

IHE Report

Economics of Childhood Immunizations in Canada: Data Book

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IHE

INSTITUTE OF
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■ ECONOMICS OF CHILDHOOD IMMUNIZATIONS IN CANADA: DATA BOOK

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■ PREFACE

Childhood contagious diseases are not the threat they once were in Canada. The latest national polio epidemic, once considered a dread disease, occurred in 1959, with 1,887 reported cases (PHAC http://www.phac-aspc.gc.ca/im/polio_e.html). Vaccines were introduced in 1955 and 1962, and with the introduction of immunization programs, the disease has largely disappeared from the Canadian landscape. This scenario, though perhaps not as dramatic, has occurred for other childhood diseases as well, including measles, mumps and rubella. As well, the primary causes of bacterial meningitis in children have been controlled through immunization.

The economic burden of these diseases has been substantial. In addition to the treatment costs, childhood infectious diseases have mortality effects, long-lasting impacts on the quality of life of children, and on lost income for parents.

Vaccines have made an enormous impact on these economic burdens. Initially the costs of childhood vaccines were manageable, and they did not pose a major financial issue. Over time, vaccines have increased in number and costs, and inequalities in coverage developed. These inequities were addressed in 2003, when the federal government provided money to provinces directly for childhood vaccines (Eggertson, 2006). With the introduction of human papillomavirus (HPV) vaccines, the potential for inter-provincial inequities have again been raised. Once again, a grant in the 2007 federal budget will provide the funds to provinces and territories to address the issue.

At the same time as vaccine prices have been rising, the cost-effectiveness of new vaccines seems to have been falling. Earlier vaccines had considerable **immediate** impact, and so the benefits in terms of reduced diseases were readily documented. The newly licensed rotavirus vaccine has the potential for saving lives in third-world countries but its cost-effectiveness in Canada needs to be established. Rotavirus disease in first world countries is wide-spread in children up to five years but there is almost no associated mortality and limited morbidity. Much of the associated cost is related to lost income for parents. One of the most recent additions to the vaccine arsenal, HPV vaccines, has the potential to strongly impact the incidence of cervical cancer and genital warts. As the time from immunization to cervical cancer diagnoses is many years in duration, the benefits related to the vaccine are not immediately evident. Nevertheless, the disease is one of great public concern.

In the world of vaccines, economics has not historically played a major role in informing policy. Because of the changing economic trends noted above, economics has become one of the tools to be used by decision-makers (Erickson, 2005). Alberta has included economic considerations along with other components in its new provincial decision-making framework (AHW, 2007).

For many years, immunizations were not part of the mainstream of healthcare funding in Canada, in part because they lay outside the federal – provincial funding framework. More recently, economic data related to immunizations has started to move to the forefront of policy-making. This book is presented as a contribution to the essential role that economics is assuming in the realm of vaccines.

In this booklet, we have tried to collate what data currently exists, in order to draw a picture of the current status of childhood immunization economics. We recognize that large gaps exist in government and scientific literature. We have gone a small way towards filling these gaps, and we regard this booklet as a start in that direction. We would appreciate comments and suggestions for other data sources which will allow us to improve the provision of information and add to our knowledge of how vaccines have been used in an environment where scarcity exists.

Source: Erickson LJ, De WP, Farand L. An analytical framework for immunization programs in Canada. *Vaccine* 2005; 23(19):2470-6.

Alberta immunization strategy 2007-2017. Alberta Health and Wellness. Available at: <http://www.health.gov.ab.ca/resources/publications/ImmStrat07.pdf>. Accessed: May 2, 2007.

■ INTRODUCTION

This booklet provides a compendium of economic information related to childhood vaccines in Canada. It is organized into three sections, each addressing a very broad economic question.

- In the first section, we draw attention to the **economic burden** of vaccine preventable childhood diseases. Among the topics that comprise economic burden are disease incidence and its economic impact. Most of the data in this section is on disease incidence, but we present some limited data on economic burden where we could find it.
- In the second section, we identify the **resources** that are used in Canada in providing children’s immunizations. We include information on the provisions of vaccines and their costs, on modes of delivery, and on the number of adverse events.
- In the third section, we address **performance**. These include indicators of program success, especially vaccine coverage, and on health outcomes.
- We have presented data across provinces, over time, and between countries. Each gives a different perspective on the Canadian “vaccine economy.” For international perspectives, we have chosen a small number of countries which are at comparable levels of development. These include Australia, the United States, the United Kingdom, Sweden, Finland and New Zealand. The same countries were not always available for comparison for each indicator.
- There is now a large number of vaccines for children that have been introduced or are newly available. The vaccines are listed in Table 1. The diseases that are related to these vaccines are also listed in Table 1. Throughout this booklet, we present information on these vaccines and diseases in the order in which they appear in this table.

Table 1: List of childhood diseases and antigens available in Canada

Disease	Vaccine Name/Description	Vaccine Code
Diphtheria	Diphtheria, Tetanus, Acellular Pertussis, Polio, <i>Haemophilus Influenzae</i> type b	DTaP-IPV-Hib
Pertussis		
Tetanus		
Polio		
<i>Haemophilus influenzae</i> type b (Hib)		
Measles	Measles, Mumps, Rubella	MMR
Mumps		
Rubella		
Varicella Zoster (chickenpox)	Varicella	Var
Hepatitis B	Hepatitis B	HB
Invasive meningococcal disease	Meningococcal Conjugate type C	Men-C
Invasive pneumococcal disease	Pneumococcal Conjugate 7 valent	Pneu-C-7
Human papillomavirus (HPV) -genital warts -cervical cancer	Human Papillomavirus	HPV
Rotavirus	Rotavirus	Rot

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SECTION ONE
THE BURDEN OF CHILDHOOD
COMMUNICABLE DISEASES



■ Economic burden of vaccine preventable diseases, Canada

Economists have presented the economic burden of disease in two components – direct medical costs and indirect (lost productivity) costs. In the following table, we present the economic burden of selected communicable diseases using these categories of costs, on a per case basis. The results show that indirect costs are a major type of resource – loss for all such diseases. There are two reasons – loss of work by parents who are caring for the children, and loss of work by children when they reach the workforce age. We note that these results are for various years. We did not update them because the differences would not have changed the message, and it would have made the results less transparent.

In the following table, we show the estimated “savings” in direct medical costs due to the avoided cases of illness that resulted from the use of vaccines. These estimates were made for children who lived in the Edmonton region. Data for tetanus and polio were unavailable. These results show substantial savings from using these vaccines.

Economic burden per case of vaccine preventable diseases in Canada

	Year	Direct cost* per case	Indirect cost** per case	Total cost per case	Source
Chickenpox - uncomplicated	1997	\$32	\$317	\$349	Law B
- complicated	1997	\$6,841	\$7,055	\$13,896	Law B
Measles	1995	\$301	\$628	\$929	Pelletier L
Mumps	1995	\$84	\$307	\$391	Pelletier L
Rubella	1995	\$68	\$326	\$394	Pelletier L
Congenital Rubella Syndrome	1995	\$281,387	\$233,466	\$514,853	Pelletier L
Meningitis	2000	\$12,867	\$2,675	\$15,542	Lebel MH
Hyper-endemicity C meningococcal disease	2002	\$26,837	\$173,495	\$200,333	De Wals P
Rotavirus (by level of treatment)	1997 -1998				Jacobs P
Inpatient hospital care		\$2,261	\$579	\$2,840	
Emergency room care		\$320	\$672	\$992	
Clinic and physician office care		\$116	\$377	\$493	
Non-formal healthcare setting		\$20	\$387	\$407	

Notes: * Direct cost includes direct medical cost in the treatment of the diseases.

** Indirect cost includes nonmedical and personal expenses, work days missed and time lost of caregivers.

Source: Law B, Fitzsimon C, Ford-Jones L, McCormick J, Riviere M. Cost of chickenpox in Canada: part II cost of complicated cases and total economic impact. The Immunization Monitoring Program-Active (IMPACT). *Pediatrics* 1999;104(1 Pt 1):7-14.

Law B, Fitzsimon C, Ford-Jones L, MacDonald N, Dery P, Vaudry W, et al. Cost of chickenpox in Canada: part I cost of uncomplicated cases. *Pediatrics* 1999;104(1 Pt 1):1-6.

Lebel MH, Kellner JD, Ford-Jones EL, Hvidsten K, Wang EC, Ciuryla V, et al. A pharmaco-economic evaluation of 7-valent pneumococcal conjugate vaccine in Canada. *Clin Infect Dis* 2003; 36(3):259-68.

De WP, Nguyen VH, Erickson LJ, Guay M, Drapeau J, St-Laurent J. Cost-effectiveness of immunization strategies for the control of serogroup C meningococcal disease. *Vaccine* 2004; 22(9-10):1233-40.

Pelletier L, Chung P, Duclos P, Manga P, Scott J. A benefit-cost analysis of two-dose measles immunization in Canada. *Vaccine* 1998 (9-10):989-96.

Jacobs P, Shane LG, Fassbender K, Wang E, Moineddin R, Ford-Jones EL. Economic analysis of rotavirus-associated diarrhea in the metropolitan Toronto and Peel regions of Ontario. *Can J Infect Dis* 2002;13(3):167-174.

**Estimated savings in medical costs from immunization,
Capital Health Region, Edmonton, 2004**

Disease	Year vaccine introduced in Alberta	Cases reported Capital Health 2004	Estimated cases averted	Estimated direct medical costs of cases averted
Diphtheria	1926	0	515	\$4,192,000
Pertussis	1939	136	5,809	\$3,038,000
Tetanus	1947	0	N/A	N/A
Polio	1955	0	1,486	N/A
<i>Haemophilus influenzae</i> type b	1987	0	40	\$77,600
Measles	1966	0	5,648	\$1,700,000
Mumps	1982	0	446	\$37,464
Rubella	1971	0	1,050	\$71,400
Varicella	2001	389	909	\$102,717
Invasive pneumococcal disease	2002	140	51	\$157,000
Invasive meningococcal disease	2001	2	70	\$1,606,600
Total				\$10,984,000

Source: Jacobs P, Brown-Ogrodnick A, Tguyen T, Ohinmaa A, Hanrahan A. The hidden economic benefit of childhood immunizations in Capital Health Region, Alberta. *Can Commun Dis Rep* 2006;32(2):18-21.

■ The changing incidence of childhood communicable diseases

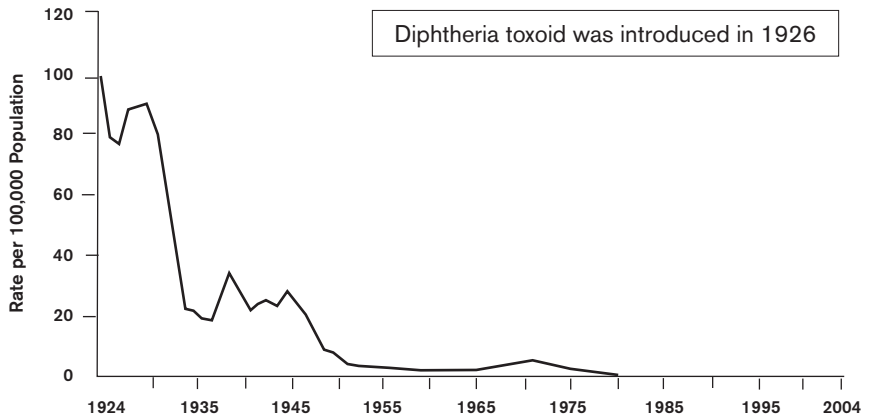
In the following graphs, we present the changing incidence of those childhood communicable diseases that are related to vaccines. For most of these diseases, we show data both before and after the introduction of the vaccine. As can be seen in these charts, incidence of disease in most cases decreased dramatically following the introduction of vaccine.

The decline in incidence of invasive *Haemophilus influenzae* type b disease was more gradual as vaccine was improved by conjugation and introduced over the course of several years. As well despite the licensure of an effective vaccine against hepatitis B in 1983, the incidence of this disease continued to rise until 1990 because the vaccine was selectively administered primarily to health care workers rather than to the entire population. Increased control of the disease has now occurred with the introduction of routine immunization programs primarily targeted to pre-adolescents through school-based programs.

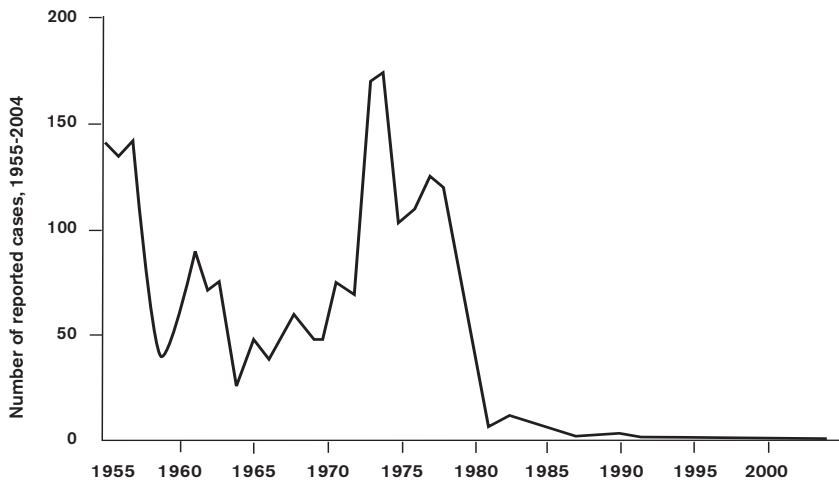
Congenital rubella, which can result in serious birth defects such as malformations of the heart, deafness, eye defects and mental retardation, has been controlled first by rubella immunization. The graph in this booklet contains incidence to 2005 but a recent outbreak of rubella in a religious group opposed to immunization in Ontario resulted in many cases of rubella, including cases in pregnant women and cases of congenital rubella syndrome are expected to result. It remains to be seen what types of universal immunization programs will be introduced for rotavirus, human papillomavirus, and the conjugated meningococcal vaccines that have recently been licensed in Canada.

Source: National Advisory Committee on Immunization. Canadian immunization guide 2006 7th ed. Ottawa, On: Public Health Agency of Canada; 2006. Available at http://www.phac-aspc.gc.ca/publicat/cig-gci/pdf/cig-gci-2006_e.pdf. Accessed: May 1, 2007.

Diphtheria - rate per 100,000 population, Canada, 1971-2005

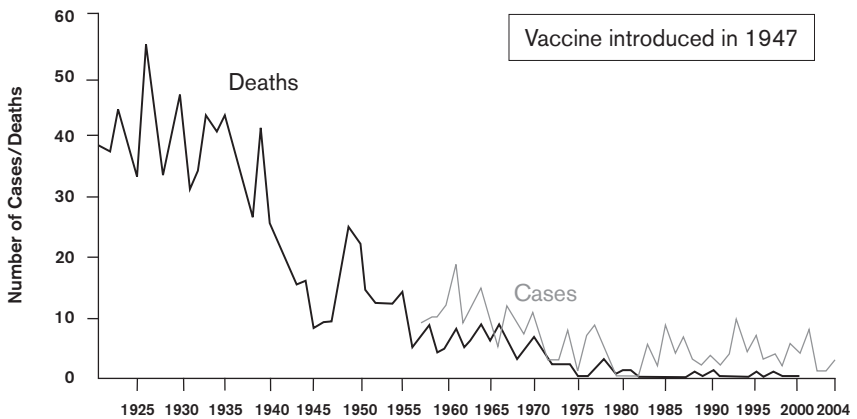


Diphtheria - number of reported cases, Canada, 1955-2004



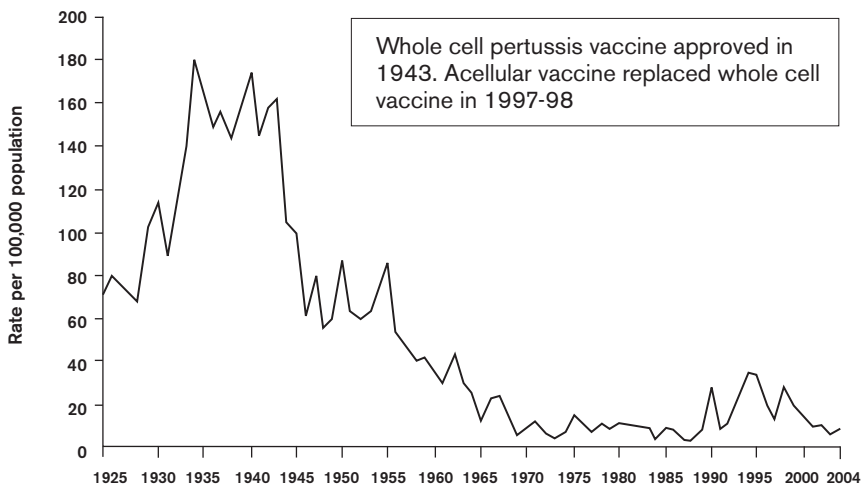
Source: Canadian immunization guide 2006 7th ed., Public Health Agency of Canada; 2006. Eight reproduced with the permission of the Minister of Public Work and Government Services Canada, 2007.

Tetanus - number of cases and deaths, 1921-2004



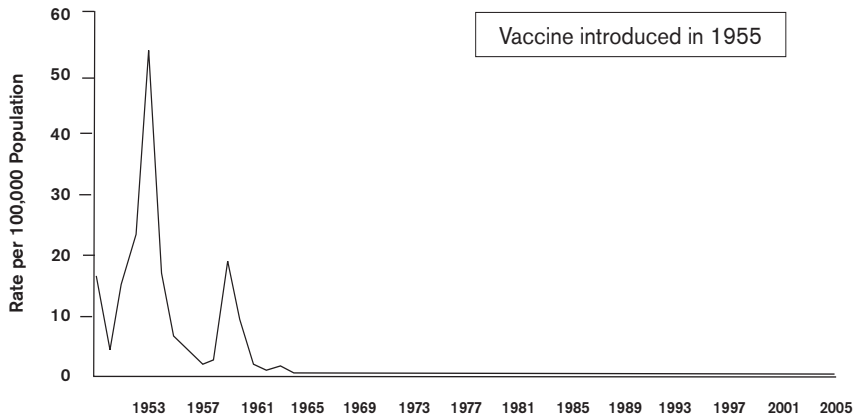
Source: Canadian immunization guide 2006 7th ed., Public Health Agency of Canada; 2006. Eight reproduced with the permission of the Minister of Public Work and Government Services Canada, 2007.

Pertussis - rate per 100,000 population, Canada, 1924-2004



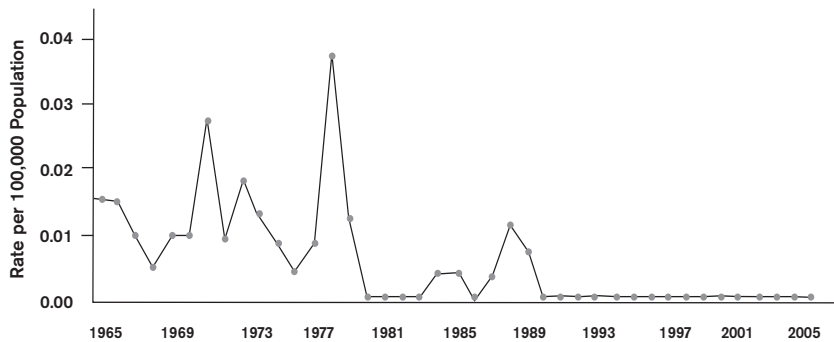
Source: Canadian immunization guide 2006 7th ed., Public Health Agency of Canada; 2006. Eight reproduced with the permission of the Minister of Public Work and Government Services Canada, 2007.

Polio - rate per 100,000 population, Canada, 1949-2005



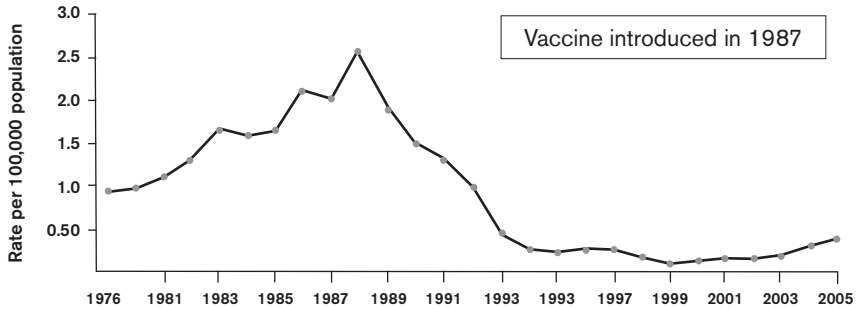
Source: Canadian immunization guide 2006 7th ed., Public Health Agency of Canada; 2006. Eight reproduced with the permission of the Minister of Public Work and Government Services Canada, 2007.

Polio - rate per 100,000 population, Canada, 1965-2005



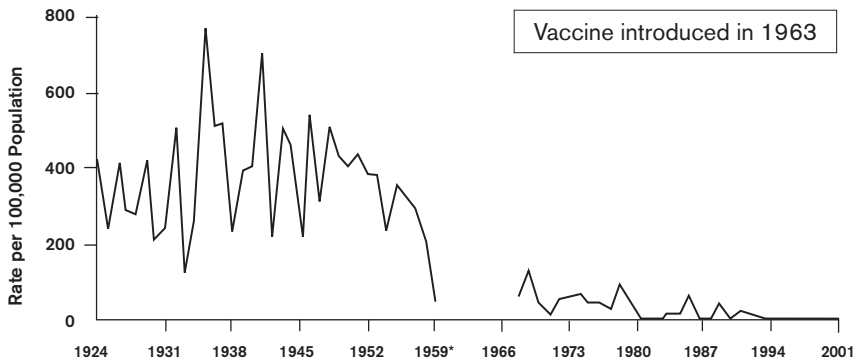
Source: Canadian immunization guide 2006 7th ed., Public Health Agency of Canada; 2006. Eight reproduced with the permission of the Minister of Public Work and Government Services Canada, 2007.

***Haemophilus influenzae* type b (invasive) - rate per 100,000 population, Canada, 1924-2004**



Source: Personal Communication: Carole Scott (Centers for Disease Control and Prevention, Canada). Selected cases of vaccine preventable diseases, Canada: 2007 (data file via email to Rita Yim April 15, 2007).

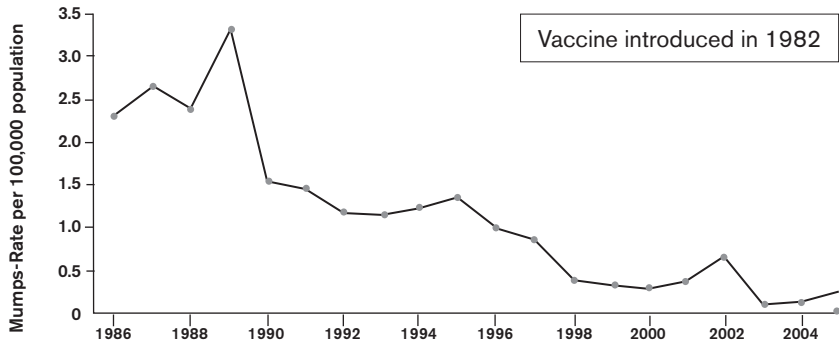
Measles - rate per 100,000 population, Canada, 1924-2005



* Measles was not nationally reported from 1959 to 1968.

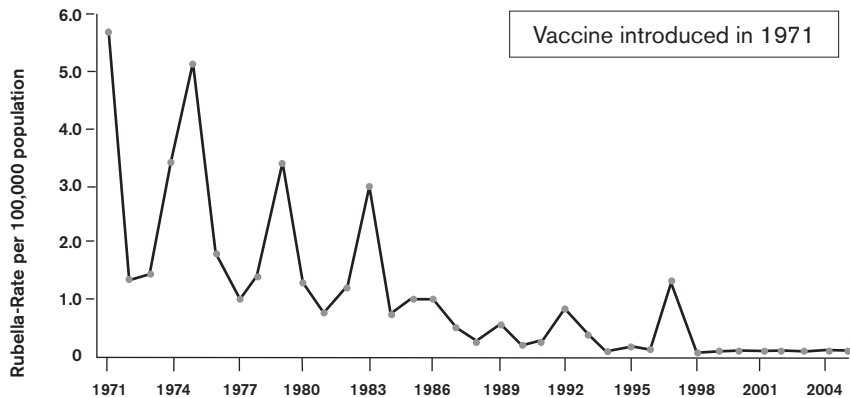
Source: Canadian immunization guide 2006 7th ed., Public Health Agency of Canada; 2006. Eight reproduced with the permission of the Minister of Public Work and Government Services Canada, 2007.

Mumps - rate per 100,000 population, Canada, 1986-2005



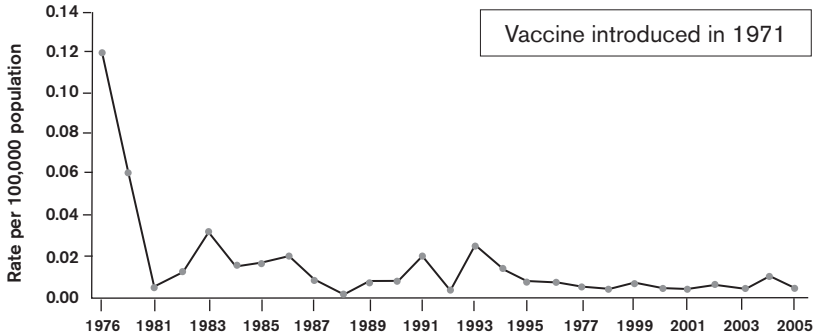
Source: Canadian immunization guide 2006 7th ed., Public Health Agency of Canada; 2006. Eight reproduced with the permission of the Minister of Public Work and Government Services Canada, 2007.

Rubella - rate per 100,000 population, Canada, 1986-2005



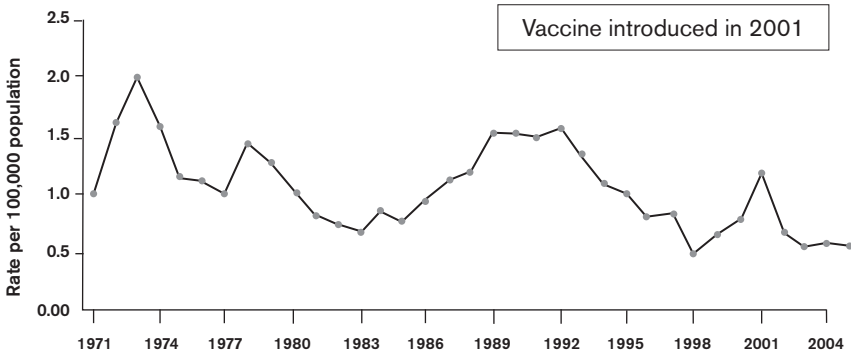
Source: Personal Communication: Carole Scott (Centers for Disease Control and Prevention, Canada). Selected cases of vaccine preventable diseases, Canada: 2007 (data file via email to Rita Yim April 15, 2007).

**Congenital rubella syndrome -
rate per 100,000 population, Canada, 1976-2005**



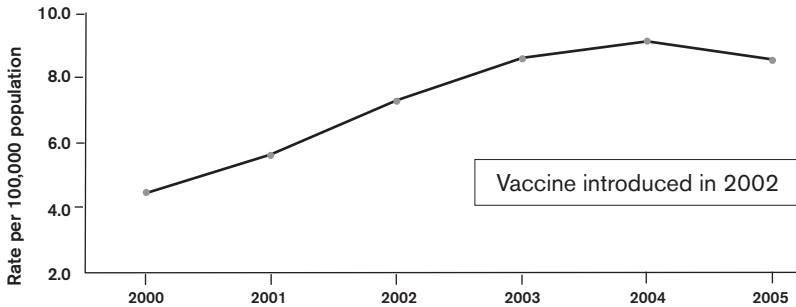
Source: Personal Communication: Carole Scott (Centers for Disease Control and Prevention, Canada). Selected cases of vaccine preventable diseases, Canada: 2007 (data file via email to Rita Yim April 15, 2007).

**Invasive meningococcal disease -
rate per 100,000 population, Canada, 1971-2005**



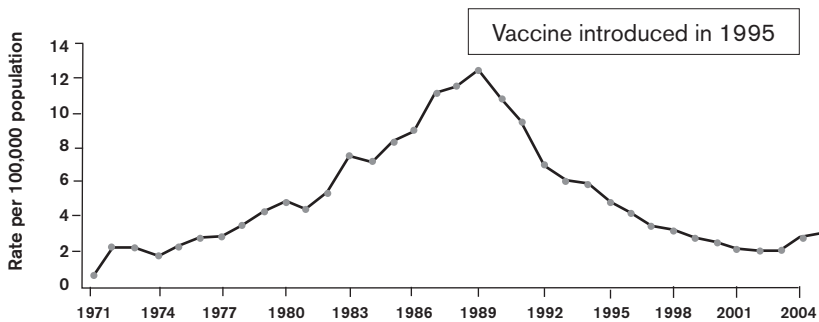
Source: Personal Communication: Carole Scott (Centers for Disease Control and Prevention, Canada). Selected cases of vaccine preventable diseases, Canada: 2007 (data file via email to Rita Yim April 15, 2007).

Invasive pneumococcal disease - rate per 100,000 population, Canada, 2000-2005



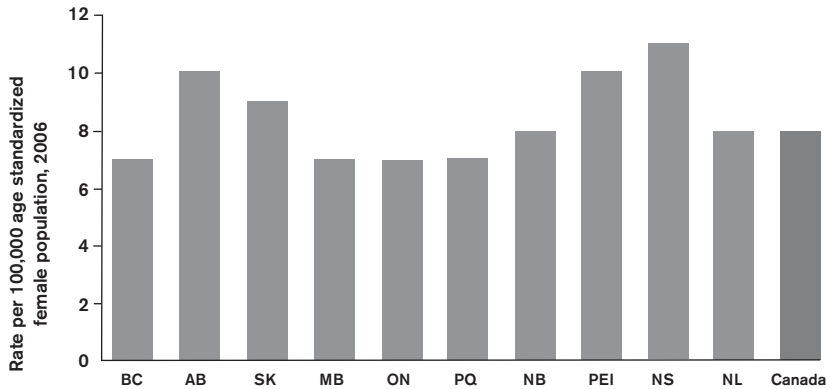
Source: Personal Communication: Carole Scott (Centers for Disease Control and Prevention, Canada). Selected cases of vaccine preventable diseases, Canada: 2007 (data file via email to Rita Yim April 15, 2007).

Hepatitis B - rate per 100,000 population, Canada, 1971-2005



Source: Personal Communication: Carole Scott (Centers for Disease Control and Prevention, Canada). Selected cases of vaccine preventable diseases, Canada: 2007 (data file via email to Rita Yim April 15, 2007).

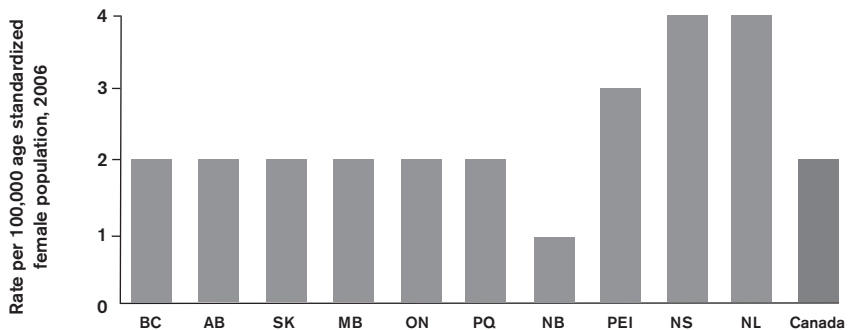
Human papillomavirus disease estimated cervical cancer rate (New Cases)



Note: Canadian total includes provincial and territorial estimates. Territories are not listed due to small numbers.

Source: Canadian Cancer Society / National Cancer Institute of Canada. Table 4 Estimated age-standardized incidence rates for major cancer sites by sex and province, Canada, 2006. Canadian cancer statistics, 2006. Toronto: ON: Canadian Cancer Society; 2006. p. 25. Available at: http://www.cancer.ca/vgn/images/portal/cit_86751114/31/21/935505792cw_2006stats_en.pdf. Access: November 2006.

Human papillomavirus disease estimated cervical cancer mortality rate



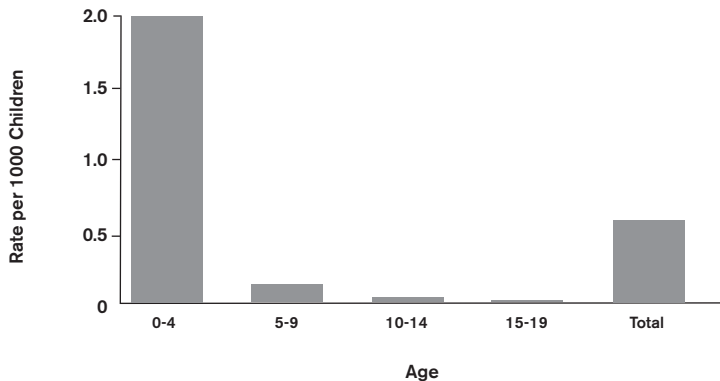
Note: Canadian total includes provincial and territorial estimates. Territories are not listed due to small numbers.

Source: Canadian Cancer Society / National Cancer Institute of Canada. Table 4 Estimated age-standardized incidence rates for major cancer sites by sex and province, Canada, 2006. Canadian cancer statistics, 2006. Toronto: ON: Canadian Cancer Society; 2006. p. 25. Available at: http://www.cancer.ca/vgn/images/portal/cit_86751114/31/21/935505792cw_2006stats_en.pdf. Access: November 2006.

**Rotavirus disease: age-specific diarrhea hospitalization,
Toronto Area / Peel Region, Ontario, November 1997 to June 1998**

Age, y	Population	Extrapolated Rotavirus Diarrhea Hospitalizations (100% Testing), per 1000 Children	Number of Rotavirus Diarrhea Hospitalizations in Population
<1	46,230	3,300	153
1	45,550	3,500	159
2	44,675	1,700	76
3	44,265	0.540	24
4	43,420	.0760	33
0-4	224,160	2.000	448
5-9	203,285	.140	28
10-14	194,385	.030	6
15-19	194,755	.007	1
Total	816,585	.587	479

**Rotavirus disease: age-specific diarrhea hospitalization,
Toronto Area / Peel Region, Ontario, November 1997 to June 1998**

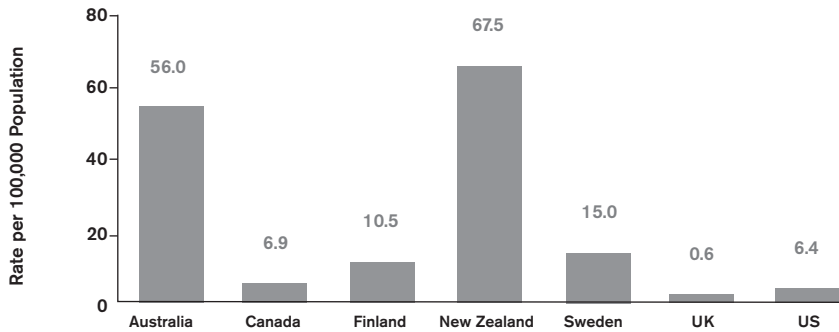


Source: Ford-Jones EL, Wang E, Petric M, Corey P, Moineddin R, Fearon M. Hospitalization for community-acquired, rotavirus-associated diarrhea: a prospective, longitudinal, population-based study during the seasonal outbreak. The Greater Toronto Area/Peel Region. PRESI Study Group. Pediatric Rotavirus Epidemiology Study for Immunization. Arch Pediatr Adolesc Med 2000; 154(6): 578-585.

■ Incidence of vaccine – preventable diseases, selected countries, 2005

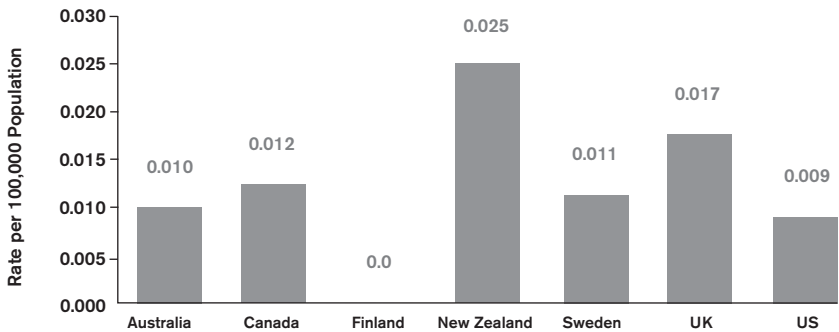
In the following graphs, we provide data on the incidence of vaccine-preventable diseases for a selected group of countries – Canada, the United States, the United Kingdom, Australia, Sweden, Finland and New Zealand. For all of these diseases, the observations are for a period in which vaccines have been introduced. The incidence of these diseases will therefore reflect the efficacy of the vaccines and the degree of coverage that is achieved by the national immunization strategies.

Pertussis - rate per 100,000 population, 2005



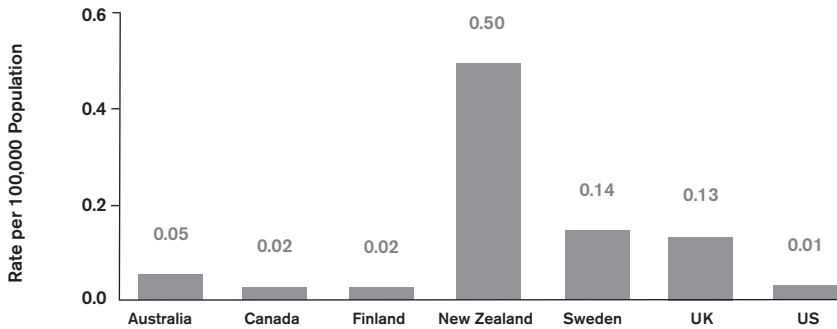
Source: World Health Organization. WHO: Immunization Profile
Available at: <http://www.who.int/vaccines/globalsummary/immunization/countryprofileresult.cfm>.

Tetanus - rate per 100,000 population, 2005



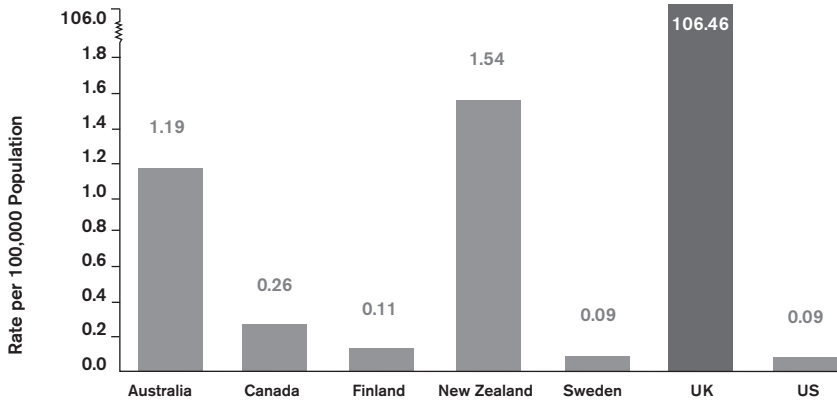
Source: World Health Organization. WHO: Immunization Profile
Available at: <http://www.who.int/vaccines/globalsummary/immunization/countryprofileresult.cfm>.

Measles - rate per 100,000 population, 2005



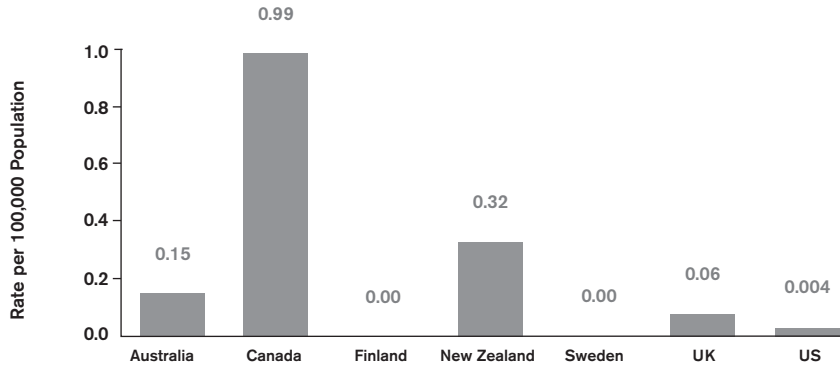
Source: World Health Organization. WHO: Immunization Profile
Available at: <http://www.who.int/vaccines/globalsummary/immunization/countryprofileresult.cfm>.

Mumps - rate per 100,000 population, 2005



Source: World Health Organization. WHO: Immunization Profile
Available at: <http://www.who.int/vaccines/globalsummary/immunization/countryprofileresult.cfm>.

Rubella - rate per 100,000 population, 2005



Source: World Health Organization. WHO: Immunization Profile

Available at: <http://www.who.int/vaccines/globalsummary/immunization/countryprofileresult.cfm>.

SECTION TWO
RESOURCES RELATED TO IMMUNIZATIONS



The resources that are directly connected to the delivery of childhood immunizations are the vaccines themselves, the resources used to deliver them, and those resulting from any adverse events associate with the administration of the vaccines. The number of vaccines that are administered are based on the childhood immunization schedules, the degree of coverage in the childhood population, and the unit prices of the vaccines that are delivered. In the table “Recommended Childhood Immunization Schedules, Selected Countries” we present a schedule of the recommended childhood vaccines in Canada and selected countries. Coverage is similar in these countries, except for MMR vaccine, where it is recommended that it be given twice before age 6. In the table “Cost of Recommended Childhood Vaccines per Child, Alberta, 2006,” we present the cost of childhood vaccines individually, and for a child who is completely immunized by age 2. There are other childhood vaccines that are either given around Grade 5, or which have been licensed in Canada, but are not yet publicly provided. These vaccines are shown in the table “Cost of Other Vaccines per Child (Canada)”. One of the publicly available vaccines is conjugate pneumococcal vaccine. In the table “Price of Pevnar (pneumococcal 7 valent conjugate vaccine), 2001” we provide the cost of this vaccine in a number of countries. Although it is more expensive than previously introduced vaccines, costs in Canada are lower than in all of the comparison countries.

In the table “Provincial Vaccine Delivery by Type of Provider (% of total immunization), 2006,” we show the method by which vaccines are provided in each province. There is a wide range of provision methods across Canada; in Alberta 99 per cent of childhood vaccines are given by a public health nurse; in Ontario 90 per cent are provided by a private physician.

Adverse events occur following immunization. Some of the adverse events are related to the vaccine while others are unrelated, occurring coincidentally. It is important to measure adverse events following immunization to demonstrate the safety of the immunization program. In the table “Vaccination Adverse Event Reports”, we show the number of adverse events that have been reported through the national surveillance system. We do not have costs for these events, but generally they are quite low.

Cost per immunized child for recommended childhood vaccines, Alberta, 2006

Timepoint	Vaccine Code	Manufacturer	Vaccine Brand Name	Dosage	Unit Price
2 months	DTaP	Sanofi Pasteur	Pentacel®	0.5 ml	\$43.85
	IPV				
	HiB				
	Pneu-C-7	Wyeth	Prevnar®	0.5 ml	\$82.19
	Men-C	ID-Bio/Baxter	Neisvac C™	0.5 ml	\$89.00
SUBTOTAL					\$215.04
4 months	DTaP	Sanofi Pasteur	Pentacel®	0.5 ml	\$43.85
	IPV				
	HiB				
	Pneu-C-7	Wyeth	Prevnar®	0.5 ml	\$82.19
	Men-C	ID-Bio/Baxter	Neisvac C™	0.5 ml	\$89.00
SUBTOTAL					\$215.04
6 months	DTaP	Sanofi Pasteur	Pentacel®	0.5 ml	\$43.85
	IPV				
	HiB				
	Pneu-C-7	Wyeth	Prevnar®	0.5 ml	\$82.19
	Men-C	ID-Bio/Baxter	Neisvac C™	0.5 ml	\$89.00
SUBTOTAL					\$215.04
12 months	MMR	Merck Frosst	M-M-R® II	0.5 ml	\$28.42
	Varicella	GlaxoSmithKline	Varilrix™	0.5 ml	\$56.45
SUBTOTAL					\$84.87
18 months	DTaP	Sanofi Pasteur	Pentacel®	0.5 ml	\$ 43.85
	IPV				
	HiB				
	Pneu-C-7	Wyeth	Prevnar®	0.5 ml	\$82.19
SUBTOTAL					\$126.04
TOTAL					\$856.03

Source: Drug manufacturers. Prices are list prices.

Cost per person immunized of other vaccines (Canada)

Disease	Vaccine (Mfg.)	Recommended Doses	List price/dose	Cost of all recommended doses
Hepatitis B	Recombivax HB (Merck Frosst)	3 doses for grade 5	\$10.80 per 0.5 ml	\$32.40 per child
Human Papillomavirus Genital warts Cervical cancer	Gardasil (Merck Frosst)	3 injections of 0.5 ml over a six month period, for females 9–26 years.	\$134.95 per 0.5 ml dose	\$404.85 per person
Rotavirus	RotaTeq (Merck Frosst)	3 doses, 1 each at 2, 4 and 6 months	\$55.00 per dose	\$165.00 per child

Source: CNW Group. Merck Frosst's GARDASIL(TM) now available in Canada - Daughters of cervical cancer survivor first to receive vaccine. CNW Group 2006. Available at: <http://www.newswire.ca/en/releases/archive/August2006/21/c7017.html>. Accessed: May 1, 2007.

Personal Communication: Reinson S (Merck Frosst). Hepatitis vaccine pricing (via email to Philip Jacobs on April 25, 2007). Merck Frost. RotaTeq fact sheet. Merck Frost 2007 May 1. Available at: http://www.merckfrosst.ca/mfcl/en/corporate/newsroom/press_releases/fact_sheet_rotateq_230806.html. Accessed: May 1, 2007.

**Price of Prevnar (pneumococcal 7 valent conjugate vaccine),
selected countries 2001**

Country	Price per vial
Canada	\$76.00
France	\$77.92
Germany	\$75.20
Italy	\$76.32
Sweden	\$85.82
United Kingdom	\$82.60
United States	\$75.45
International Median	\$77.12

Source: Patented Medicine Prices Review Board. Report on new patented drugs for human use
– Prevnar. Ottawa, ON: Patented Medicine Prices Review Board.

Cost for recommended childhood vaccines, Alberta, 2006

Disease	Country	2 mos	3 mos	4 mos	6 mos	12 mos	15 mos	18 mos	24 mos	3-5 yr	4-6 yr
Diphtheria, Tetanus, Pertussis	Canada	x		x	x			x			x
	US	x		x	x		x				x
	UK	x	x	x						x	
	Australia	x		x	x						x
<i>Haemophilus influenzae</i> type b	Canada	x		x	x	x	x				
	US	x		x	x	x					
	UK	x	x	x		x					
	Australia	x		x	x	x					
Polio	Canada	x		x				x			x
	US	x		x	x						x
	UK	x	x	x						x	
	Australia	x		x							x
Measles, Mumps, Rubella	Canada					x	x				
	US					x					x
	UK					x				x	
	Australia					x					x
Pneumococcal	Canada	x		x	x	x					
	US	x		x	x	x			x		
	UK	x		x						x	
	Australia	x		x	x			\$\$			
Meningococcal	Canada	x		x	x	or	x				
	US								‡‡		
	UK		x	x		x					
	Australia					x					
Varicella	Canada					x					
	US					x			◇		
	UK										
	Australia							x			

Notes: ## MPSV4 - Meningococcal polysaccharide vaccine

§§ 23vPPV - 23-valent pneumococcal polysaccharide vaccine recommended and funded only for Aboriginal and Torres Strait Islander people.

◇ Varicella - Catch up immunization from 24 months to 18 years of age.

Source: Canada: National Advisory Committee on Immunization. Canadian immunization guide 2006 7th ed. Ontario: Public Health Agency of Canada; 2006.

US: Department of Health and Human Services. Recommended childhood and adolescent immunization schedule United States, 2006. Center for Disease Control and Prevention; 2006. Available at <http://www.immunize.org/cdc/child-schedule.pdf>. Accessed: April 18, 2007.

UK: National Health Services. Full immunization schedule. 2007. Available at: <http://www.immunization.nhs.uk/article.php?id=97>. Accessed: April 18, 2007.

Australia: Burgess MA, McIntyre PB. Vaccines: the new Australian best-practice schedule. Med J Aust 2004 May 17;180:494-6. Available at: http://www.mja.com.au/public/issues/180_10_170504/bur10901_fm.html. Accessed: April 18, 2007.

**Provincial vaccine delivery by type of provider
(% of total immunization), 2006**

Province	Public Health Nurse	Physician	Other Including Hospital Immunization
BC	60	36	4
AB	99	1	-
SK	94	4	2
MB	30	60	10
ON	<10	90	<1
PQ	75	23	2
NB	-	-	-
PEI	80	16	4
NS	20	80	-
NL	50	50	-
YT	99	<1	-
NT	100	-	-
NU	100	-	-

Source: Personal communication: Between L Mashinter and J Talbot, former Medical Officer of Health, Nunavut (October, 2006).

Email from C O'Keefe (Director, Communicable Disease Control, Newfoundland) to L Mashinter (October 31, 2006).

Email from A Neatby (Coordinator, Communicable Disease and Immunization Programs, Prince Edward Island) to Laura Mashinter (November 2, 2006).

**Vaccination adverse event reports
per 100,000 net doses of distributed vaccines (Canada)**

Year	Unit Distributed	Adverse Event Reports	Adverse Event Reports per 100,000 Net Distributed Vaccines
1992	18,604,348	4,279	23
1993	16,240,909	3,573	22
1994	12,169,697	4,016	33
1995	11,567,500	4,627	40
1996	18,157,567	5,992	33
1997	14,135,294	4,806	34
1998	11,192,593	3,022	27
1999	15,605,263	2,965	19
2000	20,923,077	5,440	26
2001	18,917,857	5,297	28
2002	16,895,652	3,886	23
2003	20,637,500	3,302	16
2004	21,323,529	3,625	17
Total	216,370,795	54,830	25.34

Source: Public Health Agency of Canada. Canadian National Report on Immunization, 2006.
Can Commun Dis Rep 2006;32(Suppl 3):1-44.
Available at: http://www.phac-aspc.gc.ca/publicat/ccdr-rmtc/06pdf/32s3_e.pdf.

SECTION THREE
PERFORMANCE



■ Introduction

In this section we address two issues – the cost-effectiveness of vaccines in preventing communicable diseases and the performance of the Canadian public health system in providing vaccine coverage for children. The first topic is presented in the next table. It covers the cost-effectiveness of various childhood vaccines. The second topic is covered in various charts and tables. The topics covered are: changes in publicly funded programs in the provinces between 2003 and 2005; ratings of provincial immunization programs; changes in coverage over time for specific publicly funded vaccines in Canada; and differences in coverages across countries.

The Benefit/Cost ratio shows how many dollars in benefits result from the (dollar) costs of the program. If the ratio is below 1, it means that the program used more money than it saved in direct and indirect costs. The higher above 1 is the benefit / cost ratio, the more “savings” in resources are generated by the program. The net benefits of the program depend on the total number of children vaccinated and the cost of the immunization program. It should be noted that though two types of vaccines – meningococcal and pneumococcal – have benefit to cost ratios of less than 1, these programs still generate positive health benefits for the additional dollars spent, and they may well be “cost – effective” initiatives. It should be noted that those vaccines with the highest benefit to cost ratios are the ones which were initiated earlier. Those vaccines which have been initiated more recently are **relatively** less cost – effective, though they may still be economically and socially very beneficial.

Childhood vaccination programs and their benefit/cost ratios

Vaccine	Study/ Country/ Year	Program/age covered in study	Benefit to cost ratio
Meningococcal C	Skull et al. 2001, USA	All grade 10-12 high school and 1st year university students with high risk	0.63
Pneumococcal	Weycker et al. 2000	All infants in 7 different age categories from <7 months to 59 months	0.61–1.54
<i>Haemophilus influenzae</i> type b	Garpenholt et al. 1998 Sweden	All children	1.19
Hepatitis B	Margolis et al. 1995, USA	All infants	1.41
Varicella	Getsios et al. 2002; Brisson et al., 2002. Canada	All 12-month-old children	1.70–5.24
MMR	White et al. 1985	All infants	14.4
DTaP (acellular) and DTwP (whole)	Ekwueme et al. 2000, USA	All infants	27.0–31.0

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Change in publicly funded vaccination programs in Canada 2003 to 2005

Province	Childhood Vaccines*	Meningococcal Conjugate	Adolescent Pertussis	Pneumococcal Conjugate	Varicella
BC	+	◇	◇	◇	◇
AB	+	+	◇	+	◇
SK	+	◇	◇	+	+
MB	+	◇	◇	◇	◇
ON	+	+	◇	◇	◇
PQ	+	+	◇	+	Unknown
NB	+	+	◇	◇	◇
NS	+	◇	◇	◇	+
PEI	+	+	◇	+	+
NL	+	◇	+	◇	◇
YT	+	◇	◇	◇	Unknown
NT	+	◇	+	Unknown	+
NU	+	Unknown	+	+	+

Note: * diphtheria, Hepatitis B, *Haemophilus influenzae* type b, measles, mumps, pertussis, polio, rubella and tetanus

+ vaccine publicly administered as of 2003.

◇ additional vaccine publicly administered as of September 2005.

All new vaccines funded by the provinces and territories by January 2007.

Source: Eggertson L. Publicly funded vaccine coverage has increased across Canada. CMAJ 2006;174(1):20.

Assessment of publicly funded vaccination programs, Canada 2005

Province	Status	Immunization Coverage
British Columbia	Good	Provides coverage for all four recently recommended vaccines (adolescent pertussis, meningococcal, pneumococcal and varicella), but meningococcal vaccine is not given according to CPS and NACI recommendations. Meningococcal is offered to teenagers as well
Alberta	Excellent	Provides coverage for all vaccines according to the CPS and NACI recommended schedule.
Saskatchewan	Good	Provides coverage for all four recommended vaccines, but meningococcal vaccine is not given according to CPS and NACI recommendations. Meningococcal is offered to teenagers as well.
Manitoba	Good	Provides coverage for all four recommended vaccines, but meningococcal and pneumococcal vaccines are not given according to CPS and NACI recommendations.
Ontario	Good	Provides coverage for all four recommended vaccines, but meningococcal vaccine is not given according to CPS and NACI recommendations.
Quebec	Fair	Provides coverage for three of the four recommended vaccines. Meningococcal and pneumococcal vaccines are not given according to CPS and NACI recommendations. Varicella is not funded by the province.
New Brunswick	Good	Provides coverage for all four recommended vaccines, but meningococcal vaccine is not given according to CPS and NACI recommendations.
Nova Scotia	Good	Provides coverage for all four recommended vaccines, but meningococcal vaccine is not given according to CPS and NACI recommendations. Meningococcal is offered to teenagers as well.
PEI	Good	Provides coverage for all four recommended vaccines. Meningococcal vaccine is not given according to CPS and NACI recommendations. Meningococcal vaccine is offered to teenagers.
NL	Good	Provides coverage for all four recommended vaccines, but meningococcal vaccine is not given according to CPS and NACI recommendations.

Source: Canadian Pediatric Society. Are we doing enough? A status report on Canadian public policy and child and youth health. Ottawa, ON: Canadian Pediatric Society; 2005.
Available at: <http://www.cps.ca/English/Advocacy/StatusReport.htm>.

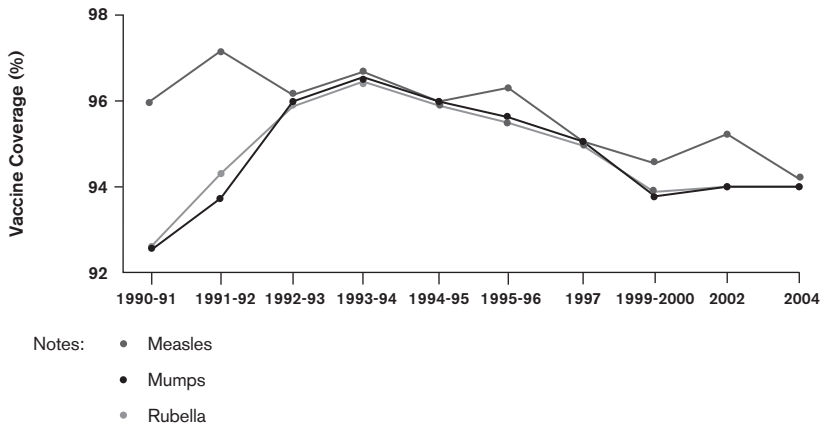
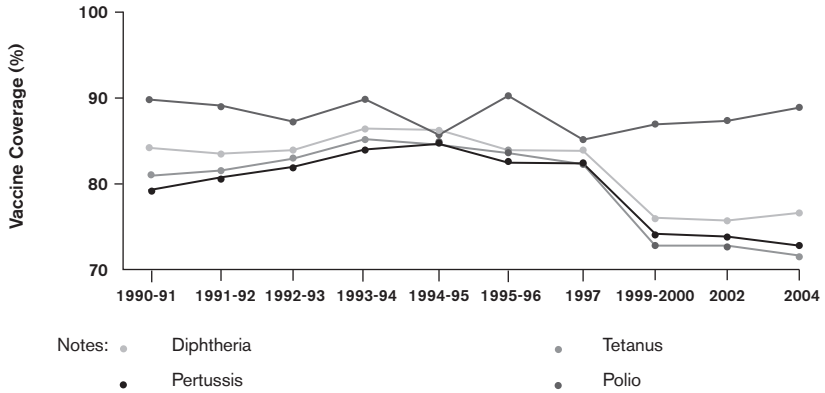
Assessment of publicly funded vaccination programs, Canada 2005 (continued)

Province	Status	Immunization Coverage
YT	Fair	Provides coverage for three of the four recommended vaccines. Meningococcal vaccine is not given according to CPS and NACI recommendations. Varicella is not funded by the territory.
NT	Fair	Provides coverage for three of the four recommended vaccines. Meningococcal vaccine is not given according to CPS and NACI recommendations. Pneumococcal vaccine is not funded by the territory.
NU	Fair	Provides coverage for three of the four recommended vaccines. Meningococcal vaccine is not funded by the territory.

Notes: All recommended childhood vaccines are provided in Quebec, Yukon, Northwest Territories and Nunavut as of January 2007, which will improve their status to "Good".

Source: Canadian Pediatric Society. Are we doing enough? A status report on Canadian public policy and child and youth health. Ottawa, ON: Canadian Pediatric Society; 2005. Available at: <http://www.cps.ca/English/Advocacy/StatusReport.htm>.

Vaccine coverage (%) of children at 2 years of age, Canada



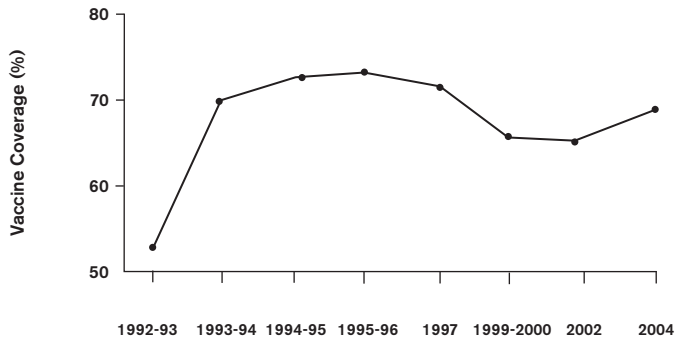
Source: 1990-91 to 1999-2000 data

McWha L, MacArthur A, Badiani T, Schouten H, Tam T, King A. Measuring up: Results from the National Immunization Coverage Survey, 2002. *CCDR* 2007; 30(5):37-50. Available at: <http://www.phac-aspc.gc.ca/publicat/ccdr-rmtc/04vol30/dr3005ea.html>.

1997, 2002 and 2004 data

Public Health Agency of Canada. Canadian National Report on Immunization, 2006. *Can Commun Dis Rep* 2006;32(Suppl 3):1-44. Available at: http://www.phac-aspc.gc.ca/publicat/ccdr-rmtc/06pdf/32s3_e.pdf.

***Haemophilus influenzae* type b**
Vaccine coverage (%) of children at 2 years of age, Canada



Source: 1990-91 to 1999-2000 data

McWha L, MacArthur A, Badiani T, Schouten H, Tam T, King A. Measuring up: Results from the National Immunization Coverage Survey, 2002. *CCDR* 2007; 30(5):37-50. Available at: <http://www.phac-aspc.gc.ca/publicat/ccdr-rmtc/04vol30/dr3005ea.html>.

1997, 2002 and 2004 data

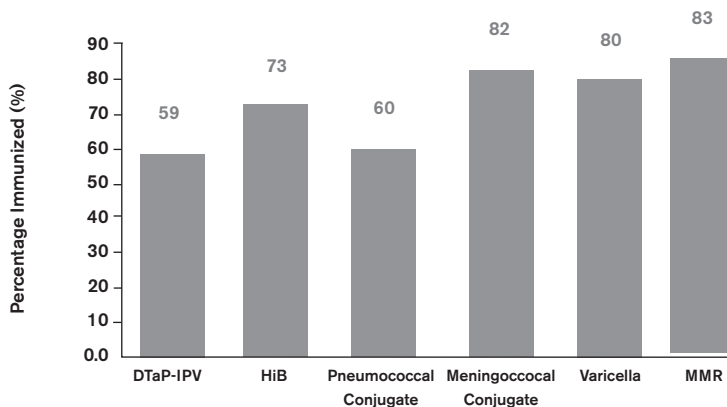
Public Health Agency of Canada. Canadian National Report on Immunization, 2006. *Can Commun Dis Rep* 2006;32(Suppl 3):1-44. Available at: http://www.phac-aspc.gc.ca/publicat/ccdr-rmtc/06pdf/32s3_e.pdf.

Capital Health (Edmonton) immunization coverage rates at 2 years of age, 2006

	DTaP-IPV-Hib	MMR	Var	Pneu-C-7	Men-C
Immunization Rates (%) for Each Vaccine January 1 to December 31, 2006	88.0%	95.0%	93.0%	88.0%	95.0%

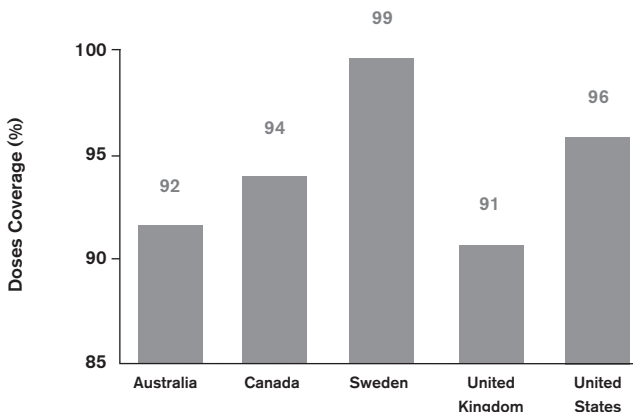
Source: Personal Communication: Loewen, J. (Communication Disease Control, Capital Health). Capital Health Immunization Rates by 2 years of Age. Immunization Rates (%) for Each Vaccine January 1 to December 31, 2006. (data from Capital Health Delayed Monitoring System, Caseworks, Immunization database.

Percentage of two-year-old children immunized in Alberta First Nations Communities, 2005



Source: Health Canada. Health protection report 2005-2006: Alberta Region. Ottawa ON: Health Canada; 2006.

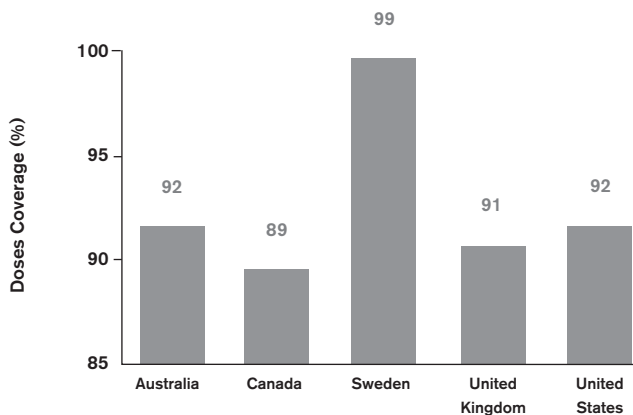
Diphtheria, pertussis and tetanus(DPT) 3-dose coverage, selected countries (%), 2005



Note: Vaccine coverage data are vaccines administered to the target population. The target population groups vary from country to country and are dependent on the immunization schedule in place.

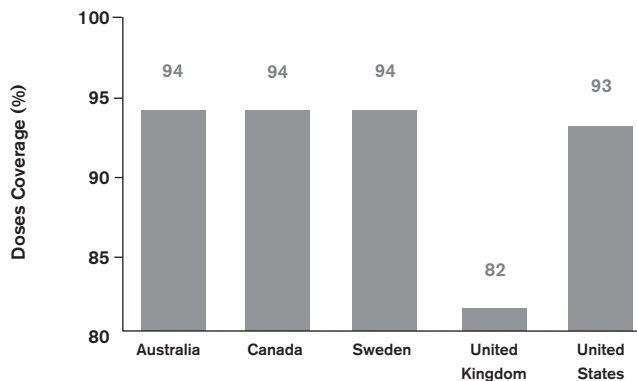
Source: WHO-UNICEF estimates of immunization of DTP3 coverage, 2005. WHO-UNICEF estimates of national immunization coverage. Available at: http://www.who.int/immunization_monitoring/en/globalsummary/timeseries/tswucoverageotp3.htm.

Polio coverage, select countries (%), 2005



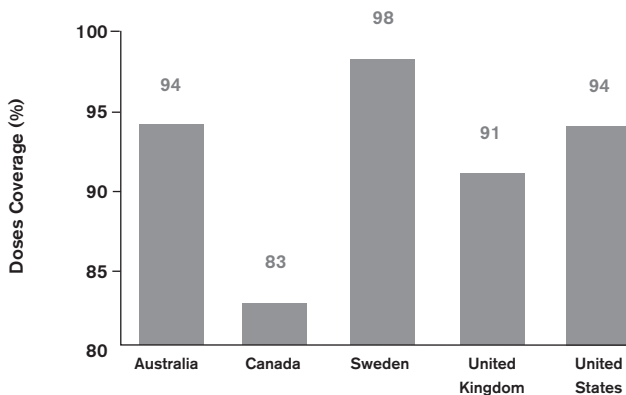
Source: WHO-UNICEF estimates of immunization of polio coverage, 2005. WHO-UNICEF estimates of national immunization coverage. Available at: http://www.who.int/immunization_monitoring/en/globalsummary/timeseries/tswucoveragepol3.htm.

Meningococcal-C coverage, selected countries (%), 2005



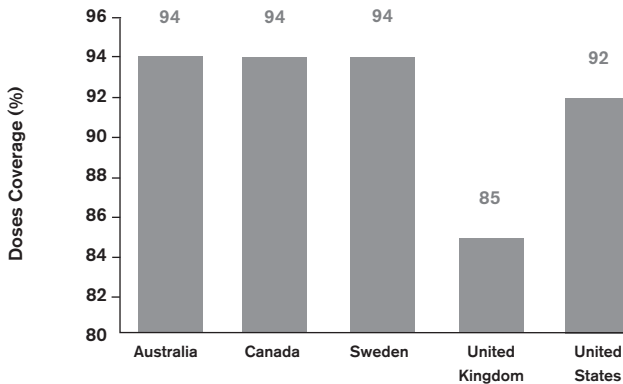
Source: WHO-UNICEF estimates of immunization of MCV coverage, 2005. WHO-UNICEF estimates of national immunization coverage.
Available at: http://www.who.int/immunization_monitoring/en/globalsummary/timeseries/tswucoveragemcv.htm.

Hib 3-dose coverage, selected countries (%), 2005



Source: WHO-UNICEF estimates of immunization of Hib3 coverage, 2005. WHO-UNICEF estimates of national immunization coverage.
Available at: http://www.who.int/immunization_monitoring/en/globalsummary/timeseries/tswucoveragehib3.htm.

MMR coverage of two-year-old children, selected countries (%), 2005



Source: Australia: Medicare Australia. Percentage of children 24-<27 months of age (age calculated 31 December 2006) assessed as fully immunized. Date of processing as at 31 March 2007. Australian childhood immunization register statistics. Australian Government; 2007. Available at: http://www.medicareaustralia.gov.au/providers/health_statistics/statistical_reporting/acir.htm.

Canada (2006): Health Canada. Canadian National Report on Immunization, 2006. Can Commun Dis Rep 2006;32(Suppl 3):1-44. Available at: http://www.phac-aspc.gc.ca/publicat/ccdr-rmtc/06pdf/32s3_e.pdf.

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■ IHE Publications

- Cost-effectiveness in the detection of syphilis
- The use and benefit of teleoncology services
- Screening newborns for hearing
- Screening newborns for cystic fibrosis
- The use of nitric oxide in acute respiratory distress syndrome
- Routine pre-operative testing – is it necessary?
- Consensus Statement on Self-monitoring in Diabetes
- Consensus Statement on How to Prevent Low Birth Weight

This booklet is a compendium of existing statistics related to the economic aspect of childhood immunizations in Canada. It brings together, in one document, data obtained from a wide range of sources. It covers topics related to the economic and epidemiological burden of childhood diseases, resources used, and system performance from provincial, national and international viewpoints.



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