Varicella Vaccination for Grades 4 and 5 Students

From Theory to Practice

Paul Rivest, MD, MSc^{1,3}

Lise Grenier, BA²

Guy Lonergan, MD, MSc^{1,2}

Lucie Bédard, MSc inf, MPH^{2,3}

ABSTRACT

Background: In 2002-2003, as part of a pilot project, varicella vaccination was offered to susceptible students in grades 4 and 5 in schools whose health services are provided by a local community services centre in Montréal. This immunization campaign was merged with the hepatitis B immunization programme.

Objectives: To calculate the proportion of grade 4 and 5 students susceptible to varicella; to calculate the proportion of susceptible students who agree to be vaccinated; to compare the proportion of susceptibles who agree to be vaccinated when varicella vaccination is offered with the first or the second dose of hepatitis B; and to assess whether a catch-up varicella immunization programme would affect the vaccine coverage of a concurrent hepatitis B vaccination programme.

Methods: The proportions of susceptible students and of parents of susceptibles who consented to vaccination were calculated. The proportions of parents of susceptibles who consented to vaccination were compared for both immunization strategies: varicella vaccination given with the first or second dose of hepatitis B vaccine. Logistic regression was performed to identify possible associations between consent to varicella vaccination and the various variables collected. Rates of vaccine coverage against hepatitis B after two doses were compared for the years 2000-2001 and 2002-2003.

Results: Of 3,856 registered students, 3,486 (90.4%) returned consent forms. Among the 3,272 students for whom information was available, 441 (13.5%) were susceptible, including 394 (89.3%) who consented to vaccination. The rates of vaccine coverage in the schools after two doses of hepatitis B vaccine were exactly the same for the 2000-2001 and 2002-2003 school years.

Conclusion: Varicella vaccination of susceptible grade 4 and 5 students associated with a coincident hepatitis B vaccination campaign can be performed without negative impact on the hepatitis B vaccination programme.

MeSH terms: Chickenpox; immunization; vaccination; hepatitis B; school

La traduction du résumé se trouve à la fin de l'article.

1. Institut national de santé publique du Québec, Ste-Foy, QC

2. Direction de santé publique de Montréal-Centre, Montréal, QC

3. Département de médecine sociale et préventive, Université de Montréal, Montréal

Correspondence and reprint requests: Paul Rivest, Direction de santé publique de Montréal-Centre, 1301 Sherbrooke Street East, Montréal, QC H2L 1M3, Tel: 514-528-2400, ext. 3678, Fax: 514-528-2452, E-mail: priverst@santepub-mtl.qc.ca.

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Since 1999, the National Advisory Committee on Immunization, the Canadian Pediatric Society, and the Canadian Task Force on Preventive Health Care have recommended varicella vaccination for any person 12 months of age and older who is susceptible to the disease.¹⁻³ Participants at the National Varicella Consensus Conference recommended that varicella vaccine be introduced to infants' regular immunization schedules before 2005.⁴ They also recommended that a catch-up programme for children aged one to twelve years be offered. Pending a routine varicella vaccination programme, vaccination should be offered to susceptible persons in the following groups: health care workers, teachers, individuals at risk of severe disease, and selected immunocompromised individuals.^{1,4}

In 2000, Prince Edward Island (PEI) became the first province to implement a routine publicly funded varicella immunization programme for children at 1 year of age.⁵ Alberta, Northwest Territories, Nunavut and Nova Scotia followed shortly thereafter.⁶ PEI and Alberta also included catch-up programmes for susceptible children in primary grade schools.

Mathematical modeling has demonstrated that infant immunization would greatly reduce the incidence of varicella, but would also shift the distribution of remaining cases towards an older population.⁷ Yet, the risk of complications associated with varicella disease is 10 times higher in adults than in children.⁸ Therefore, catch-up programmes are necessary to prevent children from becoming varicella-susceptible adults. These future cohorts of non-immune adults could be the source of outbreaks and could experience severe morbidity. Some of the scenarios considered for catch-up programmes are mass vaccination, vaccination of pre-adolescents in conjunction with hepatitis B vaccination in schools, vaccination when first beginning school, or a combination of all three.⁴

As of November 2004, Quebec had not yet introduced a varicella immunization programme. Therefore, during a 2002-2003 pilot project, varicella vaccination was offered to susceptible grade 4 and 5 students in schools whose health services are provided by a local community services centre (CLSC – Centre local de services communautaires) in Montréal.

The objectives of the pilot project were to calculate the proportion of grade 4 and 5 students susceptible to varicella; to calculate the proportion of susceptible students whose parents consented to varicella vaccination; to compare the proportion of susceptibles who agree to be vaccinated when varicella vaccination is offered with the first or the second dose of hepatitis B; and to assess whether a catch-up varicella immunization programme would affect the vaccine coverage of a concurrent hepatitis B vaccination programme.

METHODS

The study population was composed of grade 4 and 5 students in schools located in a Montreal CLSC district. In 1996, 132,562 people lived in this CLSC district, 27.1% of whom were born outside Canada. According to school population lists, there were close to 4,000 grade 4 and 5 students in 30 primary schools with significant multi-ethnic populations in the CLSC's district. There are four types of primary schools in Quebec: French public, English public, French private, and English private. There is an average of 300 to 400 students per school, and an average of 120 grade 4 and 5 students in each school. Hepatitis B vaccination for the 2001-2002 school year was postponed for a year because of a meningococcal vaccination campaign. Therefore, the 2002-2003 hepatitis B vaccination campaign was directed towards not only grade 4 students but also those in grade 5.

Data found in the literature indicate that between 10% and 20% of children are still varicella susceptible at age 10.⁹⁻¹¹ If the proportion of susceptible grade 4 students is estimated at 10% ($p=0.1$; $q=0.9$), a sample of 3,400 students (n) would be required to obtain a 95% confidence interval (CI) ($Z=1.96$) of 2% length ($d=0.02/2$) centered on this estimate ($n=Z^2 pq/d^2$).¹² If 50% of the parents of susceptible students consent to have their children vaccinated, a 95% CI of 10% length ($d=0.10/2$) would be obtained on the latter proportion with a sample of this size. About 30 schools were required to obtain the necessary sample.

Before the project got underway, information sessions on varicella, the vaccine and the project were conducted at the CLSC for school nurses. Project activities

were held in parallel with the hepatitis B vaccination programme. To determine whether the fact of having to provide consent for two vaccines at the same time might confuse parents and impede the success of the varicella vaccination campaign, the schools were divided into two groups. In the first-dose group, varicella vaccination was offered with the first dose of hepatitis B vaccine. At the end of September, parents received a letter explaining the project, an information flyer on varicella and the vaccine, and a questionnaire with a consent form for varicella vaccination, along with information about hepatitis B vaccination and a second consent form. Students who were varicella susceptible and whose parents consented to varicella immunization were vaccinated during the first week of November, at the same time as they were given a first dose of hepatitis B vaccine.

In the second-dose group, varicella vaccination was offered with the second dose of hepatitis B vaccine. Parents of students in this group had received, at the end of September, information about hepatitis B vaccination only and, after consent was given, the first dose of hepatitis B vaccine was administered during the last week of October. Information about varicella vaccination was distributed in mid-November. Students who were varicella susceptible and whose parents had consented to vaccination were immunized at the end of November when the second dose of hepatitis B vaccine was given to all students. Schools were not randomly assigned to each group. Each nurse was free to choose schools where varicella vaccination would be given with first dose of hepatitis B and schools where it would be given with the second dose. In 11 schools with high concentrations of multi-ethnic students (seven in the first-dose group, four in the second-dose group), nurses planned one meeting on-site at the beginning of the school year with parents who wanted to get information on the hepatitis B programme. They took advantage of this occasion to also talk about the pilot project.

We collected data about the sex, age, and country of birth of the child and the parents through the questionnaire for parents, as well as information about the history of varicella, vaccination against this disease, allergies or immunocompromising diseases.

TABLE 1
Student Characteristics

Characteristics	n (%)
Sex	
Male	1679 (49.5)
Female	1710 (50.5)
Age	
8	42 (1.3)
9	1449 (43.5)
10	1611 (48.4)
≥11	229 (6.8)
Student's place of birth	
Canada	2981 (93.8)
Outside Canada	196 (6.2)
Parents' place of birth	
Mother and father born in Canada	1947 (62.6)
1 parent born outside Canada	303 (9.7)
2 parents born outside Canada	862 (27.7)
Grade	
4 th grade	1667 (47.9)
5 th grade	1814 (52.1)
Language at school	
French	1886 (54.1)
English	1600 (45.9)
Type of school	
Public	3010 (86.3)
Private	476 (13.7)
Intervention Group	
1 st -dose group	1978 (56.7)
2 nd -dose group	1508 (43.3)
On-site intervention of the nurse	
Yes	1485 (42.6)
No	2001 (57.4)
History of varicella	
Yes	2715 (81.5)
No/don't remember	615 (18.5)
Vaccinated against varicella	
Yes	255 (8.9)
No	2599 (91.1)
Susceptibles	
Yes	441 (13.5)
No	2831 (86.5)
Total*	3486 (100)

* Numbers do not always add up to the totals since data for some variables may be missing.

A student was defined as susceptible and eligible for inclusion in the final analysis if the parent answered *no* or *we don't remember* to the question *Has your child ever had chickenpox?* and *no* to the question *Have you ever had your child vaccinated against chickenpox?* A student was defined as not susceptible and eligible for inclusion in the final analysis if the parent had answered *yes* to at least one of the above questions. In cases where information was inconsistent (for example, previous history of varicella and consent given for vaccination) or missing, or if there was no signed consent form, the school nurse attempted to reach one of the parents by phone or letter to make the necessary corrections.

Data collected were entered into a Microsoft Access version 97 database, and statistical analyses were performed using SPSS, version 10.1. We used normal approximation to binomial to calculate confidence interval on proportions. The

TABLE II
Number (%) of Susceptible Students
According to Different Variables

Characteristics	n (%)
Sex	
Male	248 (15.6)
Female	190 (11.7)*
Age	
≤9	184 (12.9)
≥10	254 (14.5)
Student's place of birth	
Canada	371 (12.8)
Outside Canada	61 (33.3)†
Parents' place of birth	
Mother and father born in Canada	197 (10.3)
1 parent born outside Canada	42 (14.2)
2 parents born outside Canada	181 (22.1)‡
Language at school	
French	279 (15.8)
English	162 (10.7)§
Type of school	
Public	395 (14.0)
Private	46 (10.2)
Intervention group	
1 st -dose group	268 (14.3)
2 nd -dose group	173 (12.4)
On-site intervention of the nurse	
Yes	200 (14.5)
No	241 (12.8)
Total¶	441 (13.5)

* p=0.001

† p<0.001

‡ p<0.001

§ p<0.001

|| p=0.03

¶ Numbers do not always add up to the totals since data for some variables may be missing.

Mann-Whitney's U test was used to compare the continuous variables, and the Pearson χ^2 test to compare discrete variables.¹² We used the stepwise logistic regression selection procedure at a high level (15%) on the covariates that could capture the differences between the two intervention groups (sex, age, student's place of birth, parents' place of birth, language at school, type of school, and the nurses' on-site intervention). Intervention group membership was then tested for inclusion in this model with Wald statistic test.

The success of catch-up varicella vaccination was assessed by calculating the proportion of susceptibles who were vaccinated. The effects of this campaign on the hepatitis B immunization programme were evaluated by comparing rates of vaccine coverage after the two doses, received in 2000-2001 and 2002-2003.

RESULTS

Of the 3,856 students registered, 3,486 (90.4%) returned consent forms – 1,667 in grade 4, and 1,814 in grade 5; no grade

TABLE III
Number (%) of Students Who Consented to Vaccination According to Different Variables

Characteristics	n (%)
Sex	
Male	217 (87.5)
Female	174 (91.6)*
Age	
≤9	169 (91.8)
≥10	223 (87.8)*
Student's place of birth	
Canada	332 (89.5)
Outside Canada	54 (88.5)*
Parents' place of birth	
Mother and father born in Canada	170 (86.3)
1 parent born outside Canada	39 (92.9)
2 parents born outside Canada	167 (92.3)*
Language at school	
French	246 (88.2)
English	148 (91.4)*
Type of school	
Public	355 (89.9)
Private	39 (84.8)*
Intervention group	
1 st -dose group	240 (89.6)
2 nd -dose group	154 (89.0)*
On-site intervention of the nurse	
Yes	181 (90.5)
No	213 (88.4)*
Total†	394 (89.3)

* p>0.10

† Numbers do not always add up to the totals since data for some variables may be missing.

was indicated for 5 students. Information on history of vaccination was missing on 492 (14.1%) questionnaires returned (among these, 427 had had varicella), while information on history of varicella was missing on 16 (0.5%) (among these, 7 had been vaccinated). Neither question was answered on 140 questionnaires (4.0%).

Student characteristics are presented in Table I. Of the mothers born outside Canada, 26.8% were from North Africa or the Middle East, 16.0% from the Indian sub-continent, and 13.3% from the Caribbean.

Among the 3,330 students for whom information was available, 2,715 (81.5%, 95% CI: 80.2-82.8%) had had varicella disease and 436 (13.1%) had not. In addition, 179 parents (5.4%) could not remember. Of the students born in temperate countries (Canada, the United States or Europe), 82.6% (95% CI: 81.2-83.9%) reported a history of varicella disease compared with 56.2% (95% CI: 49.2-63.2%) for students born elsewhere (p<0.001).

Of the 3,272 students for whom history of varicella disease and varicella vaccination was available, 441 (13.5%, 95% CI: 12.3-

14.6%) were considered susceptible (Table II). Among the latter, 394 (89.3%, 95% CI: 86.5-92.2%) consented to vaccination, 43 (9.8%) refused, and 4 (0.9%) did not answer (Table III). A total of 384 students were vaccinated. The proportion of susceptible students who consented to vaccination was comparable in both intervention groups. Only 11 parents out of 43 who did not consent to varicella vaccination for their child gave a reason: uncertainty about their child already having had varicella (n=4), need to get their paediatrician's advice (n=3), did not want their child receiving two vaccines the same day (n=2), pregnant mother (n=1), belief that the vaccine gives the disease (n=1). Although the occurrence of adverse events was not systematically verified for each student who received varicella vaccine, none was reported by school nurses.

In a logistic regression model among susceptible students, only parents' place of birth was associated with consent to vaccination. Susceptible students whose parents were both born in Canada were 2.02 (95% CI: 1.05-3.87, p=0.035) times more likely to refuse vaccination than students who had at least one parent born outside Canada. When it was included in a model with parents' place of birth, intervention group was not statistically associated with consent to vaccination (p=0.85).

The rates of vaccine coverage in the schools after two doses of hepatitis B vaccine were exactly the same for the two years compared: 92.7%. In 2000-2001, the rate for schools in the first-dose group was 92.2% compared with 93.3% for schools in the second-dose group (p=0.78). For the 2002-2003 school year, schools in the first-dose group had a rate of 91.2% compared to 94.6% for schools in the second-dose group (p=0.69).

DISCUSSION

Our study determined that just over 10% of grade 4 and 5 students in this specific area of Montréal reported they were not protected against varicella. Among these susceptible students, almost 90% have received the vaccine, whether consent to receive varicella vaccination was given at the same time as that for hepatitis B or given on its own before the second dose of hepatitis B vaccination. The entire process

occurred without negative impact on the vaccine coverage of a concurrent hepatitis B vaccination programme.

We found that susceptible students whose parents were both born in Canada were twice as likely to refuse vaccination than students who had at least one parent born outside Canada. It is possible that the arguments of groups against vaccination have not had as much of an effect on recent immigrant populations, which would explain the lower proportion of parents, in this group, who refuse vaccination. However, this hypothesis needs to be confirmed. Recent studies that assessed factors influencing uptake of varicella vaccine did not look at the effect of ethnicity or immigration status on demand for the vaccine.¹³⁻¹⁶

The non-random choice of the intervention site and non-random composition of the intervention groups could restrict the generalizability of our conclusions. Choosing a CLSC that is highly involved in immunization programmes might have had a positive effect on the results. Although both intervention groups differed in several ways (the second-dose group included more girls, more parents born in Canada, more students attending school where French is the language used, and more students attending a private school), the similarity of vaccine coverage against hepatitis B during previous years leads us to think that these differences had little impact on the results.

In our study, the 384 students who were vaccinated represented 10.0% of the 3,856 registered students, and 87.1% of the 441 susceptible students. In a similar intervention conducted in 2000 in Prince Edward Island, 550 (13.6%) of the 4,053 grade 4 and 5 students received the vaccine.⁵ The number of susceptible students was not known since parents were instructed not to respond if they did not wish to have their children vaccinated. The authors estimated that 26% of grade 4 and 18% of grade 5 students were susceptible and that, consequently, there were approximately 891 susceptible students in these two grades. If all children who were vaccinated were susceptible, they would then represent 61.7% of the estimated total number of susceptible children.

A five-year catch-up programme should be implemented concurrent with a universal programme. It should have two compo-

nents: the first at age 5 when a child first starts school and at which time a DPT-Polio booster is due; and a second during pre-adolescence, around age 10. In a province like Quebec, where hepatitis B vaccine is given in grade 4 and where the last booster dose between the ages of 14 and 16 is not offered systematically in all schools, a varicella vaccine catch-up programme combined with hepatitis B immunization programmes in schools could be beneficial.^{4,17} Our project has demonstrated that this type of catch-up programme can be carried out and that parents of susceptible children respond favourably.

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RÉSUMÉ

Contexte : En 2002-2003, la vaccination contre la varicelle a été offerte aux élèves susceptibles de 4^e et de 5^e année des écoles situées sur le territoire d'un centre local de services communautaires de Montréal. Cette campagne de vaccination était intégrée au programme de vaccination contre l'hépatite B.

Objectifs : 1) Calculer la proportion d'élèves de 4^e et de 5^e année sensibles à la varicelle; 2) calculer la proportion d'élèves sensibles qui acceptent d'être vaccinés; 3) comparer la proportion d'élèves sensibles qui acceptent d'être vaccinés en fonction du moment où est offerte la vaccination contre la varicelle; et 4) évaluer l'effet d'une campagne de rattrapage pour la varicelle sur le taux de couverture vaccinale du programme régulier de vaccination contre l'hépatite B.

Méthode : La proportion d'enfants sensibles et la proportion de parents d'enfants sensibles qui ont consenti à la vaccination ont été calculées. Les proportions de parents d'élèves sensibles ayant consenti à la vaccination ont été comparées en fonction des deux stratégies de vaccination : l'administration du vaccin contre la varicelle soit avec la première, soit avec la seconde dose du vaccin contre l'hépatite B. Par régression logistique, nous avons cerné les associations possibles entre le consentement à la vaccination contre la varicelle et les différentes variables recueillies. Le taux de couverture vaccinale contre l'hépatite B après deux doses a été comparé pour les années 2000-2001 et 2002-2003.

Résultats : Sur 3 856 élèves inscrits, 3 486 (90,4 %) ont retourné un formulaire de consentement. Parmi les 3 272 élèves pour lesquels l'information était disponible, 441 (13,5 %) étaient sensibles. Parmi eux, 394 (89,3 %) ont consenti à la vaccination. La proportion d'élèves sensibles et la proportion d'élèves sensibles ayant consenti à la vaccination étaient comparables dans les deux groupes d'intervention.

Conclusion : Une vaccination contre la varicelle des élèves sensibles de 4^e et de 5^e année en association avec la campagne de vaccination contre l'hépatite B peut se faire sans impact négatif sur la campagne de vaccination contre l'hépatite B.