, or 9820) indicating dialysis for chronic renal failure anytime in the last five years. Compared to most other medical illnesses, patients with chronic renal failure had very high immunization rates (Figure 3.11). The rate for patients 65 and older with renal failure was around 70% from 2004–2008; and for those 45–64 with renal failure, the rate was just below 60% for the same time period. There was, however, a large dip in the immunization rates in 2001/02. There is no clear explanation why the rates dipped to around 30% for one year, and further investigation would be needed to understand this anomaly.

Figure 3.11: Manitoba Influenza Immunization Rates by Renal Failure Diagnosis, Aged 45+
Percent of people who received the influenza vaccination, 2000/01–2007/08



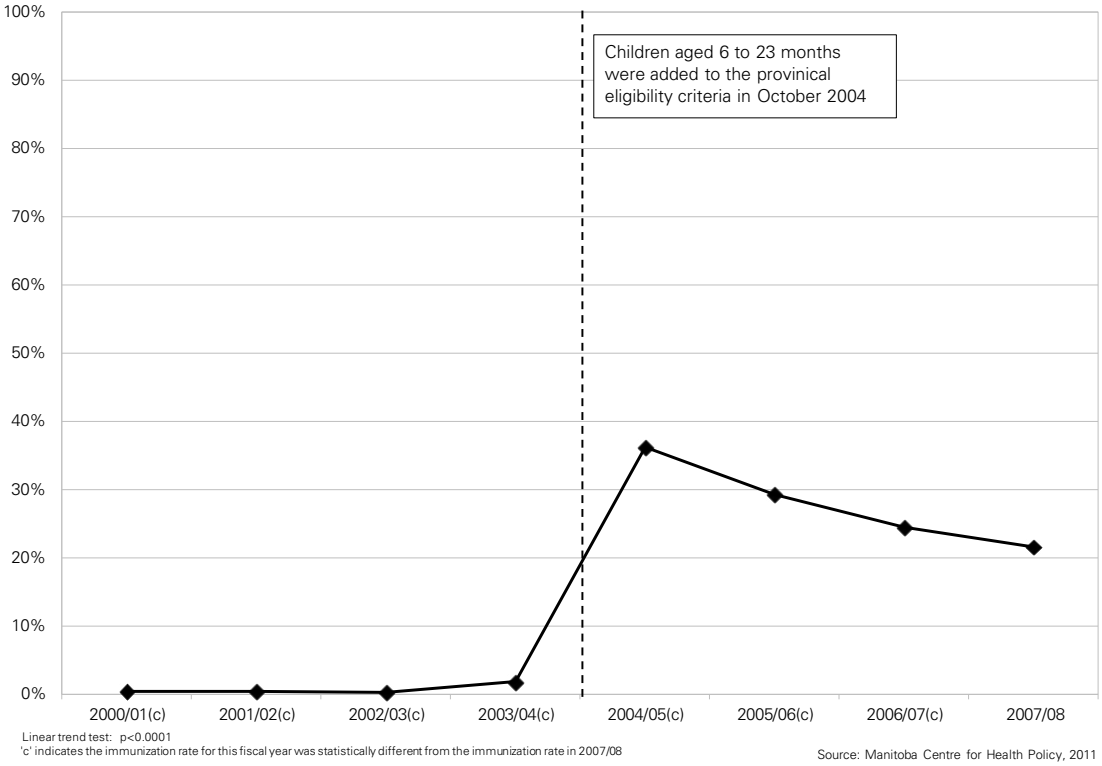
'I' indicates that the linear trend over time is significant at p<0.05

Source: Manitoba Centre for Health Policy, 2011

Influenza Immunization in Those Aged Six to 23 months

Manitoba added children aged six to 23 months to the provincial eligibility criteria in 2004. This policy change is reflected in the vaccination rate in this age group, which has increased from less than 1% in 2002/03 to a peak of 36% in 2004/05 (Figure 3.12). Unfortunately, rates have shown a consistent decline since 2004/05. The most recent data from 2007/08 shows a rate of only 22%. One can speculate that public awareness of childhood inclusion in the vaccination program was highest at its inception.

Figure 3.12: Manitoba Influenza Immunization Rates for Children Aged 6 to 23 months
Percent of children who received the influenza vaccination, 2000/01–2007/08



Linear trend test: p<0.0001
'c' indicates the immunization rate for this fiscal year was statistically different from the immunization rate in 2007/08

Source: Manitoba Centre for Health Policy, 2011

Influenza Immunization in Pregnant Women

The risks associated with influenza during pregnancy have been well documented, especially during influenza pandemics. During the 1918 and 1957 influenza pandemics, the mortality among pregnant women was disproportionately high, accounting for 50% of the maternal deaths in 1918 and 20% in 1957 (Harris, 1919; Greenberg, Jacobziner, Pakter, & Weisl, 1958). There is also excellent data demonstrating the safety of the influenza vaccination for pregnant women. Most studies have failed to detect any association with fetal malformations, cognitive or neurologic disabilities, and childhood cancers, nor have there been reports of any significant vaccine reactions, delivery complications, or poor fetal outcomes (Heinonen et al., 1973; Heinonen, Slone, & Shapiro, 1977; Black et al., 2004; Munoz et al., 2005; Englund et al., 1993; Deinard & Ogburn, Jr., 1981; Yeager, Toy, & Baker III, 1999). Still, vaccination rates among pregnant women remain extremely low. It is for this reason that we spent extra time evaluating the data for immunization rates and factors associated with these rates in the pregnant population.

Methods

Pregnant women were identified through the **hospital abstract**. All women who gave birth in a fiscal year were selected. No information on homebirths was available at the time of this study. Influenza immunizations in the 270 days prior to delivery were included. The comparison group was women aged 15–45 who did not give birth in the fiscal year.

To determine the number of children born to the mother in the past, we looked at all children who were in the mother's family. Unfortunately, this may include step children and grandchildren, who are registered with Manitoba Health under the same family number.

A logistic regression model was run to help describe the impact of individual factors associated with pregnant women who received the influenza vaccination.

Provider type was determined by assigning the tariff code for prenatal care (8400 or 8401) into one of three categories: **Obstetrician/Gynecologist**, General Practitioner/Family Physician, or both Obstetrician/Gynecologist and General Practitioner/Family Physician. Women with no prenatal care visits were excluded from the provider type analysis. The number of prenatal visits before 32 weeks gestation was determined. Women who did not receive prenatal care from a physician were included with those who had less than three prenatal visits before 32 weeks.

We also compared the proportion of women 15–45 who delivered a child in the fiscal years 2004/05–2006/07 who were immunized for influenza in the 270 days before delivery versus in the 270 days after delivery. Women were excluded who delivered in this time period and became pregnant again within one year of delivery. Fiscal years 2000–2003 were excluded as the immunization rate of pregnant women in this time period was very low (less than or equal to 1%). A McNemar's test for comparing proportions on matched pair data was used to test for a difference between the two proportions.

We also looked at the immunization rates for pregnant women who had a diagnosis of asthma, TRM, and diabetes in the one year prior to delivery. We used the same definition of asthma, TRM, and diabetes as was used in the previous section.

Results

The overall immunization rate for pregnant women has been rising since 2000/01 (Figure 3.13). However, by 2007/08 the rate was still only 6% compared to 8% of the non–pregnant population and 30–50% for other high–risk groups. The rates were higher in women who had one child under the age of five while pregnant (Table 3.3)

Pregnant women with comorbid conditions such as diabetes, asthma, and TRM had higher rates of influenza immunizations than women who did not have these conditions (Table 3.4).

In Figure 3.14, we examined the relationship between income and vaccination rates in 2007/08. There was a clear association between higher income and higher vaccination rates. The rates among the lowest income groups were as low as 4% while the highest income groups reached rates of 9% in urban areas. These differences were statistically significantly different from each other.

Figure 3.15 shows that younger pregnant women are less likely to receive the influenza vaccine. All age groups showed increases starting in 2003/04; but by 2007/08, the disparity between age groups reached the point where women over 30 were almost twice as likely to receive the vaccine as women in the 15–19 group.

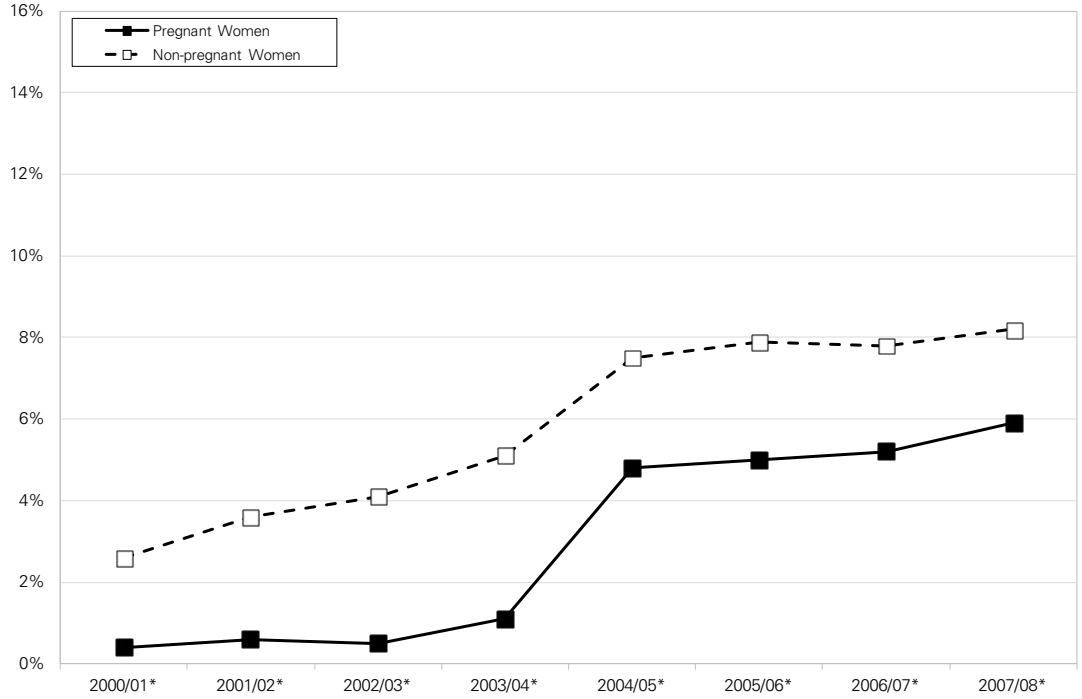
We were surprised to find that women who were followed by an obstetrician were less likely to receive an influenza vaccine than those followed by a family physician (Table 3.5). Women seeing an obstetrician alone had a rate of 4% while those who saw a family doctor, either alone or in addition to an obstetrician, were at 7%. However, in a survey of obstetricians, responses indicated that many obstetricians felt that another care provider should be responsible for vaccine administration (Schrag et al., 2003).

One would expect that the season of delivery may have an impact on vaccination rates and indeed these differences were seen. Women who delivered in January–March had a 10% immunization rate whereas women who delivered in July–September had a less than 4% vaccination rate (Table 3.5). One hypothesis is that as women progress in their pregnancy, they have more frequent visits with their doctor and thus might be more likely to receive a vaccine during flu season. A second hypothesis is that women delivering during flu season have two indications for the vaccine: pregnancy and being the member of an infant's household after delivery.

Two other factors were found to significantly affect immunization rates: number of prenatal visits prior to 32 weeks and having a child younger than 24 months. Women who saw their physician more often and those with a young child at home had higher immunization rates.

Finally, we compared immunization rates between currently pregnant and recently pregnant women (Figure 3.16). Recently pregnant women (within 270 days of delivery) not only had significantly higher immunization rates than pregnant women, but they also had higher rates than healthy non–pregnant women. In 2006/07, the overall rate for recently pregnant women was 12% compared to 5% for pregnant women (Figure 3.16) and 8% in the non–pregnant population (Figure 3.13). It appears that women are recognizing the need for vaccination to protect their infants but are still very hesitant to be vaccinated during pregnancy. This is likely a combination of a desire to protect the fetus from harm as well as limited understanding of the risks of influenza in pregnancy.

Figure 3.13: Manitoba Influenza Immunization Rates by Pregnancy Diagnosis, Aged 15–45
Percent of women who received the influenza vaccination, 2000/01–2007/08



Linear trend test: p<0.0001 for both pregnant and non-pregnant women
'*' indicates that the difference between the two groups rates are statistically significant at p<0.05

Source: Manitoba Centre for Health Policy, 2011

Table 3.3: Influenza Immunization Rates in Women Aged 15-45 who Gave Birth, 2004/05–2007/08, by Number of Children Under the Age of Five

Number of Children Under Age Five	% Immunized
0	4.72
1	6.32
2+	4.64

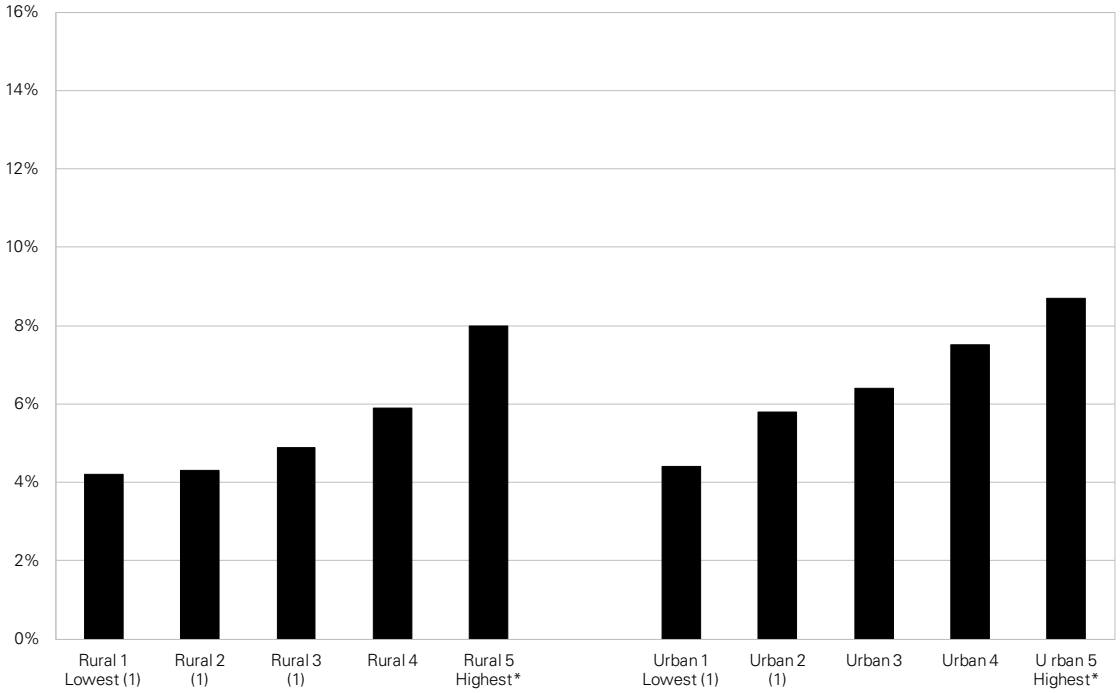
Source: Manitoba Centre for Health Policy, 2011

Table 3.4: Influenza Immunization Rates in Women Aged 15-45 who Gave Birth, 2004/05–2007/08, by Comorbid Conditions

Comorbid Condition	% Immunized
Diabetes Diagnosis	8.32
No Diabetes Diagnosis	5.19
Asthma Diagnosis	10.77
No Asthma Diagnosis	5.09
Total Respiratory Morbidity Diagnosis	8.04
No Total Respiratory Morbidity Diagnosis	5.05

Source: Manitoba Centre for Health Policy, 2011

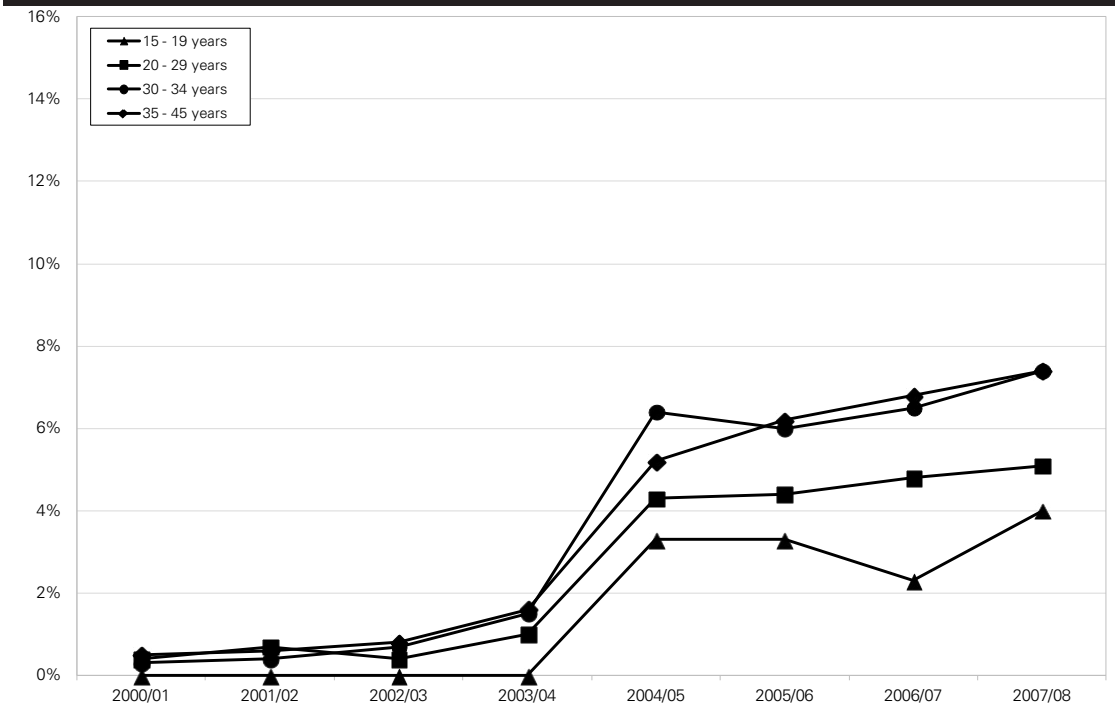
Figure 3.14: Manitoba Influenza Immunization Rates for Pregnant Women, Aged 15-45, by Income Quintile
Percent of pregnant women who received the influenza vaccination, 2000/01–2007/08



'1' indicates quintile's rate was statistically different from reference group at p<0.0125
'*' indicates the reference group. Rural 5 is the reference group for rural quintiles; Urban 5 is the reference group for urban quintiles

Source: Manitoba Centre for Health Policy, 2011

Figure 3.15: Manitoba Influenza Immunization Rates for Pregnant Women, Aged 15-45, by Age Group
Percent of pregnant women who received the influenza vaccination, 2000/01–2007/08



Source: Manitoba Centre for Health Policy, 2011

Table 3.5: Factors Associated with Receiving the Influenza Vaccination in Pregnant Women who Gave Birth in Manitoba, 2007/08

Factor	Category	% Immunized	Study Population (n)	Adjusted Odds Ratio (95% CI)
Age at delivery	19 and younger	4.0%	1,307	0.92(0.68, 1.25)
	20-29	5.1%	7,602	***Reference***
	30-34	7.4%	3,758	1.35(1.15, 1.59)
	35-45	7.4%	1,886	1.34(1.09, 1.65)
Pregnant and have a child under 24 months	No	5.7%	12,673	0.81(0.66, 0.99)
	Yes	6.9%	1,880	***Reference***
Number of Prenatal visits by a Physician[a]	Less than three before 32 weeks	3.5%	3,186	0.58(0.47, 0.72)
	Three or more before 32 weeks	6.5%	11,367	***Reference***
Physician type providing prenatal care[b]	Obstetrician	4.3%	4,660	0.57(0.48, 0.69)
	Both General / Family Practitioner and Obstetrician	7.0%	4,091	0.78(0.62, 0.99)
	General / Family Practitioner	6.8%	4,991	***Reference***
Area of Residence	Rural	5.2%	6,662	0.87(0.75, 1.01)
	Urban	6.8%	7,891	***Reference***
Income Quintile	Urban 1, Rural 1 (Lowest)	4.2%, 4.4%	1,812, 2,017	0.58(0.46, 0.72)
	Urban 2, Rural 2	4.9%, 6.4%	1,355, 1,668	0.64(0.51, 0.80)
	Urban 3, Rural 3	5.9%, 6.4%	1,121, 1,554	0.72(0.57, 0.90)
	Urban 4, Rural 4	5.9%, 7.5%	1,160, 1,236	0.82(0.65, 1.02)
	Urban 5, Rural 5 (Highest)	8.0%, 8.7%	1,044, 1,088	***Reference***
Quarter of Birth	January - March	10.1%	3,401	2.34(1.93, 2.84)
	April - June	5.6%	3,630	1.24(1.00, 1.53)
	July - September	3.7%	3,962	0.78(0.62, 0.99)
	October - December	4.6%	3,560	***Reference***

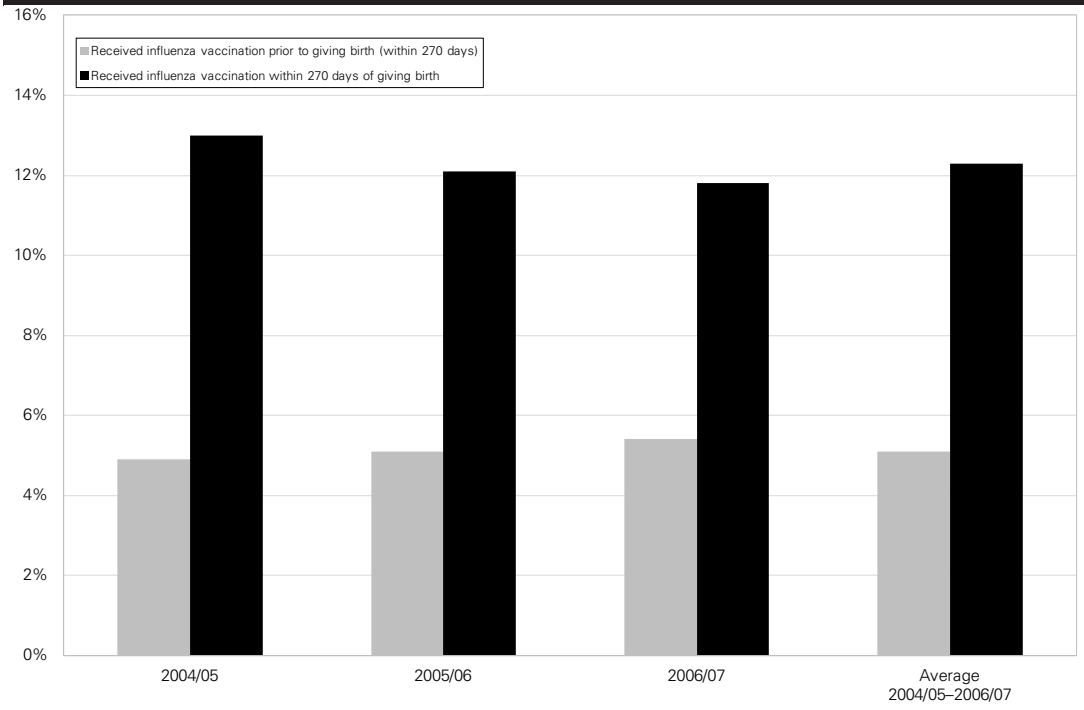
[a] Women who did not receive prenatal care from a physician are included in those who had less than three prenatal visits before 32 weeks

[b] Only those women who received prenatal care from a physician are included in this model and area of residence is excluded from this model as most Obstetricians in Manitoba practice in urban areas. ~791 women either received prenatal care from an alternative provider (midwife, nurse practitioner) or did not receive prenatal care.

Source: Manitoba Centre for Health Policy, 2011

Figure 3.16: Manitoba Influenza Immunization Rates for Women, Aged 15–45, Who Gave Birth by Timing of Vaccination

Percent of women who gave birth and received the influenza vaccination, 2004/05–2007/08



Source: Manitoba Centre for Health Policy, 2011

Chapter 4: Pneumococcal Polysaccharide (PPV–23) Immunization Program

Background

Invasive pneumococcal disease (IPD) is an important cause of morbidity and mortality in those 65 and older regardless of comorbidities and in those of any age with immunodeficiency or underlying illness including cardiac disease (e.g., congestive heart failure), respiratory disease (e.g., asthma), and diabetes mellitus. Manitoba introduced its pneumococcal polysaccharide program (PPV–23) for those at high risk due to comorbidities in 2000 and for those 65 and older in 2001. The 23–valent vaccine approved for use in Canada and used in the Manitoba program contains the capsular polysaccharides of 23 different pneumococcus serotypes which historically account for about 85% of all cases of invasive pneumococcal disease in North America.

Manitoba Program

Currently, Manitoba recommends the PPV–23 for the following people:

- Immunodeficiency: splenic disorders (**asplenia** or hyposplenism, sickle cell anemia, thalassemia major, essential thrombocytopenia, celiac disease, inflammatory bowel disease); chronic liver and renal disease; congenital immunodeficiency conditions (antibody defects, complement deficiency); immunosuppressive therapy; hematopoietic stem cell and solid organ transplantation; impaired immune responsiveness (e.g., HIV) (Public Health Agency of Canada, 2006).
- People 65 years of age and older and residents of long term care facilities
- People aged two to 64 with chronic underlying illness including cardiac disease (e.g., congestive heart failure), respiratory disease (e.g., asthma), diabetes mellitus, cerebrospinal fluid leak leaks, or cochlear implant recipients (National Advisory Committee on Immunization, 2009)

Methods

If a medical claims tariff code of 8683 or 8961 was found for an individual any time in the past, we considered that individual to have received a pneumococcal vaccination.

We analyzed the immunization status of the following groups:

Those who were 65 and older

- People identified as having congestive heart failure (defined the same as in the section on influenza)
- People identified as having diabetes (defined the same as in the section on influenza)
- People identified as having respiratory illness (defined the same as in the section on influenza)
- People identified as having a splenic disorder within the past five years. Splenic disorders were identified through medical claims by looking for the following codes: ICD–10 (D73.0, Q89.0); CCI[2] (1.OB.83, 1.OB.89, 1.OB.87); ICD–9–CM diagnoses (289.59, 759.0); and ICD–9–CM procedures (41.5 or 41.43).

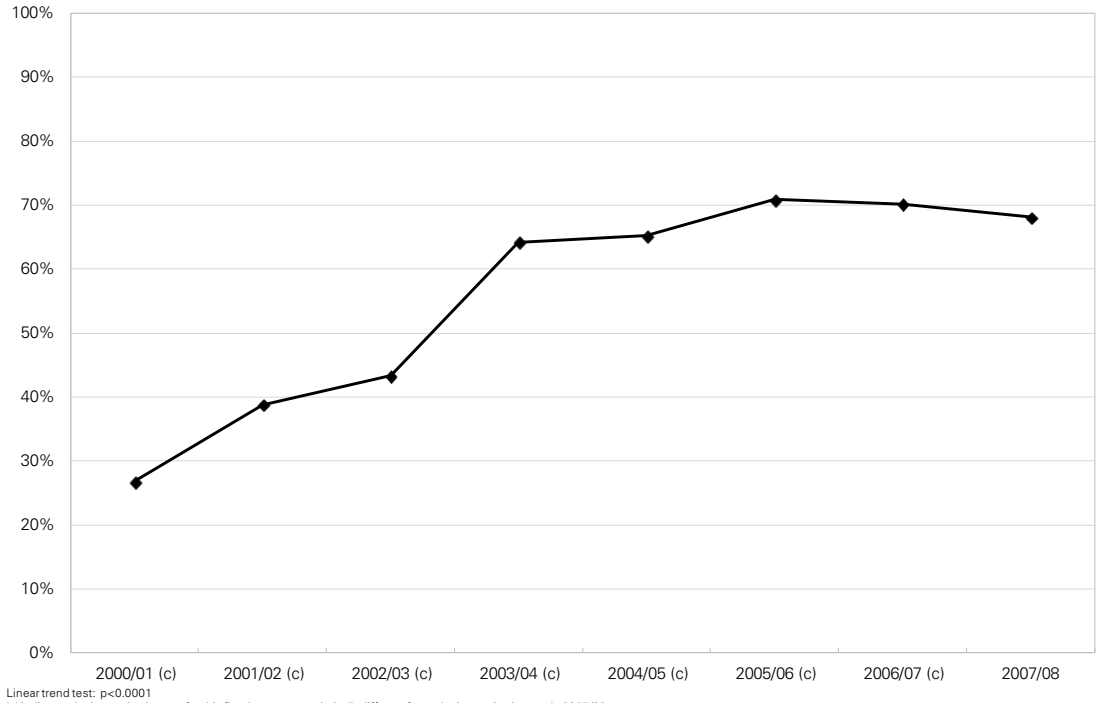
2 Canadian Classification of Health Indicators

Pneumococcal Polysaccharide (PPV–23) Immunization in those 65 and Older

For the purposes of this analysis a single dose of PPV–23 vaccine was required. Figure 4.1 shows the increase in PPV–23 uptake in Manitobans 65 and older from 27% in 2000/01 to 68% in 2007/08. Although rates were down slightly in the final year of our analysis from the peak of 71% in 2005/06, the steady increase from program inception is evident. In 2007/08, the highest immunization rates are seen in Brandon and Winnipeg with below provincial average rates seen in South Eastman, Central, North Eastman, and Burntwood (Figure 4.2). Regional variation can be seen in Figures 4.3 and 4.4.

The logistic regression model developed to look at factors associated with PPV–23 provides interesting results (Tables 4.1 and 4.2). As with the influenza vaccination, we developed three separate models: one with the number of major ADGs, one with the number of ADGS, and one without comorbidities. The relationship between income and immunization, which was repeatedly demonstrated in the pediatric models with other immunizations, does not appear to exist for PPV–23 in those 65 and older (Figure 4.5). Manitobans 65–74, compared to older age groups, and those not living in a PCH were less likely to be immunized. Individuals with no ADGs were less likely to be immunized than those with one or more major or total ADGs. Those with spouses had a higher likelihood of PPV–23 immunization; seniors with continuity of care were more likely to be immunized.

Figure 4.1: Manitoba Pneumococcal Polysaccharide (PPV-23) Immunization Rates, Aged 65+
Percent of people who received the PPV-23 vaccination, 2000/01–2007/08

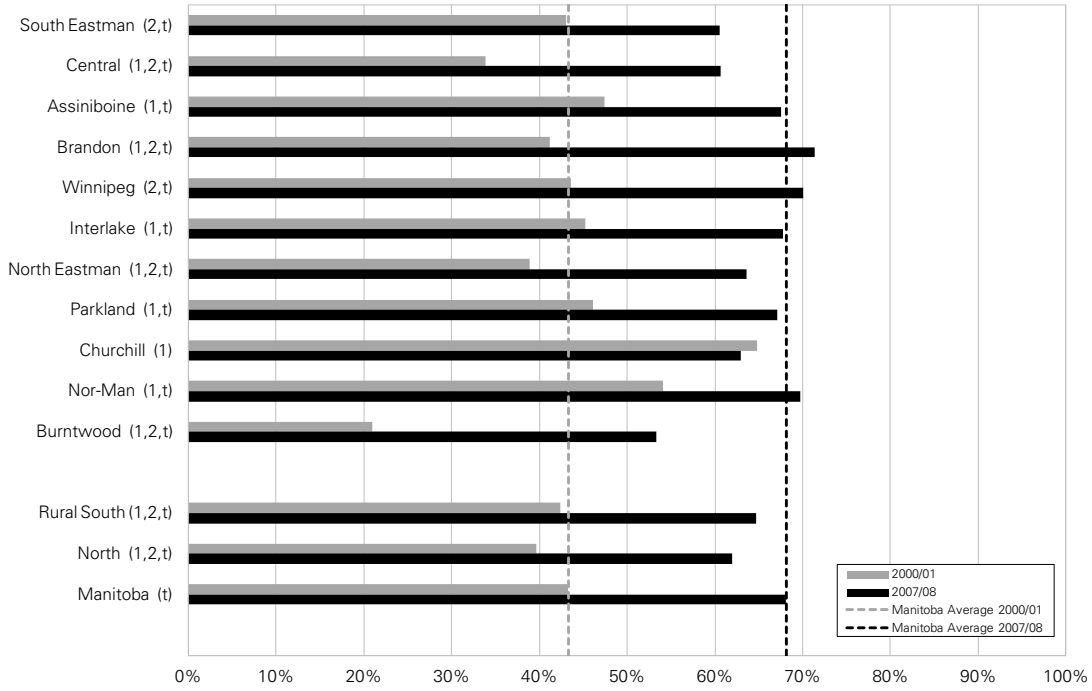


Linear trend test: p<0.0001
'c' indicates the immunization rate for this fiscal year was statistically different from the immunization rate in 2007/08

Source: Manitoba Centre for Health Policy, 2011

Figure 4.2: RHA Pneumococcal Polysaccharide (PPV-23) Immunization Rates, Aged 65+

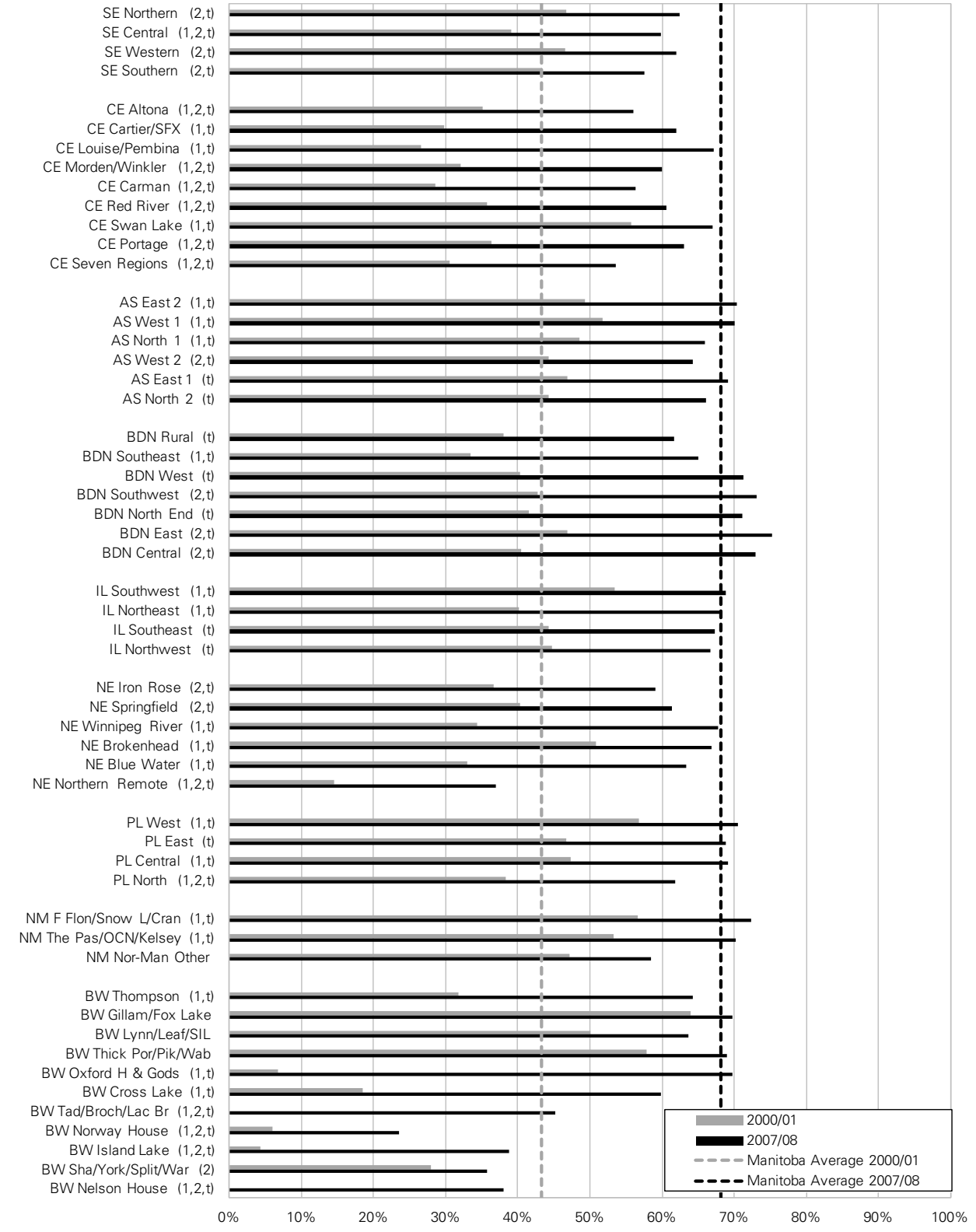
Percent of people who received the PPV-23 vaccination, 2000/01–2007/08



'1' indicates area's rate was statistically different from Manitoba average in first time period
'2' indicates area's rate was statistically different from Manitoba average in second time period
't' indicates change over time was statistically significant for that area
's' indicates data suppressed due to small numbers

Source: Manitoba Centre for Health Policy, 2011

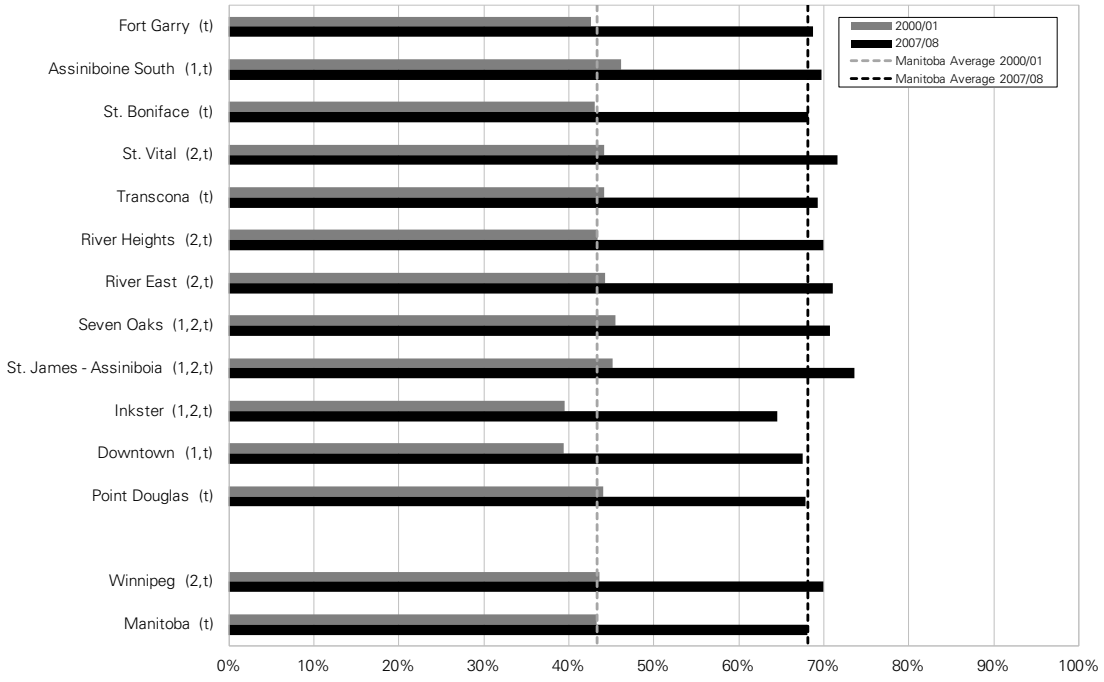
Figure 4.3: RHA District Pneumococcal Polysaccharide (PPV-23) Immunization Rates, Aged 65+
Percent of people who received the PPV-23 vaccination, 2000/01–2007/08



Source: Manitoba Centre for Health Policy, 2011

Figure 4.4: Winnipeg CA Pneumococcal Polysaccharide (PPV-23) Immunization Rates, Aged 65+

Percent of people who received the PPV-23 vaccination, 2000/01–2007/08

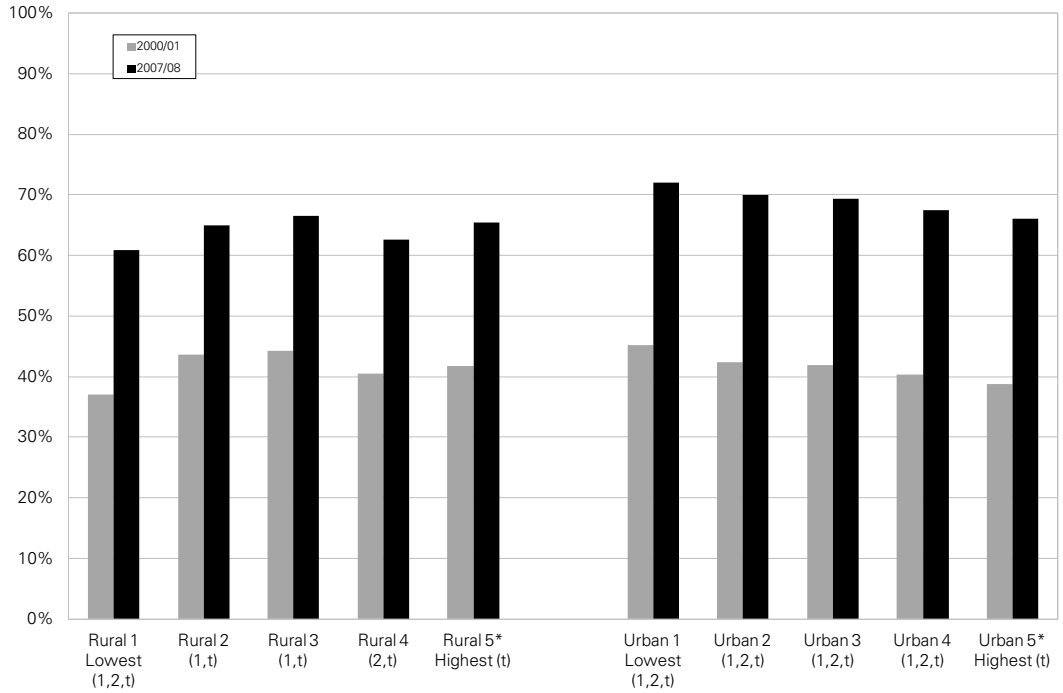


'1' indicates area's rate was statistically different from Manitoba average in first time period
'2' indicates area's rate was statistically different from Manitoba average in second time period
't' indicates change over time was statistically significant for that area
's' indicates data suppressed due to small numbers

Source: Manitoba Centre for Health Policy, 2011

Figure 4.5: Pneumococcal Polysaccharide (PPV-23) Immunization Rates by Income Quintile, Aged 65+

Percent of people who received the PPV-23 vaccination, 2000/01–2007/08



'1' indicates quintile's rate was statistically different from reference group in first time period
'2' indicates quintile's rate was statistically different from reference group in second time period
't' indicates change over time was statistically significant for that quintile
's' indicates data suppressed due to small numbers
'*' indicates the reference group. Rural 5 is the reference group for rural quintiles; Urban 5 is the reference group for urban quintiles

Source: Manitoba Centre for Health Policy, 2011

Table 4.1: Factors Associated with Receiving the Pneumococcal Polysaccharide (PPV-23) Immunization, Aged 65+

Adjusted Odds Ratio (95% Confidence Interval), 2007/08

Factor	Category	Odds Ratio (95% CI)		
		Model 1	Model 2	Model 3
Age Group	65-74	***Reference***	***Reference***	***Reference***
	75-84	2.09, (2.04, 2.14)	2.10, (2.05, 2.15)	2.15, (2.10, 2.20)
	85 and older	2.12, (2.05, 2.19)	2.16, (2.09, 2.24)	2.21, (2.13, 2.28)
Income Quintile	Quintile 1 (lowest)	1.00, (0.96, 1.04)	1.01, (0.98, 1.05)	1.00, (0.97, 1.04)
	Quintile 2	1.02, (0.98, 1.05)	1.03, (0.99, 1.07)	1.02, (0.98, 1.05)
	Quintile 3	1.05, (1.01, 1.09)	1.06, (1.02, 1.10)	1.05, (1.01, 1.09)
	Quintile 4	0.96, (0.93, 0.99)	0.96, (0.93, 1.00)	0.96, (0.92, 0.99)
	Quintile 5 (highest)	***Reference***	***Reference***	***Reference***
Number of Inpatient Hospitalizations	0-1	1.05, (1.01, 1.09)	1.08, (1.03, 1.12)	0.91, (0.87, 0.94)
	2 and older	***Reference***	***Reference***	***Reference***
Residency	Does not reside in a PCH	0.88, (0.83, 0.94)	0.84, (0.79, 0.89)	0.80, (0.76, 0.85)
	Resides in a PCH	***Reference***	***Reference***	***Reference***
Marital Status	Other	0.84, (0.82, 0.86)	0.85, (0.83, 0.87)	0.84, (0.82, 0.86)
	Married	***Reference***	***Reference***	***Reference***
Continuity of Care	No Continuity of Care	0.88, (0.85, 0.90)	0.86, (0.84, 0.88)	0.91, (0.88, 0.93)
	Less than 3 Physician Visits*	0.26, (0.25, 0.27)	0.30, (0.29, 0.32)	0.23, (0.22, 0.24)
	Continuity of Care	***Reference***	***Reference***	***Reference***
Region of Residence	Winnipeg	***Reference***	***Reference***	***Reference***
	Brandon	0.99, (0.94, 1.05)	0.98, (0.93, 1.04)	0.99, (0.94, 1.05)
	North	0.85, (0.79, 0.90)	0.88, (0.82, 0.94)	0.84, (0.78, 0.89)
	Rural South	0.81, (0.79, 0.83)	0.82, (0.81, 0.84)	0.80, (0.78, 0.82)
Sex	Male	0.97, (0.95, 0.99)	1.00, (0.98, 1.03)	1.00, (0.97, 1.02)
	Female	***Reference***	***Reference***	***Reference***
Major Aggregated Diagnostic Groups (ADGs)	0	0.74, (0.73, 0.76)		
	1	***Reference***		
	2	1.10, (1.06, 1.14)		
	3 or more	1.12, (1.06, 1.18)		
Total Aggregated Diagnostic Groups (ADGs)	0-2		***Reference***	
	3-5		1.44, (1.40, 1.48)	
	6 or more		1.78, (1.72, 1.83)	

*' for people with less than 3 physician visits, we were unable to define continuity of care

Model 1 includes the number of major ADGs as a measure of comorbidity; Model 2 includes the number of total ADGs as a measure of comorbidity; Model 3 contains no measure of comorbidity.

Source: Manitoba Centre for Health Policy, 2011

Table 4.2: Pneumococcal Polysaccharide (PPV-23) Crude Immunization Rates by Sociodemographic Factors, Aged 65+, 2002/03 and 2007/08

Factor	Category	% Immunized	
		2002/03	2007/08
Age Group	65-74 (t,l) ***Reference***	35.00	57.50
	75-84 (1,2,t,l)	48.80	76.50
	85 and older (1,2,t,l)	57.70	82.00
Income Quintile	Rural 1 (Lowest) (1,2,t,l)	37.10	60.90
	Rural 2 (1,t,l)	43.60	65.00
	Rural 3 (1,t,l)	44.20	66.50
	Rural 4 (2,t,l)	40.50	62.60
	Rural 5 (highest) (t,l) ***Reference***	41.80	65.40
	Urban 1 (lowest) (1,2,t,l)	45.20	72.00
	Urban 2 (1,2,t,l)	42.30	69.90
	Urban 3 (1,2,t,l)	41.90	69.30
	Urban 4 (1,2,t,l)	40.40	67.50
	Urban 5 (highest) (t,l) ***Reference***	38.70	66.00
Number of Inpatient Hospitalizations	0-1 (1,2,t,l)	41.60	66.60
	2 and older (t,l) ***Reference***	58.70	83.70
Residency	Does not reside in a PCH (1,2,t,l)	40.70	66.60
	Resides in a PCH (t,l) ***Reference***	83.80	92.70
Marital Status	Other (1,2,t,l)	46.20	71.10
	Married (t,l) ***Reference***	40.60	65.30
Continuity of Care	No Continuity of Care (1,2,t,l)	43.50	70.00
	Continuity of Care (t,l) ***Reference***	47.10	71.90
	Less than 3 Physician Visits* (1,2,t,l)	15.90	34.70
Region of Residence	Brandon (1,2,t,l)	41.20	71.40
	Winnipeg (1,2,t,l)	44.10	70.20
	North (1,2,t,l)	42.40	64.70
	Rural South (1,2,t,l)	39.60	62.00
	Manitoba (t,l) ***Reference***	43.30	68.10
Sex	Male (t,l)	42.50	67.30
	Female (1,2,t,l) ***Reference***	43.90	68.70
Major Aggregated Diagnostic Groups (ADGs)	0(1,2,t,l)	33.10	58.80
	1(t,l) ***Reference***	47.90	73.00
	2(1,2,t,l)	55.80	79.40
	3 or more (1,2,t,l)	62.20	86.20
Total Aggregated Diagnostic Groups (ADGs)	0-2 (t,l) ***Reference***	30.10	54.60
	3-5(1,2,t,l)	45.40	71.00
	6 or more (1,2,t,l)	53.80	78.50

'1' indicates quintile's rate was statistically different from reference group in first time period

'2' indicates quintile's rate was statistically different from reference group in second time period

't' indicates change over time was statistically significant

's' indicates data suppressed due to small numbers

'l' indicates a significant linear trend over time

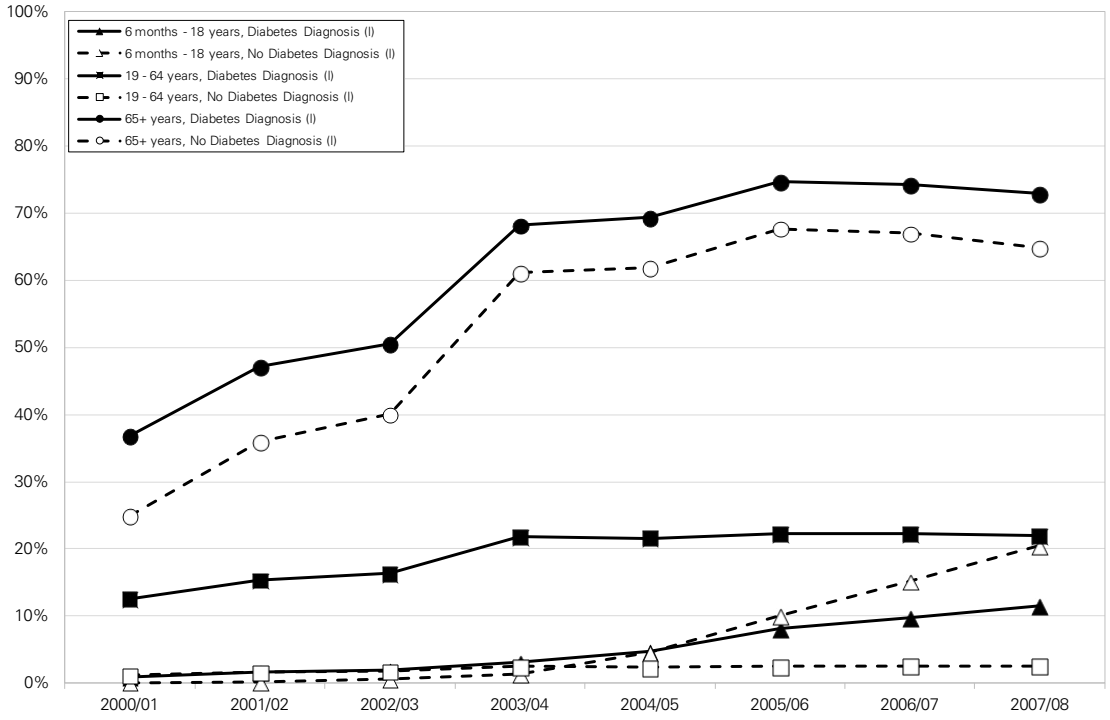
*' for people with less than 3 physician visits, we were unable to define Continuity of Care

Source: Manitoba Centre for Health Policy, 2011

Pneumococcal Polysaccharide (PPV–23) Immunization in those with Diabetes

Diabetics 65 and older had higher immunization rates than their non–diabetic counterparts in every year from 2000/01 to 2007/08 (Figure 4.6). In the final year of our analysis, for example, 73% of diabetics in this age group were immunized compared to 65% of those without diabetes. The same pattern held in the 19–64 age group. However, in 2006/07 and 2007/08, the non–diabetic six months to 18 years group had higher PPV–23 rates than diabetics in the same age group.

Figure 4.6: Manitoba Pneumococcal Polysaccharide (PPV-23) Immunization Rates by Diabetes Diagnosis
Percent of people who received the PPV-23 vaccination, 2000/01–2007/08



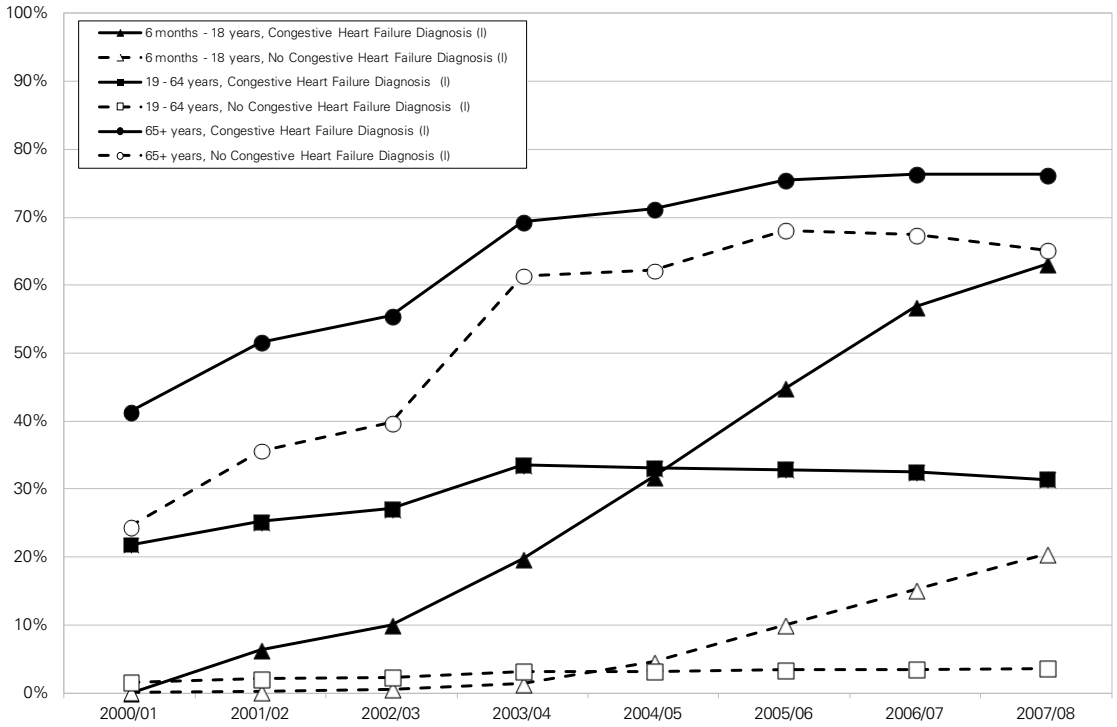
'I' indicates that the linear trend over time is significant at p<0.05

Source: Manitoba Centre for Health Policy, 2011

Pneumococcal Polysaccharide (PPV–23) Immunization in those with Congestive Heart Failure (CHF)

Cardio–respiratory comorbidities like asthma, TRM, and CHF increase risk for invasive pneumococcal disease. Figure 4.7 demonstrates that those with CHF have higher rates of immunization with PPV–23 than those without CHF across all age groups.

Figure 4.7: Manitoba Pneumococcal Polysaccharide (PPV-23) Immunization Rates by Congestive Heart Failure Diagnosis
Percent of people who received the PPV-23 vaccination, 2000/01–2007/08



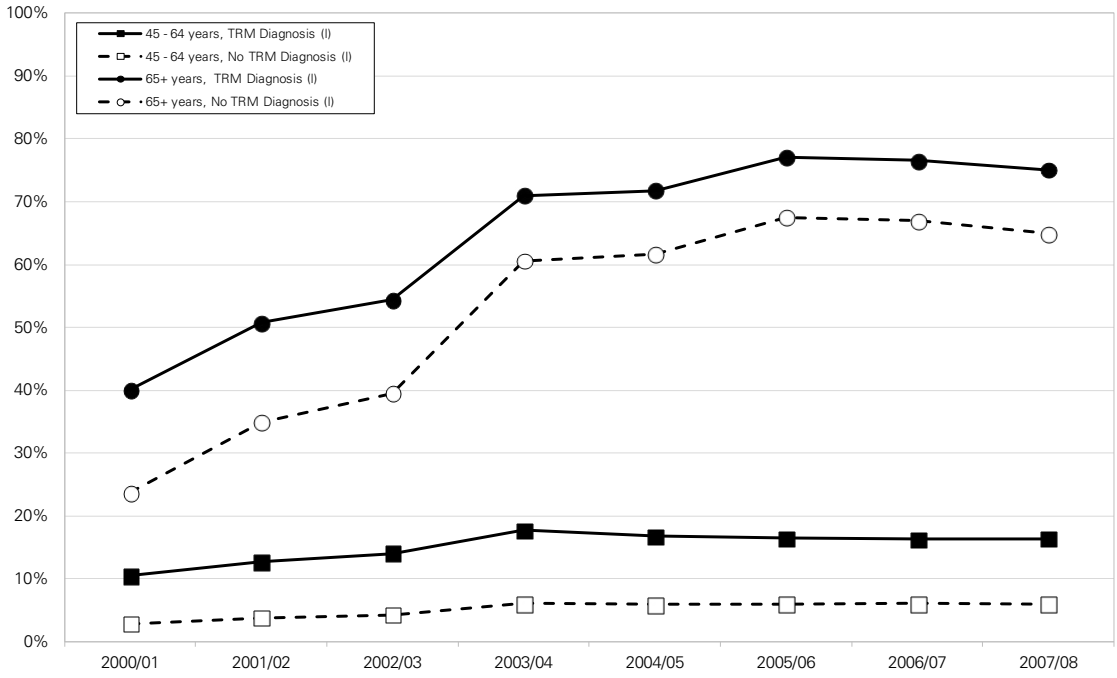
'I' indicates that the linear trend over time is significant at p<0.05

Source: Manitoba Centre for Health Policy, 2011

Pneumococcal Polysaccharide (PPV–23) Immunization in those with Respiratory Illness

Figures 4.8 and 4.9 show the increased vaccination rate with PPV–23 in targeted high risk individuals for TRM and asthma compared to those without respiratory comorbidities.

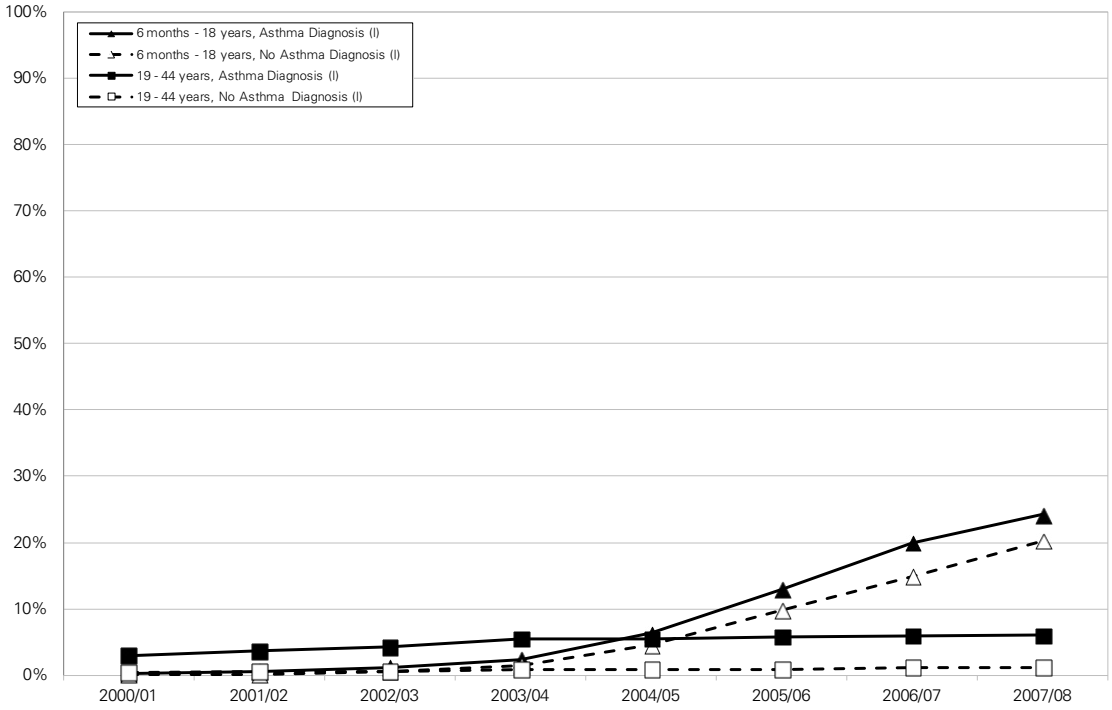
Figure 4.8: Manitoba Pneumococcal Polysaccharide (PPV-23) Immunization by Total Respiratory Morbidity (TRM) Diagnosis, Aged 45+
Percent of people who received the PPV-23 vaccination, 2000/01–2007/08



'I' indicates that the linear trend over time is significant at p<0.05

Source: Manitoba Centre for Health Policy, 2011

Figure 4.9: Manitoba Pneumococcal Polysaccharide (PPV-23) Immunization Rates by Asthma Diagnosis, Aged 6 months to 44 years
Percent of people who received the PPV-23 vaccination, 2000/01–2007/08



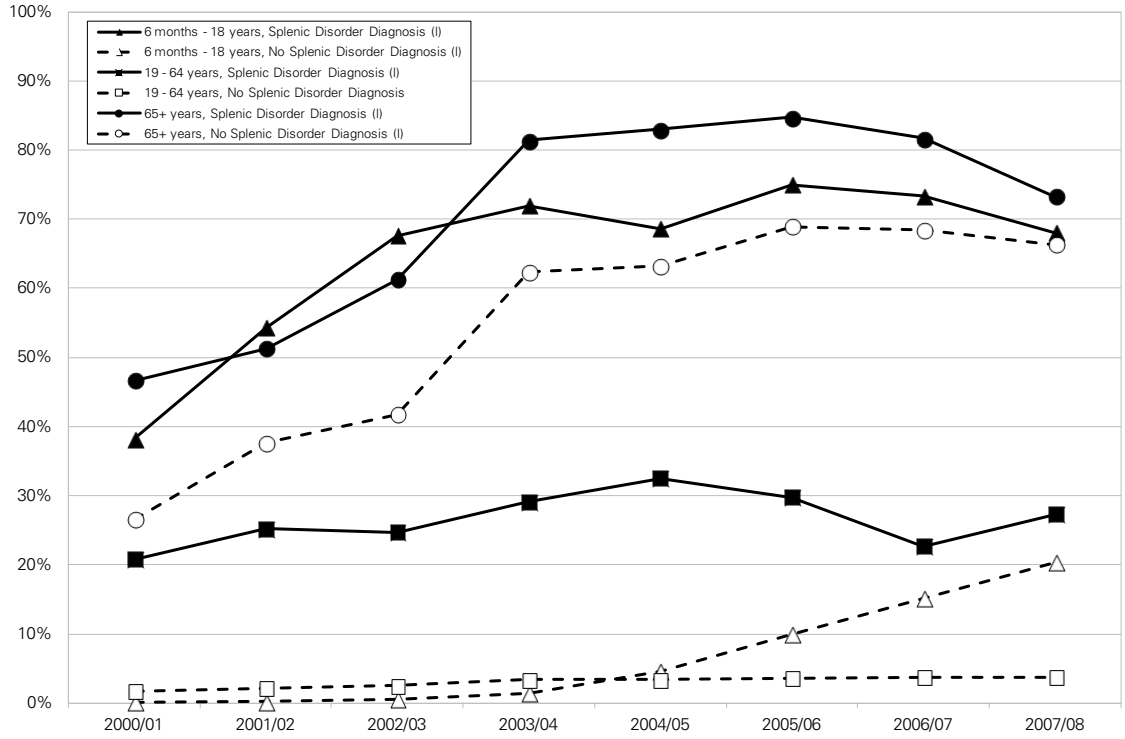
'I' indicates that the linear trend over time is significant at p<0.05

Source: Manitoba Centre for Health Policy, 2011

Pneumococcal Polysaccharide (PPV–23) Immunization in those with Splenic Disorders

Functional and anatomic asplenia increase the risk of invasive pneumococcal disease in all age groups. Figure 4.10 illustrates the impact of targeting those with splenic dysfunction for PPV–23; best illustrated is the pediatric population (six months to 18 years) where 68% of children with splenic disorders received PPV–23 compared to 20% of those without splenic disorders.

Figure 4.10: Manitoba Pneumococcal Polysaccharide (PPV-23) Immunization Rates by Splenic Disorder Diagnosis Within the Past Five Years
Percent of people who received the PPV-23 vaccination, 2000/01–2007/08



'I' indicates that the linear trend over time is significant at p<0.05

Source: Manitoba Centre for Health Policy, 2011

Chapter 5: Immunization Program Impacts on Health and the Health System

The Influenza Immunization Program—What Health and Health Systems Outcomes are Manitoba's Immunization Programs Having?

In Canada, there are two generally accepted approaches to reduce the impact of influenza: immunization with **trivalent inactivated influenza vaccine** (TIV) and chemoprophylaxis or treatment with antiviral medications specific for influenza (Public Health Agency of Canada, 2010). During the period examined in the Manitoba Immunization Study (2000/01–2007/08), antivirals were primarily used for control of influenza outbreaks in long–term care facilities, whereas immunization remained the main thrust of programs aimed at influenza control.

TIV administered intramuscularly results in the production of Immunoglobulin G antibodies to influenza hemagglutinin and neuraminidase and has a limited effect on cytotoxic T lymphocyte response. Both the humoral and cell–mediated responses of the vaccinated individual are felt to play a role in conferring immunity. There are many factors felt to play a role in a given individual's immune response to the vaccination, such as immune status, age, and previous antigen exposure. Protective antibody levels occur approximately 14 days after vaccine administration.

An important feature of seasonal influenza vaccination programs is the requirement for a new vaccine formulation and re–immunization every year to combat the so–called antigenic drift or change in the genetic signature of influenza viruses over time.

Numerous studies have demonstrated the efficacy of TIV (Public Health Agency of Canada, 2010). A number of these clinical trials show better TIV performance against lab confirmed influenza than clinically defined outcomes without laboratory confirmation. In years when TIV contains the predominant circulating strains, influenza vaccination has been shown to prevent influenza illness in approximately 70% to 90% of healthy children and adults (Langley & Faughnan, 2004; Smith et al., 2006; Negri et al., 2005; Manzoli, Schioppa, Boccia, & Villari, 2007; Demicheli, Rivetti, Deeks, & Jefferson, 2004). In years when the circulating influenza viruses do not match the vaccine strains, efficacy drops to approximately 50% in health adults (Public Health Agency of Canada, 2010).

Using **survival analysis** techniques we looked at the impact of immunization on the following endpoints: Time until all cause mortality, time until all cause hospitalization, time until antibiotic prescription (all antibiotics), and time until prescription of respiratory tract specific antibiotics (i.e., clarithromycin and azithromycin).

Endpoint—Time Until All Cause Mortality

Methods

To study the potential impact of influenza vaccination on all cause mortality, we did a survival analysis looking at the time until death for people 65 and older for 2006/07. This model controlled for influenza immunization status, age, sex, region (North, Rural South, Winnipeg), the number of ADGs (0, 1–3, 4 or more), comorbidities (diabetes, CHF, and TRM), and income quintiles (Quintile 1/lowest through Quintile 5 /highest). People living in PCHs were excluded from this analysis due to their high rates of immunization. For people who received an influenza immunization, the period of observation was the index date (two weeks after the date of immunization to allow for the immunization to become

effective) until March 31, 2007. The dependent variable was the time from index date until death or censor date (end of study or loss to follow–up) whichever came first. For those who did not receive an influenza immunization, the period of observation began on November 1, 2006.

Results

In the 65 and older population (excluding PCH residents), the **hazard ratio** for those immunized was 0.61 (0.56, 0.66) compared to those who were not immunized (Table 5.1). In other words, individuals who received influenza immunization were less likely to die of any cause during the period of observation than those who were not immunized. While this reduction in mortality may in part be due to the protective effect of influenza vaccination, recent studies examining influenza vaccine effectiveness in the elderly estimate that about 10% of wintertime mortality can be attributed to influenza (Simonsen, Taylor, Viboud, Miller et al, 2007). Therefore the estimate of a hazard ratio of 0.61 may be biased as a result of selection bias and residual confounding (i.e., those who receive influenza vaccines are different from those who do not and the variables included in the model may not adequately adjust for these differences).

Table 5.1: Survival Analysis for Time until All Cause Mortality, Aged 65+*, 2006/07

Factor	Category	Hazard Ratio (95% CI)	Probability
Immunization Status		0.61 (0.56, 0.66)	<.0001
Age		1.08 (1.07, 1.08)	<.0001
Sex	Male	1.75 (1.62, 1.89)	<.0001
	Female	**Reference**	**Reference**
Region of Residence	North	1.10 (0.87, 1.40)	0.4254
	South	0.97 (0.90, 1.06)	0.5261
	Winnipeg	***Reference***	***Reference***
Number of Aggregated Diagnostic Groups	0	1.14 (0.96, 1.35)	0.1399
	1-3	***Reference***	***Reference***
	4 or more	1.34 (1.23, 1.46)	<.0001
Diabetes Diagnosis		1.43 (1.30, 1.56)	<.0001
Congestive Heart Failure Diagnosis		2.92 (2.66, 3.20)	<.0001
Total Respiratory Morbidity Diagnosis		1.73 (1.58, 1.90)	<.0001
Income Quintile	Quintile 1 (lowest)	1.23 (1.07, 1.40)	0.0028
	Quintile 2	1.01 (0.88, 1.16)	0.8376
	Quintile 3	1.03 (0.90, 1.18)	0.6909
	Quintile 4	1.09 (0.94, 1.26)	0.2419
	Quintile 5 (highest)	***Reference***	***Reference***

* Excludes Personal Care Home residents

Source: Manitoba Centre for Health Policy, 2011

Endpoint—Time Until All Cause Hospitalization

Methods

To study the potential impact of influenza vaccination on all cause hospitalization, we completed a similar analysis to that described in the previous section. The dependent variable was the time from index date until hospitalization or censor date. For those who did not receive an influenza immunization, the period of observation began on November 1, 2006. People who were admitted to the hospital prior to November 1 and were still in the hospital on November 1 were excluded. People admitted on November 1 were included in the survival analysis and given one day of survival time.

Results

Individuals who received an influenza immunization were less likely to be hospitalized for any reason than those who had not been immunized with a hazard ratio of 0.93 (0.90, 0.97) (Table 5.2).

Table 5.2: Survival Analysis for Time until All Cause Hospitalization, Aged 65+*, 2006/07

Factor	Category	Hazard Ratio (95% CI)	Probability
Immunization Status		0.93 (0.90, 0.97)	0.0002
Age		1.04 (1.04, 1.05)	<.0001
Sex	Male	1.19 (1.15, 1.23)	<.0001
	Female	***Reference***	***Reference***
Region of Residence	North	1.89 (1.72, 2.07)	<.0001
	South	1.50 (1.45, 1.55)	<.0001
	Winnipeg	***Reference***	***Reference***
Number of Aggregated Diagnostic Groups	0	0.60 (0.54, 0.66)	<.0001
	1-3	***Reference***	***Reference***
	4 or more	1.53 (1.48, 1.59)	<.0001
Diabetes Diagnosis		1.39 (1.34, 1.45)	<.0001
Congestive Heart Failure Diagnosis		2.11 (2.02, 2.20)	<.0001
Total Respiratory Morbidity Diagnosis		1.40 (1.34, 1.46)	<.0001
Income Quintile	Quintile 1 (lowest)	1.38 (1.30, 1.46)	<.0001
	Quintile 2	1.22 (1.15, 1.30)	<.0001
	Quintile 3	1.20 (1.13, 1.27)	<.0001
	Quintile 4	1.13 (1.06, 1.21)	0.0001
	Quintile 5 (highest)	***Reference***	***Reference***

* Excludes Personal Care Home residents

Source: Manitoba Centre for Health Policy, 2011

Endpoint—Time Until First Antibiotic

Methods

To study the potential impact of influenza vaccinations on antibiotic use, we completed several survival analyses for time until first antibiotic, similar to those previously described. As the test for proportionality was violated, the final analysis was limited to those 19–64 with a diagnosis of TRM; and instead of any antibiotic, we limited the outcome to J01FA09 (Clarithromycin) and J01FA10 (Azithromycin) antibiotics. A similar analysis was performed for those 65 and older.

Results

This analysis produced an unexpected result. It appeared that people who were immunized actually had higher rates of antibiotic use than those not immunized. An attempt was made to adjust for age, sex, region of residence, number of ambulatory visits, type of antibiotic, income quintile, CHF, diabetes, and TRM. Regardless of the adjustments made, the result remained unchanged—higher antibiotic use for those who were vaccinated. This is both counterintuitive and contrary to the findings of Kwong et al. (2009), who demonstrated a decrease in antibiotic prescribing rates with universal influenza immunization programs at the population level (Tables 5.3 and 5.4).

Table 5.3: Survival Analysis for Time until First Prescription for Clarithromycin or Azithromycin with a Total Respiratory Morbidity Diagnosis, Aged 19–64, 2006/07

Factor	Category	Hazard Ratio (95% CI)	Probability
Immune Status		1.14 (1.08, 1.20)	<.0001
Number of Ambulatory Visits		1.03 (1.03, 1.03)	<.0001
Age		1.01 (1.01, 1.01)	<.0001
Sex	Male	0.80 (0.77, 0.84)	<.0001
	Female	***Reference***	***Reference***
Region of Residence	North	1.12 (1.00, 1.24)	0.0453
	South	1.17 (1.11, 1.22)	<.0001
	Winnipeg	***Reference***	***Reference***
Number of Aggregated Diagnostic Groups	0	0.61 (0.52, 0.71)	<.0001
	1-3	***Reference***	***Reference***
	4 or more	1.42 (1.36, 1.49)	<.0001
Diabetes Diagnosis		1.10 (1.03, 1.18)	0.0032
Congestive Heart Failure Diagnosis		1.03 (0.90, 1.17)	0.699
Income Quintile	Quintile 1 (lowest)	1.22 (1.14, 1.30)	<.0001
	Quintile 2	1.06 (0.99, 1.13)	0.118
	Quintile 3	1.11 (1.04, 1.19)	0.0027
	Quintile 4	1.04 (0.97, 1.12)	0.2296
	Quintile 5 (highest)	***Reference***	***Reference***

Source: Manitoba Centre for Health Policy, 2011

Table 5.4: Survival Analysis for Time until First Prescription for Clarithromycin or Azithromycin, Aged 65+, 2006/07

Factor	Category	Hazard Ratio (95% CI)	Probability
Immune Status		1.08 (1.03, 1.13)	0.0023
Number of Ambulatory Visits		1.03 (1.02, 1.03)	<.0001
Age		0.99 (0.98, 0.99)	<.0001
Sex	Male	0.86 (0.82, 0.90)	<.0001
	Female	***Reference***	***Reference***
Region of Residence	North	1.27 (1.11, 1.44)	0.0003
	South	1.31 (1.26, 1.37)	<.0001
	Winnipeg	***Reference***	***Reference***
Number of Aggregated Diagnostic Groups	0	0.47 (0.40, 0.54)	<.0001
	1-3	***Reference***	***Reference***
	4 or more	1.45 (1.38, 1.53)	<.0001
Diabetes Diagnosis		1.09 (1.04, 1.15)	0.0007
Congestive Heart Failure Diagnosis		1.19 (1.12, 1.27)	<.0001
Total Respiratory Morbidity Diagnosis		2.70 (2.58, 2.83)	<.0001
Income Quintile	Quintile 1 (lowest)	1.08 (1.01, 1.16)	0.0364
	Quintile 2	1.06 (0.99, 1.13)	0.1199
	Quintile 3	1.02 (0.95, 1.09)	0.6824
	Quintile 4	0.96 (0.89, 1.04)	0.3421
	Quintile 5 (highest)	***Reference***	***Reference***

Source: Manitoba Centre for Health Policy, 2011

Effectiveness of Influenza Vaccination in Personal Care Home Residents

In 2007/08, 87% of PCH residents in Manitoba received the influenza vaccination, making a survival analyses for this population impractical. However, in 2001/02, only 46% of residents received the influenza vaccination. We therefore did our analyses using the 2001/02 data.

Methods

All Cause Hospitalization

A survival analysis for all cause hospitalization was done to assess the effectiveness of influenza vaccinations in PCH residents. For people who received an influenza immunization, the period of observation was the index date (two weeks after the date of immunization to allow for the immunization to become effective) until April 30, 2002. The dependent variable was the time from the index date until first hospitalization or censor date (end of study or loss to follow–up) whichever came first. For those who did not receive an influenza immunization, the period of observation began on November 1, 2001. Predictors included were immunization status, age, sex, and the number of ADGs (0, 1–3, 4 or more). People who were admitted to the hospital prior to November 1 and were still in the hospital on November 1 were excluded. People admitted on November 1 were included in the survival analysis and given one day of survival time.

All Cause Mortality

A survival analysis for all cause mortality, similar to the one done for all cause hospitalization, was done to assess the effectiveness of influenza immunizations in PCH residents. This analysis failed the test of proportionality, so a Kaplan Meier Survival function was done. The survival function could not be calculated in SAS® with the presence of time–dependent variables like immunization status, so the start date of the study was moved to December 1, 2001, when approximately 90% of the immunizations were complete. People who were immunized after December 1, 2001 and those who died before December 1, 2001 were excluded. Values for age, sex (male), and number of ADGs (1–3) were entered as predictors in the model.

Results

All Cause Hospitalization

Personal care home residents receiving influenza immunization were less likely to be hospitalized for any cause than those who were not immunized against influenza (Tables 5.5). However, when age, sex, and number of ADGs were controlled the protective effect was no longer statistically significant.

Table 5.5: Crude Rates of Hospitalizations for Residents of Personal Care Homes by Influenza Immunization Status, 2001/02

Influenza Immunization Status	# of Hospitalizations	# of Days Hospitalized	Crude Rate of Hospitalization (95% CI)
Not Immunized	770	878,920	87.6 (81.4, 93.8)
Immunized	482	604,917	79.7 (72.6, 86.8)

Source: Manitoba Centre for Health Policy, 2011

Table 5.6: Survival Analysis for Time until All Cause Hospitalization for Residents of Personal Care Homes, 2001/02

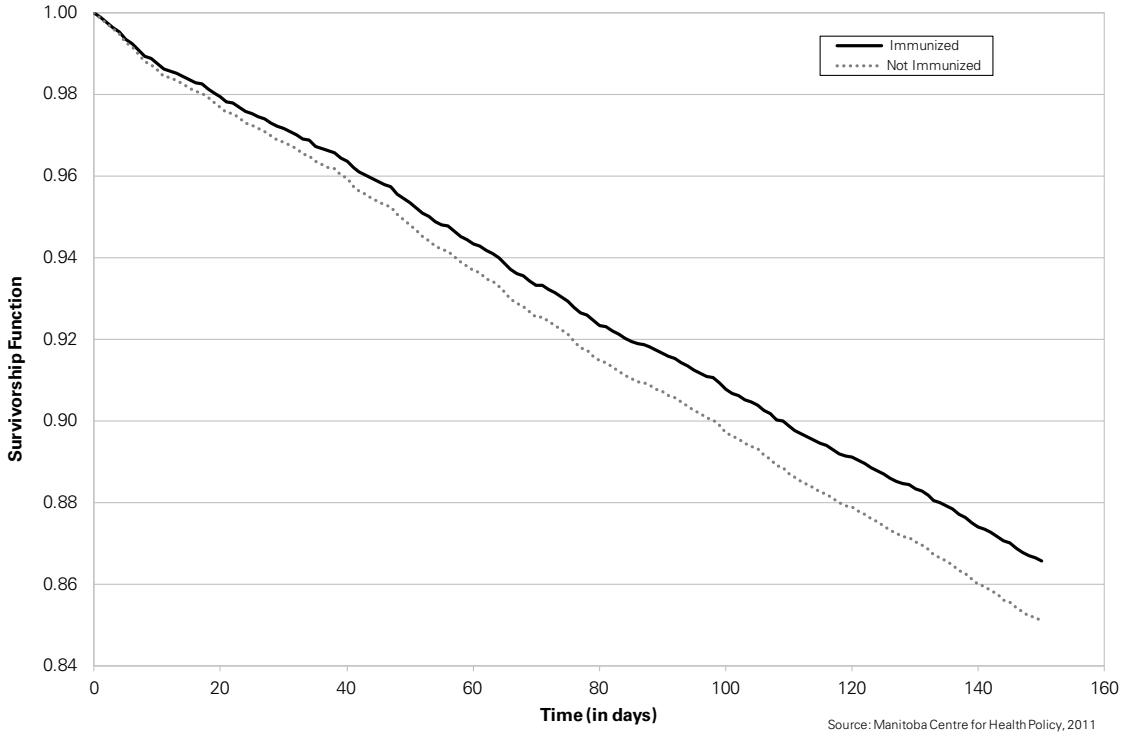
Factor	Category	Hazard Ratio (95% CI)	Probability
Immune Status		0.96 (0.84, 1.10)	0.54
Age		0.99 (0.98, 1.00)	0.0236
Sex	Male	1.56 (1.37, 1.78)	<.0001
	Female	***Reference***	***Reference***
Number of ADGs	0	0.99 (0.61, 1.61)	0.9604
	1-3	***Reference***	***Reference***
	4+	1.74 (1.47, 2.05)	<.0001

Source: Manitoba Centre for Health Policy, 2011

All Cause Mortality

Personal care home residents receiving influenza immunization were less likely to die of any cause compared to unimmunized residents (Figure 5.1).

Figure 5.1: All Cause Mortality Kaplan Meier Survival Curve for Residents of Personal Care Homes by Immunization Status based on Immunization Status on December 1, 2001
The median age (86), male, and 1-3 ADGs were entered into the model. Immunizations occuring after December 1 and deaths before December 1 were excluded.



Source: Manitoba Centre for Health Policy, 2011

The Varicella Vaccine Program

In 2002, NACI recommended the varicella vaccine for healthy children (aged 12 months and up). As discussed in "The Primary Series-Varicella" in Chapter 2, the varicella vaccine became part of the provincial immunization program in Manitoba in 2004 for:

- Children aged 12 months
- Susceptible pre–schoolers at the time of their other boosters
- Children in Grade Four

Methods

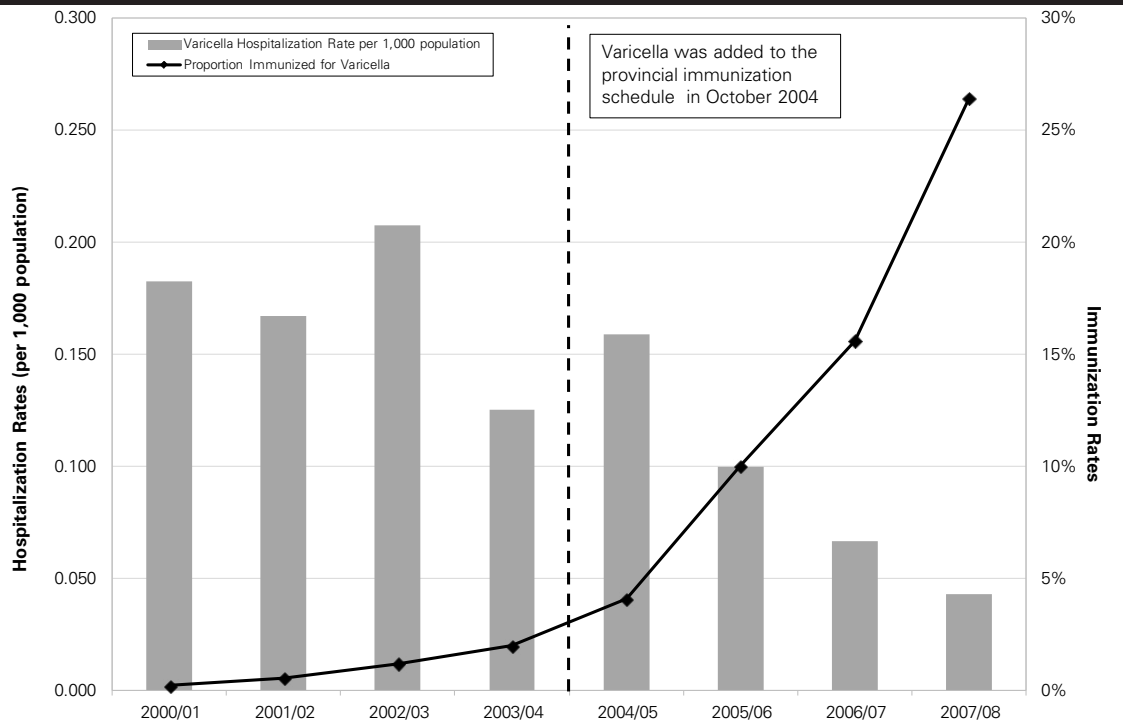
In order to assess the impact of the varicella universal program, we identified children admitted to hospital with a discharge diagnosis of varicella. The incidence of children (18 and younger) hospitalized, from 2000/01 to 2007/08 for varicella or varicella complications, was determined from the hospital abstracts (ICD–9–CM of 052, 052.0, 052.1, 052.2, 052.7, 052.8, or 052.9; ICD–10–CA of B01, B01.0 and G02.0, B01.1 and G05.1, B01.2 and J17.1, B01.8, B01.9, or P35.8). The varicella vaccination rate was determined by the presence of tariff code 8672 or 8674 for children 18 and younger during the same time period.

Results

Figure 5.2 illustrates the rapid decline in hospitalizations due to varicella after introduction of Manitoba's Varicella vaccine program in 2004. These data are also represented in Table 5.7

During the period of observation (2000/01), the varicella hospitalization rate (all ages) dropped from 0.183 per 1,000 to 0.043 per 1,000, while the proportion of the population immunized increased from 0.21% to 26.43%. Kwong et al. (2008) found a 57% decrease in varicella–related hospitalizations after the introduction of publically funded varicella immunizations. Studies from the United States report declines in varicella–related hospitalization of between 71% and 88% (Seward et al., 2002; Zhou, Harpaz, Jumaan, Winston, & Shefer, 2005; Davis, Patel, & Gebremariam, 2004).

Figure 5.2: Varicella Hospitalization Rates (per 1,000 population) Compared to Varicella Immunization Rates for Children Aged 0–18, 2000/01–2007/08



Source: Manitoba Centre for Health Policy, 2011

Table 5.7: Varicella Hospitalizations Compared to Varicella Immunizations for Children Aged 0–18, 2000/01–2007/08

Year	Population	Number of Children Hospitalized	Hospitalization Rate per 1,000 Population	Number of Children Immunized	Proportion Immunized
2000/01	306,832	56	0.183	642	0.21%
2001/02	305,141	51	0.167	1,697	0.56%
2002/03	303,738	63	0.207	3,607	1.19%
2003/04	303,345	38	0.125	6,059	2.00%
2004/05	302,399	48	0.159	12,356	4.09%
2005/06	300,363	30	0.100	30,160	10.04%
2006/07	299,587	20	0.067	46,725	15.60%
2007/08	301,787	13	0.043	79,772	26.43%

Source: Manitoba Centre for Health Policy, 2011

Chapter 6: Vaccine Safety

Background

Vaccine safety is critically important to patients, providers, regional health units, provincial and federal health ministries, and the pharmaceutical industry. Vaccine development is a long and resource intensive process that begins with pre–clinical testing to determine if a vaccine candidate produces the desired protective immune response without any evidence of toxicity. The vaccine then moves through several phases of clinical studies involving human participants; the number of subjects ranges from 10–100 in phase one to 300–30,000 in phase three of clinical trials (Public Health Agency of Canada, 2006). Upon completion of the these studies, the final application is filed by the sponsor to the **Biologics and Genetic Therapies Directorate (BGTD)** of Health Canada which is the regulatory authority responsible for establishing safety, efficacy, and quality of vaccines (Health Canada, 2010).

BGTD reviews the chemistry, manufacturing, and clinical data submitted and also performs on–site inspections of manufacturing facilities and independent laboratory analysis of the vaccine. Based on this review, BGTD will either authorize the vaccine for use in Canada or reject the application. BGTD may require the sponsor to conduct phase four or post–marketing surveillance, which looks at effectiveness in the general population and allows for the detection of rare or unexpected adverse events referred to as signals.

All approved vaccines in Canada are accompanied by a product monograph which is a scientific document that states the indications for the vaccine's use and includes information required for optimal, safe, and effective use of the vaccine. The product monograph is organized in three sections: Health Professional Information, Scientific Information, and Consumer Information.

Since 2005, Canada's vaccine surveillance system has been called the **Canadian Adverse Event Following Immunization Surveillance System (CAEFISS)** and is classified as a passive surveillance system. Providers complete a standard report form which is available online from the Canadian Paediatric Society and regional health units. This form captures select minor adverse events as well as severe, unusual, or unexpected adverse events. Adverse events are described in terms of frequency and range from very common (greater than one in 10, e.g., sore arm at injection site) to very rare (less than one in 10,000, e.g., anaphylaxis). In addition, active surveillance has been performed by the Canadian Pediatric Society since 1991 through the **Immunization Monitoring Program ACTive (IMPACT)** which operates across 12 pediatric tertiary care centres, representing 90% of pediatric beds in Canada (Canadian Paediatric Society, 2010).

Adverse Events Following Immunization (AEFI) are collected at the regional health authority level, funneled to the provincial **Communicable Disease Control Branch**, and reported to the **Public Health Agency of Canada (PHAC)**. In Manitoba, analysis of AEFI reports occurs at the regional and provincial levels.

With the 2009 pandemic influenza H1N1 mass vaccination program roll out, there was considerable interest and effort devoted to assessing and revamping AEFI reporting at all levels. As such, PHAC developed a list of Adverse Events of Special Interest (AESI) which meshed very well with this project's objective to investigate the use of Manitoba's administrative data for the purposes of detecting rare events possibly associated with immunization. The AESIs were reviewed but since not all conditions were diagnosed specifically in medical claims, we decided to limit our analysis to conditions diagnosed in hospital.

Methods

The following conditions were selected for further study:

- Encephalitis/Myelitis/**Acute disseminated encephalomyelitis** (EMA): ICD–9–CM/ICD–10–CA 3235, 3209, 3238, 3239, 3234, 3230, 3234, 3234, 0499, G040, G042, G048, G049 G050, G051, G052, G058, A86
- **Guillain–Barré Syndrome** (GBS): ICD–9–CM/ICD–10–CA 3570, G610
- **Idiopathic thrombocytopenic purpura** (ITP): ICD–9–CM/ICD–10–CA 287.3, D69.3

Only the first diagnosis of a condition per person in the period 2000/01 to 2007/08 was counted, so that a person was only counted once per condition. Immunizations which occurred in the 12 weeks prior to hospital admission were identified. If a person had more than one immunization in the 12 weeks prior to the diagnosis date, the immunization closest to the diagnosis date was chosen. Two analyses were conducted, one with any immunization (including influenza) and one looking specifically at influenza immunizations.

Onset of Guillain–Barré Syndrome/Encephalitis or ITP within 42 days of immunization could be considered to be plausibly associated with immunization (Glanz et al., 2006). A case–control analysis method was used to look at the relationship between vaccination and development of each of the three aforementioned rare conditions. Cases where the condition was diagnosed before six months of age were excluded (n=28) as were those where the number of ADGs was missing (n=20). Cases were matched to controls (four controls for each case) by birth year, sex, region or residence, and number of ADGs (0, 1–3, 4 or more) in the year prior to diagnosis date. The date of admission to hospital where condition was diagnosed was used as the diagnosis date. The following ADGs were excluded: 15, 19, 27, 29, 30, 31, and 34. A conditional logistic regression analysis was then done, looking at immunization for any antigen for cases and controls. The conditional logistic regression analysis was then repeated, looking at influenza immunizations for cases and controls.

Results

Results are displayed in Tables 6.1 and 6.2. During the period of observation for hospitalized patients with EMA, GBS, or ITP, no statistically significant association is seen with influenza vaccination and any of the conditions of interest. Similar results were observed in the other immunization analyses.

Table 6.1: Cases Diagnosed with Conditions Associated with Immunizations, 2000/01-2007/08

Condition	Number of People Hospitalized for Condition	Number of People who Received in the Previous 12 weeks	
		Influenza Immunization	Any Immunization*
Encephalitis/ Myelitis/ Acute disseminated encephalomyelitis	379	14	24
Guillain-Barré Syndrome	156	16	17
Idiopathic thrombocytopenic purpura (ITP)	462	33	54

*The any immunization analysis also includes influenza

Source: Manitoba Centre for Health Policy, 2011

Table 6.2: Risks Associated with Immunizations—Case Control Study, Matching on Birth Year, Sex, Region of Residence, and Number of ADGs (0,1-3, 4 or more)

Condition	Influenza Immunization Odds Ratio (95% CI)	Any Immunization* Odds Ratio (95% CI)
Encephalitis/ Myelitis/ Acute disseminated encephalomyelitis	0.54 (0.27, 1.11)	0.62 (0.36, 1.07)
Guillain-Barré Syndrome	1.57 (0.68, 3.62)	1.31 (0.62, 2.77)
Idiopathic thrombocytopenic purpura (ITP)	1.18 (0.71, 1.97)	1.40 (0.94, 2.09)

*The any immunization analysis also includes influenza

Source: Manitoba Centre for Health Policy, 2011

Discussion

Multiple approaches are used in North America to detect rare events. All approaches for monitoring vaccine safety have strengths and weaknesses, whether they are passive surveillance systems (such as in Canada—CAEFIS or in the United States—**Vaccine Adverse Event Reporting System** (VAERS)), active (IMPACT), or post marketing. Both MIMS and Manitoba's administrative database are population–based data sources allowing for the detection of rare events requiring hospitalization and the generation of baseline rates for rare diseases over time. This capacity forms the basis for the observed versus expected analysis performed in the process of vaccine adverse event signal detection. Further, the ability to design and execute case control studies provides another important tool in hypothesis generation and testing around vaccine safety.

Chapter 7: Limitations

Although the capacity exists for every Manitoban currently registered in the province's universal health registry (i.e., assigned a six digit Manitoba PHIN) to have a complete MIMS record, there are likely limitations and gaps in MIMS due to a combination of systemic and individual factors.

Immunization data enters MIMS through one of two pathways: manually by MIMS data entry clerks using MIMS data entry enabled computer stations or, in the case of fee–for–service physicians or salaried 'shadow billing' physicians, the vaccine specific billing codes used to remunerate physicians are utilized to populate MIMS through a data merging process. Immunizations delivered by public health nurses in clinics, school based settings, and First Nations communities as well as immunizations given in institutional settings (such as hospital and long term care facilities) are entered into MIMS using the manual method.

Despite the comprehensive population based capabilities of MIMS, immunizations delivered in private settings, such as work places and pharmacies, are not entered into MIMS. The vast majority of these are believed to be seasonal influenza vaccine doses, so MIMS data alone would produce an underreporting of seasonal influenza doses administered in Manitoba. Vaccines administered to individuals that do not meet Manitoba's eligibility criteria for publicly funded vaccines (such as vaccines required for travel) are not assigned a tariff (billing) code and as such are not reliably captured by MIMS.

There are several points in the immunization data entry process where errors can occur, producing erroneous immunization records in MIMS. These include physician coding and data entry errors at the physician billing level, MIMS data entry clerk input errors, public health line listing errors, etc.

Children not continuously registered with Manitoba Health from birth due to immigration or emigration, followed by a return to Manitoba, have lower rates of immunization across every age group and antigen. Although it is the policy of many public health units to update the MIMS records for all such clients, those non–continuously registered individuals receiving immunizations from physicians in Manitoba without MIMS data entry terminal access (which are the majority) could have been immunized in their home country or province before obtaining a Manitoba Health number and would be unlikely to have had their MIMS record updated unless accessing vaccine in the public health clinic settings.

Chapter 8: Conclusions and Recommendations

Overall, Manitoba's publicly funded immunization programs are producing consistent and stable immunization rates across most antigens and ages over time. This finding would seem to contradict the popular view that fewer Manitobans are choosing immunization for themselves and their children. However notable exceptions exist and are worth highlighting. The execution of the primary series seems to be improving as seen in this study's age two analysis, which shows increasing rates despite a more complex immunization schedule. The notable declines in complete from birth immunization for most antigens at age seven suggest that more focus be given to improving uptake of the pre–school booster. For the influenza and pneumococcal programs, the targeted high risk approach produces higher immunization rates as expected; however, rates in some high risk groups, such as pregnant women, could clearly be higher.

There is significant "between RHA" and "within RHA" variability in rates which represents an opportunity for targeted programming using the RHA, RHA district, and/or Winnipeg CA boundary as a valid population target. Additionally, RHA immunization rates differ between adult and childhood programs (Table 8.1). For example, for most of the childhood immunizations, Parkland's rates are above the Manitoba average; while for the adult influenza immunization, it is below the Manitoba average.

Income quintile, maternal age at birth, continuity of care, and family size are consistently associated with immunization rates and could be used to define target groups for specific interventions.

In terms of the utility of MIMS—we believe that it is a robust and efficient platform for generating immunization coverage data, and when linked with other administrative databases produces valuable high risk group immunization data. Underreporting in MIMS due to systemic and individual factors is likely occurring and as such adult MIMS needs to be validated similar to the work done with pediatric MIMS data. Manitobans not continuously registered from birth with Manitoba Health increase in proportion with age, over time and have significantly lower rates of immunization. Further exploration of this group is strongly recommended in order to validate the accuracy of MIMS and study the needs of the group.

Using MIMS linkage to other administrative databases for the purposes of assessing vaccine impact proved challenging and more work needs to be done in this area to fully realize its potential—however several interesting findings were generated through our analyses.

- Those 65 and older who received the influenza vaccination had lower all cause mortality and lower all cause hospitalizations than those who were not immunized.
- A rapid decline in hospitalizations due to varicella was observed after the introduction of the varicella vaccination program.
- No statistically significant association was seen between vaccinations and adverse events.

Finally, linking MIMS with large population based administrative data allowed for the relationship between vaccination and rare conditions to be studied and opens the door for the use of this approach in real time as a tool for early detection and/or assessment of safety signals.

Table 8.1: Summary of RHA Immunization Rates Compared to the Manitoba Average

Antigen	Age	South Eastman		Central		Assiniboine		Brandon		Winnipeg		Interlake		North Eastman		Parkland		Nor-Man		Burntwood	
		2002/03	2007/08	2002/03	2007/08	2002/03	2007/08	2002/03	2007/08	2002/03	2007/08	2002/03	2007/08	2002/03	2007/08	2002/03	2007/08	2002/03	2007/08	2002/03	2007/08
Influenza	65+	—	—	—	—		—	+	+	+	+		—	—	—	—	—			—	—
PPV-23	65+		—	—	—	+		—	+		+	+		—	—	+		+		—	—
Tetanus	2			—	—	+	+			+							+	—		—	—
	7	+			+	+	+	+			—					+	+		+	—	—
	17	+	+	+	+	+	+	+	+	—	—		+			+	+		—	—	—
Pertussis	2			—	—	+	+			+							+	—		—	—
	7	+			+	+	+	+			—			—		+	+	+	+	—	—
	17			+	+	+	+		+	—	—		+		—	+	+	+		—	—
Hib	2			—	—	+	+			+							+	—		—	—
Polio	2			—	—	+	+								+	+			+	—	—
	7[a]	+			+	+	+			—	—		+		+	+	+	+	+		
PCV-7*	2		+		—												+				—
Measles	2			—	+	+	+							—		+					
	7	+	+		+	+	+	+		—	—				+	+	+	+	+	—	
	11																				
Varicella*	2			—	—				+	+	+		—		—					—	—
	7		—				+		+				—		—		+				—
	11		—		+		+				—		—				+		+		+
HBV	11		+			+	+	+	+		—			—		+	+			—	—
Men-C*	7			—																	
	11	—					+		+	—	—					+	+	+		+	
All †	2		+		—	+	+			+						+	+			—	—
	7	+			+	+	+	+	+		—			—		+	+	+	+	—	—
	17	+		+	+	+	+	+	+	—	—		+		—	+	+			—	—

Cells that are blank are similar to the Manitoba average for that time period. Cells with a "+" were higher than the Manitoba average for that time period, while cells with a "—" were lower than the Manitoba average for that time period.

a An additional dose of the polio vaccine was added to the recommended immunization schedule in October 2004

* Added to the recommended immunization schedule in October 2004

† includes: Tetanus, Diphtheria, Pertussis, Polio, Mumps, Rubella & Hib

Source: Manitoba Centre for Health Policy, 2011

Reference List

Edmonton's Children & Youth Report. 2006. http://www.edmonton.ca/for_residents/ChildrenYouthReport.pdf. Accessed July 23, 2010.

Control of Communicable Diseases Manual. 19th Edition. Washington, DC: American Public Health Association; 2008.

American Academy of Pediatrics. *Red Book: Report of Committee on Infectious Diseases*. 27th edition. American Academy of Pediatrics; 2006.

Black SO, Shinefield HR, France EK, Fireman BH, Platt ST, Shay D. Effectiveness of influenza vaccine during pregnancy in preventing hospitalizations and outpatient visits for respiratory illness in pregnant women and their infants. *Am J Perinatol.* 2004;21(6):333–339.

Canadian Paediatric Society. Canadian Immunization Monitoring Program ACTive. 2010. http://www.cps.ca/english/surveillance/impact/impact.htm. Accessed October 18, 2010.

Davies HD, McGeer A, Schwartz B, et al. Invasive group a streptococcal infections in Ontario, Canada. *The New England Journal of Medicine.* 1996;335(8):547–554.

Davis MM, Patel MS, Gebremariam A. Decline in varicella–related hospitalizations and expenditures for children and adults after introduction of varicella vaccine in the United States. *Pediatrics.* 2004;114(3):786–792.

Deinard AS, Ogburn P, Jr. A/NJ/8/76 influenza vaccination program: effects on maternal health and pregnancy outcome. *Am J Obstet Gynecol.* 1981;140(3):240–245.

Demicheli V, Rivetti D, Deeks JJ, Jefferson TO. Vaccines for preventing influenza in healthy adults. *Cochrane Database Syst Rev.* 2004;(3):CD001269.

Englund JA, Mbawuike IN, Hammill H, Holleman MC, Baxter BD, Glezen WP. Maternal immunization with influenza or tetanus toxoid vaccine for passive antibody protection in young infants. *J Infect Dis.* 1993;168(3):647–656.

Glanz JM, McClure DL, Xu S, et al. Four different study designs to evaluate vaccine safety were equally validated with contrasting limitations. *J Clin Epidemiol.* 2006;59(8):808–818.

Greenberg M, Jacobziner H, Pakter J, Weisl B. Maternal mortality in the epidemic of Asian influenza, New York City, 1957. *Am J Obstet Gynecol.* 1958;76(4):897–902.

Harris JW. Influenza occuring in pregnant women: a statistical study of thirteen hundred and fifty cases. *JAMA.* 1919;72:978–980.

Health Canada. Biologics, radiopharmaceuticals and genetic therapies– drug and health products. 2010. http://www.hc–sc.gc.ca/dhp–mps/brgtherap/index–eng.php. Accessed October 18, 2010.

Heinonen OP, Shapiro S, Monson RR, Hartz SC, Rosenberg L, Slone D. Immunization during pregnancy against poliomyelitis and influenza in relation to childhood malignancy. *Int J Epidemiol.* 1973;2(3):229–235.

Heinonen OP, Slone D, Shapiro S. Immunizing agents. In: Kaufman D, eds. *Birth defects and drugs in pregnancy*. Littleton, MA: Publishing Sciences Group; 1977:314–321.

Institute of Health Economics. The economics of childhood immunizations in Canada: data book. IHE. 2007. http://www.ihe.ca/documents/IHE_Report_Economics_of_Childhood_Immunizations_in_Canada_May_2007.pdf. Accessed July 23, 2010.

Kata A. A postmodern Pandora's box: anti–vaccination misinformation on the internet. *Vaccine*. 2010b;28(7):1709–1716.

Kwong JC, Maaten S, Upshur RE, Patrick DM, Marra F. The effect of universal influenza immunization on antibiotic prescriptions: an ecological study. *Clin Infect Dis.* 2009;49(5):750–756.

Kwong JC, Tanuseputro P, Zagorski B, Moineddin R, Chan KJ. Impact of varicella vaccination on healthcare outcomes in Ontario, Canada: Effect of a publicly funded program? *Vaccine*. 2008;26(47):6006–6012.

Langley JM, Faughnan ME. Prevention of influenza in the general population. *CMAJ.* 2004;171(10):1213–1222.

Luman ET, McCauley MM, Shefer A, Chu SY. Maternal characteristics associated with vaccination of young children. *Pediatrics.* 2003;111(5 Part 2):1215–1218.

Manitoba Government. Province expands campaign to protect against flue: Manitobans encouraged to "say yes to the flu shot" (News Release). October 27, 1999. http://www.gov.mb.ca/chc/press/top/1999/10/1999–10–27–01.html. Accessed July 21, 2010.

Manitoba Health. Interim measles (rubeola) protocol. Manitoba Health. 2010. http://www.gov.mb.ca/health/publichealth/cdc/protocol/measles.pdf. Accessed July 21, 2010.

Manitoba Health Communicable Disease Control. Poliovirus infections—Protocol. Manitoba Health, Public health. 2001a. http://www.gov.mb.ca/health/publichealth/cdc/protocol/poliovirus.pdf. Accessed July 21, 2010.

Manitoba Health Communicable Disease Control. Tetanus—Protocol. Manitoba Health, Public Health. 2001b. http://www.gov.mb.ca/health/publichealth/cdc/protocol/tetanus.pdf. Accessed July 21, 2010.

Manitoba Health Communicable Disease Control. Meningococcal invasive disease– Protocol. Manitoba Health, Public Health. 2003. http://www.gov.mb.ca/health/publichealth/cdc/protocol/mid.pdf. Accessed July 21, 2010.

Manitoba Health Communicable Disease Control. Measles/mumps/rubella (MMR) vaccine. Manitoba Health. 2005. http://www.gov.mb.ca/health/publichealth/cdc/fs/mmr.pdf. Accessed July 22, 2010.

Manitoba Health Communicable Disease Control. Diphtheria, Pertussis, Tetanus, Polio and Haemophilus influenzae type b (DaPTP–Hib) vaccine. Manitoba Health. 2007. http://www.gov.mb.ca/health/publichealth/cdc/fs/daptphib.pdf. Accessed July 21, 2010.

Manitoba Health Communicable Disease Control. Manitoba Immunization Schedule. 2008. http://www.gov.mb.ca/health/publichealth/cdc/fs/irg.pdf. Accessed October 18, 2010.

Manitoba Health Communicable Disease Control. Manitoba monthly communicable disease report; up to December 31, 2009. Manitoba Health—Public Health Division. February 16, 2010. http://www.gov.mb.ca/health/publichealth/cdc/surveillance/scd/dec09.pdf. Accessed July 21, 2010.

Manzoli L, Schioppa F, Boccia A, Villari P. The efficacy of influenza vaccine for healthy children: a meta–analysis evaluating potential sources of variation in efficacy estimates including study quality. *Pediatr Infect Dis J.* 2007;26(2):97–106.

Martens P, Fransoo R, *The Need to Know* Team, Burland E, Prior H, Burchill C, Romphf L, Chateau D, Bailly A, Ouelette C. What Works? A First Look at Evaluating Manitoba's Regional Health Programs and Policies at the Population Level. Manitoba Centre for Health Policy. 2008. http://mchp–appserv.cpe.umanitoba.ca/reference/fullwwreport.pdf. Accessed September 1, 2009.

Mennito SH, Darden PM. Impact of practice policies on pediatric immunization rates. *J Pediatr.* 2010;156(4):618–622.

Munoz FM, Greisinger AJ, Wehmanen OA, et al. Safety of influenza vaccination during pregnancy. *Am J Obstet Gynecol.* 2005;192(4):1098–1106.

National Advisory Committee on Immunization. Canada communicable disease report: statement on seasonal trivalent inactivated influenza vaccine (TIV) for 2009–2010. Public Health Agency of Canada. 2009. http://www.phac–aspc.gc.ca/publicat/ccdr–rmtc/08pdf/acs–3.pdf. Accessed July 21, 2010.

Negri E, Colombo C, Giordano L, Groth N, Apolone G, La VC. Influenza vaccine in healthy children: a meta–analysis. *Vaccine.* 2005;23(22):2851–2861.

Public Health Agency of Canada. Canadian immunization guide. 2006. http://www.phac–aspc.gc.ca/publicat/cig–gci/pdf/cig–gci–2006_e.pdf. Accessed July 21, 2010.

Public Health Agency of Canada. Statement on Seasonal Trivalent Inactivated Influenza Vaccine (TIV) for 2010–2011: Canadian Communicable Disease Report. 2010. http://www.phac–aspc.gc.ca/publicat/ccdr–rmtc/10pdf/36–acs–6.pdf. Accessed October 18, 2010.

Rennels MB, Edwards KM, Keyserling HL, et al. Safety and Immunogenicity of Heptavalent Pneumococcal Vaccine Conjugated to CRM197 in United States Infants. *Pediatrics.* 1998;101(4):604–611.

Roberts JD, Poffenroth LA, Roos LL, Bebchuk JD, Carter AO. Monitoring childhood immunizations: a Canadian approach. *Am J Public Health.* 1994;84(10):1666–1668.

Schrag SJ, Fiore AE, Gonik B, et al. Vaccination and perinatal infection prevention practices among obstetrician–gynecologists. *Obstet Gynecol.* 2003;101(4):704–710.

Seward JF, Watson BM, Peterson CL, et al. Varicella disease after introduction of varicella vaccine in the United States, 1995–2000. *JAMA.* 2002;287(5):606–611.

Simonsen L, Taylor R, Viboud C, Miller M, Jackson L. Mortality benefits of influenza vaccination in elderly people: an ongoing controversy. *The Lancet Infectious Diseases.* 2007;7(10):658–666

Smith S, Demicheli V, Di PC, et al. Vaccines for preventing influenza in healthy children. *Cochrane Database Syst Rev.* 2006;(1):CD004879.

Spasoff RA. *Epidemiologic Methods for Health Policy*. New York, NY: Oxford University Press, Inc. 1999.

Wiecha JM, Gann P. Does maternal prenatal care use predict infant immunization delay? *Fam Med.* 1994a;26(3):172–178.

Yeager DP, Toy EC, Baker III B. Influenza vaccination in pregnancy. *Am J Perinatol.* 1999;16(6):283–286.

Zhou F, Harpaz R, Jumaan AO, Winston CA, Shefer A. Impact of varicella vaccination on healthcare utilization. *JAMA.* 2005;294(7):797–802.

Glossary

Acronyms

ADGs	Aggregated Diagnostic Groups
AEFI	Adverse Events Following Immunization
aP	Acellular Pertussis
AS	Assiniboine Regional Health Authority
BDN	Brandon Regional Health Authority
BGTD	The Biologics and Genetic Therapies Directorate
BW	Burntwood Regional Health Authority
CA	Community Area
CAEFISS	The Canadian Adverse Event Following Immunization Surveillance System
CE	Central Regional Health Authority
CHF	Congestive Heart Failure
D or d	Diphtheria
DaPTP	Diphtheria, Acellular Pertussis, Tetanus, and Polio
DPT–P	Diphtheria, Pertussis, Tetanus, and Polio
EMA	Acute disseminated encephalomyelitis
GBS	Guillain–Barré Syndrome
HBV	Hepatitis B
Hib	*Haemophilus influenzae* Type B
HPV	Human Papilloma Virus
ICD–9–CM	International Classification of Diseases, 9th Revision, Clinical Modification
ICD–10–CA	International Classification of Diseases and Related Health Problems, 10th Revision, Canada
IL	Interlake Regional Health Authority
IMPACT	Immunization Monitoring Program ACTive
IPD	Invasive Pneumococcal Disease
IPV	Inactivated Polio Vaccine
ITP	Idiopathic Thrombocytopenic Purpura
MCHP	Manitoba Centre for Health Policy
Men–C	Meningococcal Conjugate Vaccine
MIMS	Manitoba Immunization Monitoring System
MMR	Measles, Mumps, and Rubella
NACI	National Advisory Committee on Immunization
NE	North Eastman Regional Health Authority
NM	NOR–MAN Regional Health Authority
OPV	Oral Polio Virus
PCH	Personal Care Home
PCV	Pneumococcal Conjugate Vaccine
PCV–7	Pneumococcal Conjugate Vaccine, which provides protection against seven pneumococcal serotypes
PCV–13	Pneumococcal Conjugate Vaccine, which provides protection against 13 pneumococcal serotypes
PHAC	Public Health Agency of Canada

PHIN	Personal Health Identification Number
PMR	Premature Mortality Rate
PL	Parkland Regional Health Authority
PPV–23	Pneumococcal Polysaccharide Vaccine 23
RHA	Regional Health Authority
SAS©	Statistical Analysis Software
SE	South Eastman Regional Health Authority
T	Tetanus
Tdap	Tetanus, diphtheria, and acellular pertussis
TIV	Trivalent Inactivated Influenza Vaccine
TRM	Total Respiratory Morbidity
VAERS	Vaccine Adverse Event Reporting System
V	Varicella

Acellular Pertussis (aP) Vaccine

A vaccine to protect against illness due to whooping cough (**pertussis**); it is a more purified product than the whole cell vaccine, containing only specific proteins as opposed to entire cells.

Acute Disseminated Encephalomyelitis (EMA)

A neurological disorder characterized by inflammation of the brain and spinal cord, which often occurs after a viral infection but may appear following a **vaccination**.

Administrative Data

Information collected "usually by government, for some administrative purpose (e.g., keeping track of the population eligible for certain benefits, paying doctors or hospitals), but not primarily for research or surveillance purposes" (Spasoff, 1999). **Manitoba Centre for Health Policy**'s research uses administrative data from hospital discharge summaries, physician billing claims, claims for prescription drugs, and other health related data. Using these data, researchers can study the utilization of health resources over time and the variations in rates within and across the provinces.

Adverse Events Following Immunization (AEFI)

Any undesirable or unexpected event that occurs following **immunization,** which may or may not be caused by the administration of the **vaccine**.

Aggregated Diagnostic Groups (ADGs)

Formerly known as Ambulatory Diagnostic Groups, ADGs continue to be part of the Adjusted Clinical Group (ACG) case–mix system. The ACG method groups every ICD–9–CM and ICD–10–CA diagnosis code assigned to a patient into one of 32 different ADGs based on five clinical and expected utilization criteria:

1. duration of the condition (acute, recurrent, or chronic)
2. severity of the condition (e.g., minor and stable versus major and unstable)
3. diagnostic certainty (symptoms focusing on diagnostic evaluation versus documented disease focusing on treatment services)
4. etiology of the condition (infectious, injury, or other)
5. specialty care involvement (medical, surgical, obstetric, haematology, etc.)

Antigen
A foreign substance that evokes an immune response when introduced to the body (i.e., causes the immune system to produce antibodies against the antigen).

Asplenia
The absence of a functional spleen.

Asthma
A disease in which inflammation of the airways causes airflow into and out of the lungs to be restricted.

Bacteremia
The existence of bacteria in the bloodstream.

Biologics and Genetic Therapies Directorate (BGTD)
The federal authority in Canada that regulates biological drugs (products derived from living sources) and radiopharmaceuticals (drugs containing a radioactive compound) for human use.

Booster
An additional dose of a **vaccine** after an earlier dose, re–exposing the person to the immunizing **antigen** and increasing immunity against the antigen.

Bronchitis
Inflammation of the bronchial tubes.

Canadian Adverse Event Following Immunization Surveillance System (CAEFISS)
A national monitoring system in Canada for reporting undesirable events following immunization.

CancerCare Manitoba
Health services organization responsible for cancer prevention, detection, care, research, and education throughout Manitoba. Previously called the Manitoba Cancer Treatment and Research Foundation (MCTRF).

Census
Official count of a population, often including demographic information such as age, sex, employment, and income. **Statistics Canada** conducts a Census every five years. It takes account of all persons living in Canada, including any individuals residing in Canada on a temporary basis. The Census also includes Canadians abroad on military missions or on merchant vessels that are registered in Canada (Statistics Canada, 2006).

Chronic Renal Failure
Renal failure is the loss of the kidneys' ability to remove wastes, concentrate urine, and maintain electrolytes levels in the blood. At the **Manitoba Centre for Health Policy**, our definition of renal failure includes both acute and chronic renal failure. Renal disease associated with some other conditions, along with renal failure due to trauma, pregnancy, and labour, have typically not been included in our definition.

Communicable Disease Control Branch
Branch of **Manitoba Health** that is responsible for the "prevention and control of communicable diseases in Manitoba. This responsibility is carried out in collaboration with others involved with the identification and management of communicable diseases."
Source: Manitoba Health http://www.gov.mb.ca/health/publichealth/cdc/index.html Accessed: 23/03/2011

Complete for Age from Birth
A child, at the specified observation point (age two for example), that has received all of the recommended doses for a given **antigen** according to the provincial **immunization schedule**.

Congestive Heart Failure (CHF)
Also called congestive cardiac failure or just heart failure, it is the inability of the heart to pump a sufficient amount of blood throughout the body or the requirement for elevated filling pressures in order to pump effectively.

Continuity of Care
The extent to which individuals see a given healthcare provider (versus two or more other providers) over a specified period of time. A provider may be defined either as an individual physician, a physician group practice, or a clinic.

Continuously Registered
Individuals that have had healthcare coverage provided by Manitoba's universal healthcare program since birth.

Covariate
A secondary variable that can have an effect on the dependent variable.

Data Suppression
Data is suppressed when the number of persons or events involved is five or less in order to avoid potential identification of individuals in an area. Data is not suppressed when the actual event count is zero. This process of suppressing data is conducted to protect the anonymity of study participants

Diabetes/Diabetes Mellitus
A chronic condition in which the pancreas no longer produces enough insulin (Type I Diabetes) or when cells stop responding to the insulin that is produced (Type II Diabetes), so that glucose in the blood cannot be absorbed into the cells of the body.

Diphtheria (D or d)
An acute, infectious disease often characterized by fever, sore throat, and difficulty breathing, which is caused by the bacterium *Corynebacterium diphtheriae*.

Dissemination Area
A small, relatively stable geographic unit composed of one or more blocks. It is the smallest standard geographic area for which all **census** data are disseminated. Dissemination areas cover all the territory of Canada.

Emphysema
A condition of the lung in which the air sacs are damaged, resulting in difficulty breathing.

Encephalitis
Inflammation of the brain.

Epidemic
An outbreak of a disease that affects many people simultaneously, at a frequency higher than expected.

Epiglottitis
Inflammation of the epiglottis.

General Practitioner/Family Physician
A physician who operates a general or family practice and is not certified in another specialty in Manitoba.

Guillain–Barre Syndrome (GBS)
A disorder in which the body's immune system attacks the peripheral nervous system, often resulting in muscle weakness.

Haemophilus Influenza Type B (Hib)
A bacteria that can cause potentially fatal brain infections, such as **meningitis** and **pneumonia**, in young children.

Hazard Rate
"The probability that if the event in question has not already occurred, it will occur in the next time interval, divided by the length of that interval. The time interval is made very short, so that in effect the hazard rate represents an instantaneous rate."
Source: Spruance SL; Reid JE; Grace M; Samore M. Hazard Ratio in Clinical Trials. *Antimicrobial Agents and Chemotherapy*. 2004;48(8):2787–2792 http://aac.asm.org/cgi/reprint/48/8/2787

Hazard Ratio
"An estimate of the ratio of the **hazard rate** in the treated versus the control group"; usually the result of a **survival analysis**.
Source: Spruance SL; Reid JE; Grace M; Samore M. Hazard Ratio in Clinical Trials. *Antimicrobial Agents and Chemotherapy*. 2004;48(8):2787–2792 http://aac.asm.org/cgi/reprint/48/8/2787

Hepatitis
Inflammation of the liver.

Hepatitis B Virus (HBV)
A virus that causes **hepatitis**.

Herpes Zoster (Shingles)
A nerve infection that is caused by reactivation of the virus causing chicken pox and that is characterized by painful skin rash.

Hospital Abstract

A form/computerized record filled out upon a patient's discharge (separation) from an acute care hospital. The abstract contains information from the patient's medical record based on their stay in hospital, such as gender, residence (postal code), diagnoses and procedure codes, admission and discharge dates, length of stay, and service type (inpatient, day surgery, outpatient). Abstract records are stored in the Hospital Abstracts Database.

Human Papilloma Virus (HPV)

A grouping of over 150 related viruses, many of which can be transmitted sexually. Although genital HPV infections are common and often go away without any treatment, other HPV infections can cause various types of cancer (such as cervical, penile, anal, head, and neck).

ICD–9–CM

Acronym for International Classification of Diseases, 9th Revision with Clinical Modifications (ICD–9–CM), which is the 9th version of the ICD (International Classification of Disease) coding system (with Clinical Modifications), developed by the World Health Organization that is used to classify diseases, health conditions and procedures. This version was used extensively in Canadian hospitals. As of April 1, 2004, Manitoba hospitals replaced ICD–9–CM with **ICD–10–CA** for coding diagnoses and the Canadian Classification of Health Interventions for coding procedures.

ICD–10–CA

Acronym for International Classification of Diseases, 10th Revision with Canadian Enhancements (ICD–10–CA), which is based on the 10th version of the ICD (International Classification of Disease) coding system, developed by the World Health Organization that is used to classify diseases and related health problems (morbidity), but includes enhancements developed by Canadian Institute for Health Information (CIHI) for use in Canadian hospitals and other medical facilities. The Canadian Classification of Health Interventions (CCI) is the companion classification system to ICD–10–CA for coding procedures in Canada. ICD–10–CA and CCI are being used on Manitoba hospital abstracts beginning April 1, 2004.

Idiopathic Thrombocytopenic Purpura (ITP)

A bleeding disorder in which the blood does not clot properly due to platelets being destroyed by the immune system.

Immunity

The ability to avoid infection or disease by having sufficient biological defenses.

Immunization

An intervention to initiate or increase resistance against infectious disease.

Immunization Monitoring Program ACTive (IMPACT)

"A paediatric hospital–based national active surveillance network for adverse events in children following immunization, vaccine failures, and selected infectious diseases that are, or are soon to be, vaccine preventable. IMPACT is administered by the Canadian Paediatric Society with funding from the Immunization and Respiratory Infections Division of the **Public Health Agency of Canada.**"
Source: Canadian Paediatric Society http://www.cps.ca/English/surveillance/impact/impact.htm Last updated: 03/2011. Accessed: 22/03/2011.

Immunization Schedule

Timetable of recommended times to receive **immunizations**. In Manitoba, this schedule is based on current provincial immunization programs and policies and reflects the most common immunization scenarios.

Immunodeficiency

A state in which the body's immune system is inadequate.

Income Quintiles

A method to measure the average (mean) household income of residents, ranking them from poorest to wealthiest and then grouping them into five income quintiles (one being poorest and five being wealthiest). Each quintile contains approximately 20% of the population. The income quintile measure is derived from **Statistics Canada Census** data by aggregating household income to the dissemination area and then ranking neighbourhoods by income quintile. Income quintiles are available for both urban and rural populations. Income quintiles are often used as a proxy measure of **socio–economic status**.

Influenza

Commonly referred to as the flu, it is an infectious respiratory disease. Caused by influenza A and B viruses, it spreads from person to person via virus–laden respiratory secretions. It is an important cause of **morbidity** and death.

Logistic Regression

The regression technique used when the outcome is a binary, or dichotomous, variable. Logistic regression models the probability of an event as a function of other factors. Note that these models are only able to state that there is a relationship (association) between the explanatory and the outcome variables. This is not necessarily a causal relationship, since it is based on observational data for the most recent time period. The explanatory variable may be associated with an increase or decrease (not that it caused the increase or decrease).

Manitoba Centre for Health Policy (MCHP)

A unit within the Department of Community Health Sciences, Faculty of Medicine, University of Manitoba. MCHP is active in health services research, evaluation, and policy analysis, concentrating on using the **Manitoba Health** database to describe and explain patterns of care and profiles of health and illness.

Manitoba Health

A provincial government department responsible for providing healthcare services in Manitoba.

Manitoba Health Insurance Registry

A database, maintained by **Manitoba Health** for administrative purposes, of all individuals registered to receive health services in Manitoba. Every family in Manitoba is assigned a family registration number, and every individual is assigned a unique encrypted **Personal Health Identification Number (PHIN)**.

Manitoba Immunization Monitoring System (MIMS)

A population–based monitoring system that provides monitoring and reminders to help achieve high levels of immunization. The goal of this system is to compile information on all immunizations administered in Manitoba to ensure recommended immunizations are received. Immunization status is monitored by comparing the system record and the recommended schedule. This system also gives information on immunization histories and some demographic information from the **Manitoba Health Insurance Registry**. The MIMS database, as of 2005/2006, includes approximately 200,000 immunization records and about 170 data elements which are input by 134 sites in Manitoba with MIMS access.

Measles

A highly contagious and acutely infectious viral disease. Symptoms include fever, cough, head cold, rash, conjunctivitis (inflammation or infection of the membrane lining the eyelids), and Koplik spots (white spots on the inner lining of the mouth).

Meningitis

Inflammation of the meninges, which are the membranes covering the brain and spinal cord.

Meningococcal Disease

Infections caused by the bacterium meningococcus (*Neisseria meningitidis)*. Many people carry meningococci bacteria without any harmful effects. But in rare instances, meningococci cause serious diseases, such as **meningitis** and meningococcemia, a widespread blood infection.

Morbidity

Any departure, subjective or objective, from a state of physiological or psychological well–being (i.e., sickness or illness).

Mumps

An acute contagious viral disease characterized by swollen saliva glands and fever.

National Advisory Committee on Immunization (NACI)

A national committee comprised of experts in pediatrics, infectious diseases, immunology, medical microbiology, internal medicine, and public health. NACI makes recommendations for the use of vaccines approved for use in humans in Canada, advises on the need for national vaccination strategies, and makes recommendations for vaccine development research. NACI publishes in the Canadian Immunization Guide and the Canada Communicable Disease Report.
Source: Public Health Agency of Canada http://www.phac–aspc.gc.ca/naci–ccni/index–eng.php Last updated: 10/01/2011 Accessed: 23/03/2011

Obstetrician/Gynecologist

A specialist that deals with the female reproductive system and pregnancy.

Odds Ratio

The ratio of the odds of an event occurring in one group to the odds of it occurring in another group, or to a data–based estimate of that ratio.

Pediatrician
A physician who deals with the care of infants and children and the treatment of their diseases.

Personal Care Home (PCH)
A residential facility for predominantly older persons with chronic illness or disability. It may be proprietary (for profit) or non–proprietary. Non–proprietary PCHs may further be classified as secular or ethno–cultural (associated with a particular religious faith or language other than English) as well as either freestanding or juxtaposed with an acute care facility.

Personal Health Identification Number (PHIN)
A unique numeric identifier assigned by **Manitoba Health** to every person registered for health insurance in Manitoba, and to non–residents who are treated at facilities which submit claims electronically. Introduced as a linkage key in 1984, it was issued to the public in 1994 as the basic access identifier for the Pharmacare/Drug Programs Information Network (DPIN).

Pertussis
Also known as whooping cough, it is a highly contagious bacterial infection of the respiratory tract.

Pneumococcal Conjugate Vaccine (PCV–7)
A vaccine for infants and young children to help prevent serious **pneumococcal disease**. This vaccine protects against seven strains of ***Streptococcus pneumoniae***.

Pneumococcal Disease
Caused by the bacteria ***Streptococcus pneumoniae*** (pneumococcus), it is the leading cause of **bacteremia**, **meningitis**, and bacterial **pneumonia**. Pneumococcal disease is most common in the very young, the elderly, and certain high risk groups such as individuals with **asplenia,** immune deficiency, or a chronic illness.

Pneumococcal Polysaccharide Vaccine 23 (PPV–23)
A vaccine to help prevent serious **pneumococcal disease** recommended for adults 65 years or older and for anyone aged two to 64 with long–term health problems. This vaccine protects against 23 strains of ***Streptococcus pneumoniae***.

Pneumonia
Inflammation of the lungs caused by a bacterial, viral, or fungal infection. Lobar pneumonia affects a section (lobe) of a lung. Bronchial pneumonia (or bronchopneumonia) affects patches throughout both lungs. Bacterial pneumonia in adults is commonly caused by a bacterium called ***Streptococcus pneumoniae*** or *Pneumococcus*.

Polio
A highly infectious viral disease that affects the nerve cells of the brain and spinal cord and may result in paralysis.

Polyvalent
Capable of counteracting more than one agent (such as a toxin or **antigen**).

Population Health Research Data Repository (Repository)

A comprehensive collection of administrative, registry, survey, and other databases primarily comprised of residents of Manitoba. This repository is housed at the **Manitoba Centre for Health Policy (MCHP)**. It was developed to describe and explain patterns of healthcare and profiles of health and illness, facilitating inter–sectoral research in areas such as healthcare, education, and social services. The administrative health database, for example, holds records for virtually all contacts with the provincial healthcare system, the Manitoba Health Services Insurance Plan (including physicians, hospitals, personal care homes, home care, and pharmaceutical prescriptions) of all registered individuals. MCHP acts as a trustee or steward of the information in the Repository for agencies such as **Manitoba Health**.

Premature Mortality Rate (PMR)

The rate of deaths of residents aged 74 and younger, per 1,000 residents 74 and younger. The values are standardized to account for age/sex differences in populations. The rate is usually expressed as a number per thousand, in order to provide an indicator that is comparable among different areas or regions. Premature mortality rates are often used as an overall indicator of population health and are correlated with other commonly used measures. PMR is an important indicator of the general health of a population; high PMR indicates poor health status.

Primary Series

The first unit of recommended **vaccinations**. Manitoba's **immunization schedule** recommends immunization with DTaP–IPV–Hib (**diphtheria, tetanus, pertussis, polio, and *Haemophilus influenzae*** type B) at two, four, six, and 18 months. These five **antigens** are delivered with a single intramuscular injection. In addition, Manitoba recommends MMR (**measles, mumps, and rubella)** and **varicella** (separate injections) at 12 months. Additionally, as of 2009, **Men–C** (*Neisseria meningitidis*—Serogroup C) **vaccine** has been added to the 12 month **vaccination** schedule.

Public Health Agency of Canada (PHAC)

The Government of Canada agency responsible for public health, whose "primary goal is to strengthen Canada's capacity to protect and improve the health of Canadians and to help reduce pressures on the health–care system".
Source: Public Health Agency of Canada http://www.phac–aspc.gc.ca/about_apropos/index–eng.php
Last updated: 19/01/2011. Accessed: 23/03/2011

Quadracel®

A commercial brand of a **quadravalent** vaccine which provides protection against **diphtheria, tetanus, pertussis,** and poliomyelitis (**polio**). It is indicated for **immunization** of infants and children, from two months to six years of age.

Quadrivalent

Capable of counteracting four agents (such as a toxin or **antigen**).

Region of Residence

The area where people live at any given point in time and where their health service use is allocated, regardless of where the service was provided. Regions are assigned according to the municipal code for the last region of residence on a claim or prior to admission to a hospital or personal care home. For determining residency in **Regional Health Authorities (RHAs)**, either postal code or municipality code is used.

Regional Health Authority (RHA)
Regional governance structure set up by the province to be responsible for the delivery and administration of health services in specified areas. In Manitoba, as of July 1, 2002, there are 11 RHAs: Winnipeg, Brandon, South Eastman, Assiniboine, Central, Parkland, North Eastman, Interlake, Burntwood, NOR–MAN, and Churchill.

Repository
See **Population Health Research Data Repository (Repository)**

Rubella
Also known as German measles, it is a viral disease characterized by rash and fever, which can seriously affect the fetus of an infected pregnant woman.

Seroconversion
The development of antibodies in response to an **antigen,** either via infection or **immunization**.

Socio–Economic Status (SES)
Characteristics of economic, social, and physical environments in which individuals live and work as well as their demographic and genetic characteristics.

Statistical Analysis Software (SAS®)
A statistical software package for analyzing data.

Statistics Canada
A federal government department that is a major source of population information, such as population projections, for the provinces.

Streptococcus pneumoniae
A significant human pathogenic bacterium that causes respiratory infections in children and adults and is the leading cause of a leading cause of **meningitis**, bacterial **pneumonia,** and acute otitis media (inner ear infection).

Suppressed
See **Data Suppression**

Survival Analysis
Analysis of data that deals with time until the occurrence of any well–defined event, such as death.

Tariff Code
A specific code used to identify each service provided by a physician or a nurse practitioner as defined in the Tariff Manual.

Tetanus (T)
An infectious disease that affects the body's muscles and nerves. It is often due to the contamination of a skin wound by a bacterium called *Clostridium tetani*, which is often found in soil.

Total Respiratory Morbidity (TRM)

A measure of the burden of all types of respiratory illnesses in the population and includes any of the following respiratory illnesses: **asthma**, chronic or acute **bronchitis**, **emphysema**, chronic airway obstruction, or chronic obstructive pulmonary disease (COPD). This combination of diagnoses is used to overcome problems resulting from different physicians (or specialists) using different diagnosis codes for the same underlying illness (e.g., asthma versus chronic bronchitis).

Trivalent Inactivated Influenza Vaccine (TIV)

An **immunization** against influenza that includes three virus strains: two from the human influenza A subtypes and one from the influenza B lineages. TIV is reformulated annually to compensate for variation in the antigen strains.
Source: Public Health Agency of Canada. Statement on Seasonal Trivalent Inactivated Influenza Vaccine (TIV) for 2010–2011: Canadian Communicable Disease Report.
http://www.phac–aspc.gc.ca/publicat/ccdr–rmtc/10pdf/36–acs–6.pdf Last update: August 2010. Accessed: 23/03/2011

Vaccinations

The introduction of **vaccines** into the body to produce immunity to diseases.

Vaccine

A substance administered into the body to improve immunity to a certain disease.

Vaccine Adverse Event Reporting System (VAERS)

A national **vaccine** safety surveillance program in the United States of America that collects information about undesirable events that occur following vaccination. The Centers for Disease Control and Prevention and the Food and Drug Administration are co–sponsors of VAERS.

Varicella (V)

Also known as chicken pox, it is a contagious disease characterized by rash and fever and is caused by the varicella zoster virus.

Appendix 1: Tariff Codes for Vaccinations

Tetanus vaccination: 8601, 8602, 8603, 8609, 8641, 8642, 8643, 8649, 8651, 8652, 8653, 8659, 8701, 8702, 8703, 8709, 8781, 8782, 8783, 8789, 8798, 8798, 8802, 8802, 8804, 8804, 8805, 8806, 8806, 8807, 8807, 8907, 8907, 8921, 8922, 8923, 8924, 8924, 8929

Pertussis vaccination: 8601, 8602, 8603, 8609, 8720, 8721, 8722, 8723, 8729, 8781, 8782, 8783, 8789, 8802, 8802, 8804, 8804, 8806, 8806, 8807, 8807, 8907, 8907, 8921, 8922, 8923, 8924, 8924, 8929

Polio vaccination: 8611, 8612, 8613, 8619, 8798, 8798, 8802, 8802, 8804, 8804, 8805, 8805, 8806, 8806, 8807, 8807, 8921, 8922, 8923, 8924, 8924, 8929, 8931, 8931, 8932, 8933, 8939

Measles vaccination: 8621, 8629, 8670, 8670, 8673

***Haemophilus influenzae* type B vaccination:** 8781, 8782, 8783, 8789, 8802, 8802, 8804, 8804, 8806, 8806, 8807, 8807, 8901, 8901, 8902, 8903, 8909

Hepatitis B vaccination: 8911, 8911, 8912, 8912, 8913, 8913, 8919, 8899, 8899, 8905, 8905

Pneumococcal conjugate vaccine–7: 8681, 8682, 8683, 8684, 8961

Meningococcal conjugate vaccine: 8685, 8686, 8687, 8981

Varicella vaccine: 8672, 8674

C**omposite of Tetanus, Diphtheria, Pertussis, Polio, Mumps, Rubella, *Haemophilus influenzae* type B** (number of doses depends on age): 8601, 8602, 8603, 8609, 8609, 8611, 8612, 8613, 8619, 8641, 8642, 8643, 8649, 8651, 8652, 8653, 8659, 8661, 8670, 8673, 8701, 8702, 8703, 8709, 8711, 8712, 8713, 8719, 8720, 8721, 8722, 8723, 8729, 8781, 8782, 8783, 8789, 8798, 8802, 8804, 8805, 8806, 8806, 8807, 8807, 8901, 8902, 8903, 8907, 8907, 8909, 8921, 8922, 8923, 8923, 8924, 8928, 8929, 8931, 8932, 8933, 8939

Appendix 2: Additional Tables

Appendix Table 2.1: Percent of Children who are Complete for Age, 2000/01–2007/08

Antigen	Age	2000/01	2001/02	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08
Tetanus	2	72.70	72.30	72.70	71.70	72.00	69.30	74.00	73.60
	7	83.20	81.10	79.00	75.60	72.60	70.70	72.60	73.00
	17	66.80	66.10	64.30	62.40	65.30	66.00	66.70	66.60
Pertussis	2	72.50	72.10	72.60	71.60	71.90	69.30	73.90	73.50
	7	80.00	78.40	76.60	73.30	70.60	68.80	71.40	72.50
	17	60.20	64.70	66.70	65.10	68.70	73.80	54.20	58.30
Hib*	2	72.00	71.50	71.70	71.00	71.30	68.80	73.70	73.10
Polio[a]	2	90.10	89.90	89.90	89.10	89.20	88.30	89.30	88.70
	7[a]	94.40	93.40	91.90	90.60	90.20	89.30	89.10	85.20
PCV-7*	2	0.00	s	0.20	2.00	6.80	17.40	77.70	69.60
Measles	2	87.50	87.80	88.40	87.90	87.60	86.30	87.30	87.60
	7	85.50	84.00	82.30	80.20	77.70	77.10	79.80	80.30
Varicella*	2	0.50	1.80	4.20	7.50	11.70	31.50	69.00	76.30
HBV	11	60.90	66.00	69.20	73.20	73.20	73.40	73.60	73.00
Men-C*	11	3.70	4.20	3.90	3.80	2.30	26.60	77.60	78.50
All†	2	70.20	69.70	70.30	69.60	69.80	67.00	71.80	71.50
	7	73.30	73.50	73.50	70.80	68.90	67.30	69.70	70.60
	11	75.30	77.20	78.50	77.90	76.40	75.10	73.60	70.20
	17	49.70	53.00	53.70	52.80	56.20	58.90	53.60	57.20

's' indicates data suppressed due to small numbers

* Added to the recommended immunization schedule in October 2004

[a] An additional dose added in 2007

† includes: Tetanus, Diphtheria, Pertussis, Polio, Mumps, Rubella and *Haemophilus influenzae* type B

Source: Manitoba Centre for Health Policy, 2011

Appendix Table 2.2: Percent of Children who Received At Least One Dose of an Antigen, 2000/01–2007/08

Antigen	Age	2000/01	2001/02	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08
Tetanus	2	96.10	95.50	96.10	95.20	95.40	95.10	95.70	95.30
	7	98.20	97.90	96.80	95.80	95.00	94.40	94.20	94.40
	17	94.70	94.80	95.50	95.60	95.20	95.90	96.00	95.50
Pertussis	2	96.00	95.40	96.10	95.20	95.30	95.20	95.60	95.30
	7	98.10	97.60	96.70	95.60	94.70	94.10	93.90	94.30
	17	90.70	91.20	92.10	92.30	92.40	94.10	95.10	94.80
Hib*	2	96.00	95.30	95.90	95.10	95.30	95.00	95.60	95.20
Polio[a]	2	96.10	95.60	96.10	95.20	95.40	95.20	95.70	95.40
	7[a]	98.20	97.70	96.70	95.80	95.00	94.30	94.10	94.30
PCV-7*	2	0.00	0.10	1.30	5.30	13.40	39.90	90.30	92.90
Measles	2	87.50	87.80	88.40	87.90	87.60	86.30	87.30	87.60
	7	97.10	96.40	95.10	94.00	93.10	92.30	92.70	92.50
Varicella*	2	0.50	1.80	4.20	7.50	11.70	31.50	69.00	76.30
HBV	11	66.60	72.60	75.70	79.90	80.00	81.30	81.70	81.50
Men-C*	11	3.70	4.20	3.90	3.80	2.30	26.60	77.60	78.50

* Added to the recommended immunization schedule in October 2004

[a] An additional dose added in 2007

Source: Manitoba Centre for Health Policy, 2011

Appendix Table 2.3: Percent of Children who Received At Least One Dose of an Antigen But Are Not Complete for Age, 2000/01–2007/08

Antigen	Age	2000/01	2001/02	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08
Tetanus	2	23.40	23.50	23.40	23.50	23.40	25.80	21.70	21.70
	7	15.00	20.20	17.80	20.20	22.40	23.70	21.60	21.40
	17	27.90	33.20	31.20	33.20	29.90	29.90	29.30	28.90
Pertussis	2	23.50	23.60	23.50	23.60	23.40	25.90	21.70	21.80
	7	18.10	22.30	20.10	22.30	24.10	25.30	22.50	21.80
	17	30.50	27.20	25.40	27.20	23.70	20.30	40.90	36.50
Hib*	2	24.00	24.10	24.20	24.10	24.00	26.20	21.90	22.10
Polio[a]	2	6.00	6.10	6.20	6.10	6.20	6.90	6.40	6.70
	7[a]	3.80	5.20	4.80	5.20	4.80	5.00	5.00	9.10
PCV-7*	2	s	3.30	1.10	3.30	6.60	22.50	12.60	23.30
Measles	7	11.60	13.80	12.80	13.80	15.40	15.20	12.90	12.20
HBV	11	5.70	6.70	6.50	6.70	6.80	7.90	8.10	8.50
Men-C*	11	95.10	92.30	0.00	0.00	0.00	0.00	0.00	0.00
All†	2	26.10	26.10	26.10	26.10	26.00	28.60	24.30	24.30
	7	25.10	25.40	23.50	25.40	26.50	27.80	25.00	24.30
	11	23.30	19.70	19.20	19.70	20.60	22.10	22.90	25.70
	17	45.80	44.20	43.50	44.20	40.00	37.60	43.00	38.80

's' indicates data suppressed due to small numbers

* Added to the recommended immunization schedule in October 2004

[a] An additional dose added in 2007

† includes: Tetanus, Diphtheria, Pertussis, Polio, Mumps, Rubella and *Haemophilus influenzae* type B

Source: Manitoba Centre for Health Policy, 2011

Appendix Table 2.4: Percent of Children who Received No Doses of an Antigen, 2000/01–2007/08

Antigen	Age	2000/01	2001/02	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08
Tetanus	2	3.90	4.50	3.90	4.80	4.60	4.90	4.30	4.70
	7	1.80	2.10	3.20	4.20	5.00	5.60	5.80	5.60
	17	5.30	5.20	4.50	4.40	4.80	4.10	4.00	4.50
Pertussis	2	4.00	4.60	3.90	4.80	4.70	4.80	4.40	4.70
	7	1.90	2.40	3.30	4.40	5.30	5.90	6.10	5.70
	17	9.30	8.80	7.90	7.70	7.60	5.90	4.90	5.20
Hib*	2	4.00	4.70	4.10	4.90	4.70	5.00	4.40	4.80
Polio[a]	2	3.90	4.40	3.90	4.80	4.60	4.80	4.30	4.60
	7[a]	1.80	2.30	3.30	4.20	5.00	5.70	5.90	5.70
PCV-7*	2	100.00	99.90	98.70	94.70	86.60	60.10	9.70	7.10
Measles	2	12.50	12.20	11.60	12.10	12.40	13.70	12.70	12.40
	7	2.90	3.60	4.90	6.00	6.90	7.70	7.30	7.50
Varicella*	2	99.50	98.20	95.80	92.50	88.30	68.50	31.00	23.70
HBV	11	33.40	27.40	24.30	20.10	20.00	18.70	18.30	18.50
Men-C*	11	96.30	95.80	96.10	96.20	97.70	73.40	22.40	21.50

* Added to the recommended immunization schedule in October 2004

[a] An additional dose added in 2007

Source: Manitoba Centre for Health Policy, 2011

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