

Meningococcal Serogroup C Conjugate Vaccination in Canada: How Far Have We Progressed? How Far Do We Have to Go?

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ABSTRACT

Since routine meningococcal C conjugate vaccination was introduced into Canada in 2002, there have been a large regional variation in the routine programs, changes to the timing of the infant series in some provinces, and wide differences in catch-up programs. As immunization is viewed as a provincial responsibility, less attention has been paid to determining national coverage rates and the direct and indirect effects of the widely varying provincial/territorial vaccination programs on the nation as a whole. Canada's disjointed regional immunization campaigns leave the population at risk of disease for an extended length of time. The United Kingdom has proven that with a pro-active approach to planning, coordination, and implementation of a national immunization program, excellent long-term control of invasive meningococcal disease in a large population could be achieved in as little as one year. A summation of the current meningococcal immunization strategies used in Canada and an estimate of overall vaccine coverage of children and youth is provided.

Key words: Immunization; meningococcal C conjugate vaccine; coverage rate; herd immunity; Canada

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Although rare, invasive meningococcal disease (IMD) can be a frightening disease, with 181 confirmed cases in 2005 and a case fatality rate ranging from 3.7% to 21.7% depending on the age group. Serogroup B disease accounts for the highest incidence of IMD, and shares a more stable disease incidence with serogroups Y and W135. Serogroup C disease has demonstrated a cyclical fluctuation in recent times¹ and has been associated with a higher rate of septicemia and mortality, particularly among adolescents, as shown during the 1991-92 Canadian outbreak. Routine meningococcal C conjugate (MCC) vaccination began in Canada in 2002. The latest National Advisory Committee on Immunization (NACI) recommendations for routine MCC immunization include infants, children aged 1-4 years, adolescents and young adults.² There is wide variation among the provinces/territories (P/T) with regard to how they have implemented infant series and catch-up MCC programs.

In 1999, the UK became the first country to implement a national immunization program with MCC vaccine in response to increasing rates of IMD. The impact on IMD was profound. There was an overall decrease in disease incidence of 81% from 1999 to 2001,³ and at the same time the number of deaths decreased from 67 to 5.⁴ Recognizing that vaccine effect is more easily seen in areas with increased disease incidence, the key to progress in reducing IMD incidence was attributed to immunizing the entire cohort in a short time period instead of one cohort each year, and to the robust herd immunity that was obtained. Similar reductions in disease incidence demonstrated in Quebec in 2001 were the result of a mass MCC immunization program aimed at those ages 6 months to 20 years.⁵

While several studies have examined the changes in IMD since the introduction of the MCC vaccines, there are no data describing the extent of MCC vaccination coverage to the NACI recommended target groups from a national perspective. A recent study from the Immunization Monitoring Program ACTIVE (IMPACT) reported

that from 2000-2006, a significant decrease in the incidence and number of cases of IMD – in both children and adults – occurred in those provinces that introduced immunization programs earlier, compared to unchanged rates in provinces with later introduction of programs. The indirect effects of the MCC programs were examined by comparing the incidence of IMD in adults over 30 years in provinces with early introduction versus late programs. They found a decrease in IMD in adults living in provinces with early MCC programs, and attributed this effect to herd immunity.⁶ British Columbia reported decreasing trends in IMD in children associated with an MCC program which began in 2003,⁷ along with an increase in the median age of IMD (42 years). Ontario recently reported a marked reduction in IMD incidence in children and adolescents vaccinated since 2004 and a downward trend in IMD in unvaccinated older age groups, also suggesting a herd effect of MCC vaccination.⁸ These indirect effects were much less extensive than those reported in the UK, likely because the UK program was a mass immunization in response to an IMD epidemic.⁴

While recently published Canadian data provide a useful summary of MCC vaccine effect, this is merely part of the picture. The direct and indirect effects of vaccine programs can only be assessed with knowledge of the proportion of the population immunized. To examine progress on the extent of national MCC vaccination coverage, the following questions still need to be answered:

- What are the details of the various routine and catch-up MCC immunization programs utilized by the individual Canadian P/T since the start of the campaign?

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Figure 1. Provincial MCC vaccination programs as of 2009

Province	Age in Years as of Dec 31, 2007																				
	<1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
NL	*									CU					CU						
NS	*									CU			CU		CU	CU					
PEI	*														CU QV	QV					
NB	*														CU QV	QV					
QC	*																				
ON	*											CU				CU	CU	CU	CU	CU	CU
MB†																					
SK	*			CU								CU									
AB	*																				
BC	*	CU										CU							CU		
Nu	*														CU						
NWT	*														CU						
YK	*														CU						

Shaded squares indicate eligible for monovalent MCC vaccination

QV - Quadravalent Conjugate ACYW-135

CU - Start of Catch-up vaccination

* Start of infant vaccination program

† Manitoba introduced infant series at 12 months of age as of Jan 1, 2009

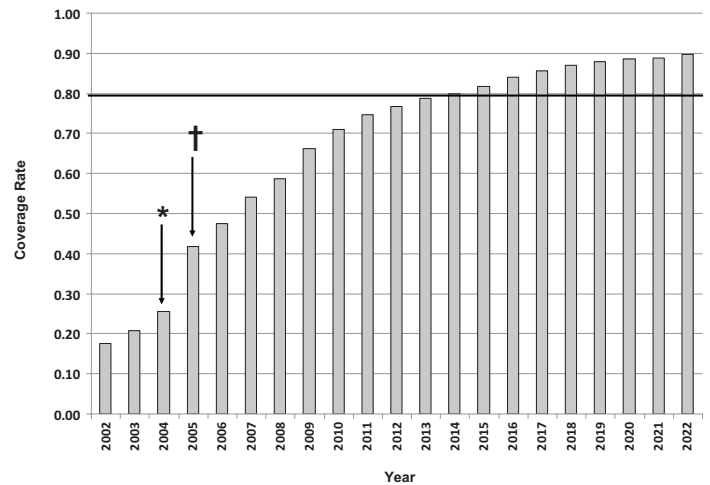
- What is the current total national coverage of Canadian children and adolescents aged <1 to 20 years immunized with at least one dose of MCC?
- When may Canada expect to achieve national coverage similar to that reported in the UK?
- By when will all children and adolescents from age 1 to 20 years in Canada have the opportunity to have received at least one dose of MCC?

The Canadian national MCC experience

To answer these questions, MCC immunization information was gathered from the Public Health Agency of Canada, and compared to reports by each of the provincial/territorial public health nurses/epidemiologists. These individuals were asked for details of those ages 1 year to 20 years who were potentially vaccinated according to their provincial MCC program up to December 31, 2007 (Figure 1). The details included: year the province/territory began routine provincial MCC immunization, ages targeted including catch-up programs, changes made to the program, monovalent versus quadravalent vaccine, and annual provincial MCC estimated coverage rates. Special high-risk groups, including close contacts during outbreaks and those who purchased the vaccine privately, were not included. In the case of Alberta, the provincial mass meningococcal vaccination of 2002 was also not included because a plain polysaccharide vaccine was used. This vaccine provides only short-term protection and asymptomatic carriage is not affected.⁹

There is no Canadian national immunization registry in place (currently under development as part of the National Immunization Strategy [NIS]), and the majority of P/T were unable to provide coverage rate information. To date, no information is available on coverage rates from the National Immunization Survey 2008. To develop an estimate of national MCC coverage rates, rates reported by the BC Centre for Disease Control¹⁰ were applied to National Census data¹¹ as these rates follow a similar pattern to those presented by DeWals.⁵

Using these data, it was estimated that the total number of individuals in Canada aged 1 to 20 years who have potentially been vaccinated with MCC as of the end of 2007 is approximately 4.4 million, or 54% of the eligible population.

Figure 2. Estimated Canadian national coverage rates of individuals aged <1 year to 20 years following meningococcal serogroup C immunization programs

* Federal support made available to provinces/territories

† All regions adopt MCC program (except one)

Assuming national herd immunity will be achieved at a total coverage of at least 80% in all age groups, as was seen in the UK experience,⁶ the total time to achieve similar indirect effects in Canada using the current immunization schedules is estimated to be five more years (by the year 2014) (Figure 2).

It will take until the year 2022 for all Canadians aged 1 to 20 years to potentially be offered at least one dose of MCC vaccine, and the potential total coverage at that time would be approximately 89.6%.

DISCUSSION

In 2004 the federal government, as part of the NIS, provided to the P/T a total of \$300 million over three years towards payment for the introduction of the newer NACI-recommended vaccines, including MCC.¹² This money was insufficient to immunize the recommended target groups and it appears that it may still take a total of 12 years from the introduction of the MCC program across the country to achieve an 80% national total coverage. In contrast, the UK has shown that with a proactive approach to funding, planning, coordination, and implementation of a national immunization program, excellent long-term control of IMD could be achieved in as little as one year.¹³ Several dynamic models developed in Canada¹⁴ and the UK¹⁵ demonstrate the value of an infant immunization series used in combination with a catch-up vaccination for adolescents in gaining rapid control of IMD, and stress the importance of developing herd immunity as part of any national disease control program. Canada's disjointed regional immunization campaigns, with wide variations in catch-up programs, may leave segments of the population at increased risk of disease, with outbreak potential for an extended length of time.

The lack of a national immunization registry makes it difficult, without using regular surveys, to produce an ongoing reliable estimate of national coverage rates and herd immunity. This is not just a problem when assessing the population at risk of meningococcal disease, but also for other recent vaccine programs, such as varicella vaccine, where herd immunity is also an important part of the overall vaccine effect.

A limitation of this study is that the Canadian MCC total coverage estimates presented are extrapolated from BC provincial data that may not appropriately represent our national situation. The data estimates exclude MCC immunization administered as a response to cases of MCC disease or MCC vaccine administered privately to those not covered as part of publicly funded programs. However, these additional numbers are likely to be quite small. There is little doubt that Canada's overall MCC vaccine total coverage is substantially lower than in the UK, despite having programs in place in most regions for over five years. Comparable evidence of national herd immunity is yet to be seen.⁶ One goal of the NIS is to provide objective measures of progress and program evaluation. This would be facilitated by timely estimates of coverage rates, such as could be provided by Immunization Registries, and tracking of the proportion of the population immunized to estimate the effectiveness of these programs. In keeping with this, a summary of the current MCC immunization strategies used in Canada has been provided, along with an estimate of national total coverage and projections of when herd immunity might be achieved.

REFERENCES

1. National Advisory Committee on Immunization (NACI). Enhanced Surveillance of Invasive Meningococcal Disease in Canada: 1 January, 2004, through 31 December, 2005. *Can Commun Dis Rep* 2007;33(10):1-15.
2. National Advisory Committee on Immunization (NACI). Update on the Invasive Meningococcal Disease and Meningococcal Vaccine Conjugate Recommendations. *Can Commun Dis Rep* 2009;36(ACS3):1-40.
3. Ramsay ME, Andrews NJ, Trotter CL, Kaczmarski EB, Miller E. Herd immunity from meningococcal serogroup C conjugate vaccination in England: Database analysis. *BMJ* 2003;326(7385):365-66.
4. Miller E, Salisbury D, Ramsay M. Planning, registration, and implementation of an immunisation campaign against meningococcal serogroup C disease in the UK: A success story. *Vaccine* 2001;20(Suppl 1):S58-S67.
5. DeWals P, Deceuninck G, Boulianne N, DeSerres G. Effectiveness of a mass immunization campaign using serogroup C meningococcal conjugate vaccine. *JAMA* 2004;292(20):2491-94.
6. Bettinger J, Scheifele D, LeSaux M, Halperin S, Vaudry W, Tsang R. The influence of meningococcal serogroup C conjugate vaccine in Canada. *Pediatr Infect Dis J* 2008;28(3):220-24.
7. Siu T, Wrenzy T, Dawar M, Patrick D. The impact of routine immunization using meningococcal C conjugate vaccine on invasive meningococcal disease in British Columbia. *Can J Public Health* 2008;99(5):380-82.
8. Kinlin LM, Jamieson F, Brown E, Brown S, Rawte P, Dolman S, et al. Rapid identification of herd effects with the introduction of serogroup C meningococcal conjugate vaccine in Ontario, Canada, 2000-2006. *Vaccine* 2009;27:1735-40.

9. Stephens DS. Conquering the meningococcus. *FEMS Microbiol Rev* 2007;31(1):3-14.
10. British Columbia Centre for Disease Control. Two-year olds; grade six students; grade 12 students with up-to-date immunizations. Vancouver, BC: British Columbia Centre for Disease Control, 2008. Available at: <http://www.bccdc.org> (Accessed September 2008).
11. Statistics Canada. Age and sex, 2006 counts for both sexes, for Canada, provinces and territories - 100% data. Ottawa, ON: Statistics Canada, 2007.
12. Keelan J, Lazar H, Wilson K. The national immunization strategy: A model for resolving jurisdictional disputes in public health. *Can J Public Health* 2008;99(5):376-79.
13. Borrow R, Miller E. Long-term protection in children with meningococcal C conjugate vaccination: Lessons learned. *Expert Rev Vaccines* 2006;5(6):851-57.
14. DeWals P, Coudeville L, Trottier P, Chevat C, Erickson LJ, Nguyen V. Vaccinating adolescents against meningococcal disease in Canada: A cost-effectiveness analysis. *Vaccine* 2007;25(29):5433-40.
15. Trotter CL, Gay NJ, Edmunds WJ. Dynamic models of meningococcal carriage, disease, and the impact of serogroup C conjugate vaccination. *Am J Epidemiol* 2005;162:89-100.

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RÉSUMÉ

Depuis le lancement de l'immunisation systématique contre le méningocoque du groupe C par le vaccin conjugué au Canada en 2002, on observe d'importants écarts régionaux dans les programmes de vaccination systématique, des changements dans le calendrier vaccinal des nourrissons de certaines provinces et de grandes différences dans les programmes de rattrapage. L'immunisation étant de compétence provinciale, on a peu cherché à déterminer les taux de couverture nationaux et les effets directs et indirects des importants écarts dans les programmes de vaccination des provinces et des territoires sur l'ensemble du pays. Les campagnes de vaccination régionales disjointes du Canada exposent la population à la maladie sur une période prolongée. Au Royaume-Uni, on a prouvé qu'en abordant de façon proactive la planification, la coordination et la mise en œuvre d'un programme national d'immunisation, on peut obtenir en une seule année un excellent contrôle à long terme des méningococcies invasives dans une vaste population. Nous présentons une synthèse des stratégies d'immunisation contre le méningocoque en usage au Canada et une estimation de la couverture vaccinale globale des enfants et des adolescents.

Mots clés : immunisation; vaccin conjugué contre le méningocoque du groupe C; taux de couverture; immunité de groupe; Canada