Human papillomavirus vaccine uptake in boys and girls in a school-based vaccine delivery program in Prince Edward Island, Canada

Carol A. McClure*, Mary-Ann MacSwain, Heather Morrison, Carolyn J. Sanford

Chief Public Health Office, Department of Health and Wellness, Government of Prince Edward Island, 16 Fitzroy Street, 2nd Floor Sullivan Building, Charlottetown, PE, Canada C1A 7N8

ARTICLE INFO

Article history:
Received 4 November 2014
Received in revised form 10 February 2015
Accepted 17 February 2015
Available online 27 February 2015

Keywords:
Human papillomavirus
HPV
HPV vaccination
Uptake
School-based
Public Health Nursing

ABSTRACT

Background: In 2013, Prince Edward Island was the first province to introduce HPV vaccine universally to grade six boys in a school-based program. Because uptake rates in boys are unknown in this type of vaccination program, uptake of HPV vaccination in boys was measured and compared with uptake rates in girls and then analyzed with factors such as county, urban–rural location of the school, and school board to identify where the vaccine program could be improved.

Methods: HPV vaccination records from the provincial childhood immunization registry in PEI were merged with Department of Education data containing all grade six girls and boys in PEI. Vaccine uptakes between years and between sexes were compared using two sample tests of proportions. Logistic regression modeling which accounted for the hierarchical nature of the data was used to analyze associations between factors and uptake rates.

Results: Although uptake was high in boys and girls, a significantly greater proportion of girls (85%) received all three doses of the HPV vaccine compared to boys (79%; p = 0.004). The odds of grade six girls being fully vaccinated for HPV were 1.5 times greater than that of grade six boys, and the odds of students in the English Language School Board receiving all three doses were more than twice as great as the odds of French Language School Board students.

Conclusions: HPV vaccination for boys in PEI has had a successful launch, almost reaching the Canadian Immunization Committee recommendations of >80% for the early years of a program. PEI has a highly organized Public Health Nursing program that is involved in all childhood and school-based vaccinations in PEI and in this context very high coverage rates were obtained. Areas to target for improving uptake include the boys and the students in the French Language School Board.

© 2015 The Authors. Published by Elsevier Ltd. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).

1. Introduction

The World Health Organization recognizes human papillomavirus (HPV) as the most common sexually transmitted infection in the world [1]. Although cervical cancer is the most common cancer caused by HPV, other cancers associated with HPV infection are squamous cell carcinomas of the anus, vagina, vulva, penis, and the oropharynx (the base of the tongue, the tonsil, and pharynx) [2]. Approximately 43–88% of these different anogenital cancers worldwide and 56% of oral cancers in North America are associated with HPV infection [3–5]. In addition, HPV (mainly types 6 and 11) cause warts in the anogenital areas including the anus, penis, vagina, and vulva [6]. Genital warts are common having an annual incidence between 1 and 2 cases per 1000 people in North America [7]. They are highly infectious and cause significant direct health care costs as well as indirect costs including psychosocial harm [8–10]. Although rare, recurrent respiratory papillomatosis is also caused by HPV [11].

In the fall of 2008 an HPV vaccination program was initiated in grade 6 girls in Prince Edward Island (PEI)¹, Canada. In February 2010, Health Canada approved the use of the quadrivalent HPV vaccine in boys aged 9–12. By January 2012, the National Advisory Committee on Immunization (NACI) [see footnote 1] recommended

* Corresponding author. Tel.: +1 902 368 5101; fax: +1 902 620 3354.
E-mail addresses: cmcclure@his.org (C.A. McClure), mamacswain@his.org (M.-A. MacSwain), cjsanford@gov.pe.ca (C.J. Sanford).

¹ Abbreviations: Prince Edward Island (PEI), National Advisory Committee on Immunization (NACI).

http://dx.doi.org/10.1016/j.vaccine.2015.02.047
0264-410X/© 2015 The Authors. Published by Elsevier Ltd. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).
the use of HPV vaccine to protect males against intraepithelial neoplasia, anal cancer and anogenital warts [12]. In 2013, PEI was the first province to introduce HPV vaccine universally to boys in grade 6. In 2014, Alberta added boys to their HPV vaccination program [13].

Increasing the proportion of the population that is vaccinated will decrease the risk of individuals becoming infected either directly or indirectly from the herd effect [6,14]. This is a major aim of a successful vaccination program. Unfortunately, vaccination uptake by boys in the United States has been quite variable and not very high [15–18]. Quantification of the uptake of HPV vaccines in both boys and girls in PEI is necessary to ensure successful delivery of the school-based program.

The aims of this study were two fold. The first aim was to measure the uptake of HPV vaccination in boys after the first year of the universal school-based program. The second aim was to determine if there were any changes in the girls' recent uptake rate relative to previous years. Additionally, the relationships between HPV vaccination and factors such as county, urban–rural location of the school, and school board were analyzed to identify areas where the vaccine program could be improved.

2. Methods

2.1. Description of vaccine program and student status

The PEI HPV vaccine program is a school-based program that is administered by Public Health Nursing and covers all grade six girls and boys. A specific Public Health Nurse is assigned to every school in PEI. Prior to vaccine delivery, an information package that includes a parental consent form, a fact sheet, and a Question and Answer document is sent home with students. The consent must be signed and returned to Public Health prior to the immunization date. If consent forms are not returned prior to the date of vaccine delivery or if consent has been refused, a public health nurse will phone the parent or guardian to discuss the HPV immunization and answer questions. At the end of the phone call, parents may give consent or a refusal. The three doses of vaccine are administered by the school Public Health Nurse and additional Public Health Nurses as deemed necessary based on the grade 6 population. Students are immunized by class, both boys and girls together using the NACI recommended schedule [19]. All three doses are required to be considered fully immunized.

2.2. Data collation and analyses

An extract of HPV vaccination records from September 1, 2013 to September 2, 2014 were received from the provincial childhood immunization registry in PEI. These records were merged with a dataset provided by the Department of Education containing all grade 6 girls and boys in PEI for the 2013–2014 school year, using a minimum of two common identifiers. In cases where a student’s record was found to be incomplete, vaccination records were individually reviewed, and where possible data were extracted manually. Students were not counted in the analysis if there was evidence to show a student had moved, received HPV vaccine doses in another province or a previous school year, or refused the vaccine for legitimate medical reasons. Vaccine uptake rates in girls from previous school years (2008–2009, 2011–2012, and 2012–2013) were calculated similarly with the exception of the 2008–2009 school year in which only the number of grade 6 girls attending all PEI schools was provided as a denominator for the uptake rate. Vaccine uptake rates between years and between sexes were compared using two sample tests of proportions.

Unconditional associations between predictors and the outcome (fully immunized or not) were tested using chi square analysis, and those with a p-value <0.20 were retained for investigation in the multivariable model. A logistic regression model was used which accounted for the hierarchical nature of the data (students clustered in schools, schools clustered in school boards) by controlling for clustering of individual schools using robust standard errors and using school board as a fixed effect. This model was repeated two more times using vaccine initiation (≥1 dose) and receipt of 2 or more doses as the outcome measure. All analyses were conducted using Stata 13.1 [20].

3. Results

Of the 1443 students registered in the school system, 1349 (93%) records merged with the immunization database. Of the remaining 94 (7%) unmerged records, 50 had data entry issues and eventually merged while the remaining 44 (3%) records did not have a corresponding record in the immunization database. Three records were excluded from the analysis because the vaccine was refused for legitimate medical reasons or the student had moved in or out of the province during the school year. The final 2013–2014 grade 6 cohort consisted of 725 boys and 715 girls. Of these students, 242 (17%) received at least one dose outside of the school vaccination clinic. Thirty-eight (3%) had an indication that they had missed a school clinic or that they needed to make an appointment with Public Health Nursing for their vaccine but failed to get their final dose.

Although uptake was high in boys and girls, a significantly greater proportion of girls (85%) received all three doses of the HPV vaccine compared to boys (79%; p=0.004). The proportion of grade 6 girls who received all three doses for HPV vaccine has increased significantly since the start of the program, from 81% in the 2008–2009 school year, to 85% in the 2013–2014 school year (p<0.03) (Table 1). The pattern of uptake is similar across the years with the decrease in the number of students between the second and third dose larger than the decrease in number of students between the first and second dose.

Results of unconditional associations between complete immunization status and predictors are displayed in Table 2. Sex of the student and school board were included in a multivariable logistic model which controlled for clustering by individual schools (n=43) using robust standard errors. Both sex and school board significantly predicted immunization status (Table 3). More specifically, the odds of grade 6 girls being fully vaccinated for HPV were 1.5 times greater than of grade 6 boys (OR=1.50, 95% CI 1.14–1.98).

<table>
<thead>
<tr>
<th>Table 1</th>
<th>HPV vaccine dose uptake by school year and sex.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Girls (n=801)</td>
<td>Girls (n=731)</td>
</tr>
<tr>
<td></td>
<td>%</td>
</tr>
<tr>
<td>One dose</td>
<td>87.6</td>
</tr>
<tr>
<td>Two doses</td>
<td>84.9</td>
</tr>
<tr>
<td>Three doses</td>
<td>81.1</td>
</tr>
</tbody>
</table>
Additionally, the odds of students in the English Language School Board receiving all three doses were more than twice as great as the odds of French Language School Board students (OR = 2.14, 95% CI 1.25–3.66). Results of modeling using ≥1 dose and ≥2 doses as the outcomes were similar to using complete vaccination status (data not shown).

### 4. Discussion

To our knowledge, this is the first report of HPV vaccine uptake for boys in a school-based program. Boys had a successful first year and their uptake is comparable to the results of the girls in 2008–2009 when their program was initiated. Historically PEI has had good uptake for HPV vaccine in girls. Rates of HPV uptake for girls across Canada vary greatly. The Canadian Immunization Committee have set a benchmark of ≥80% fully vaccinated in the early years of the program [21]. Uptake of HPV vaccine in girls appears to be lower in Ontario and westward compared with Quebec and the Atlantic provinces [22,23]. Various surveys, including sentinel sites, have been conducted in the United States and have demonstrated uptake of HPV vaccine in boys (≥1 dose) to vary between 6.8% and 20% [15–18]. PEI is fortunate to have a public-health delivered immunization program which has seen much success in the implementation of new vaccines in the province [24]. Having specific nurses assigned to individual schools in PEI works well in building relationships and trust between the teachers and administration at the schools and to some extent the parents. In addition to school-based immunizations, these nurses are the primary point of contact for any health-related issues that may come up at the school such as disease follow-up, contact tracing or reporting of school outbreaks. The nurses also build rapport with the school population by training teachers, parents and volunteers how to conduct school-wide head checks for lice detection and prevention. Having dedicated public health nurses assigned to school-based programs also increases parental engagement and satisfaction and is associated with an increased likelihood of HPV vaccine initiation and completion [25]. Using the public health nurses to deliver the HPV vaccination program in schools is likely one reason for the high acceptance and completion rates of HPV vaccination in both boys and girls.

The trend in uptake starts with a very high rate of students receiving the initial dose. A slight decrease in rate is seen for the second dose and a larger drop occurs for the third dose. It is possible that this lag for the third dose is due to logistical issues as 3% of the students in 2013–2014 school year did not get their final dose even though they had at least one vaccine and had a comment about missing the school clinic or needing to make an appointment for the vaccine. Students have three opportunities to be immunized within their school setting. If they miss the first dose, then there are two more opportunities to be immunized at school. After that, the student would be required to make an appointment for the third and final immunization at a Public Health Nursing office and that could present a barrier for some. This similar trend of attrition is found in girls in other Atlantic provinces for almost all of the years of vaccination [26,27] which further supports a logistical barrier to receiving a third dose if it is not possible to receive the vaccine at school where it is highly convenient.

Although 79% of grade six boys had received three doses of HPV vaccine, they were significantly less likely to be immunized than the girls (85%). This significant difference was found when the outcome was 1 dose, 2 doses, or fully immunized in the model and therefore was a difference in terms of intention to vaccinate. Having lower rates in boys than girls is consistent with multiple jurisdictions in the United States [15,17,28]. In these studies, none of the adolescent boy groups achieved an initiation rate higher than 21% whilst the vaccine initiation rate in the adolescent girl groups ranged from 27% to 57%. Public health and the media have focused much of the HPV vaccine campaigns on girls [29] with particular attention to the prevention of cervical cancer [6]. There is growing evidence and greater information available regarding other HPV associated cancers and genital warts and in time the importance and awareness surrounding the need for this vaccine in boys should improve [30]. As the vaccine program is new for boys, it is possible that the 85% initiation rate will increase over time similar to the girls program which started with an 88% initiation rate in 2008, and had a 91% initiation rate in 2013.

There was a significant difference between the English and French Language School Boards with students from the French Language School Board being less likely to be immunized. This significant difference was found when the outcome was ≥1 dose, ≥2 doses, or fully immunized in the model and therefore was a difference in terms of intention to vaccinate. Materials and consents are provided to the schools in the appropriate language and follow-up contact from a public health nurse is also conducted in the appropriate language reducing the chance of unequal programs. Returned consent forms and follow-up reminder calls by public health nurses were found to have a significant relationship with HPV vaccine initiation based on a survey from Nova Scotia, Canada of their school-based HPV program for girls [25].

Although the characteristics of families who attend French Language School Board schools are unknown, it is possible that there may be differences in parental education levels, household income, culture, and religion compared with families in the English Language School Board. These differences might account for some of the difference seen between the two school boards. Higher levels of education of the parents or guardians have the potential to decrease the likelihood of HPV vaccination [30,31]. It has also been suggested that this difference in HPV uptake is not unique to the HPV vaccine. This is something that we are currently investigating to ascertain whether the immunization uptake for all publicly funded vaccines are lower in the French versus English language schools.
The school-based program is administered to grade 6 boys and girls who are mostly 11–12 years old. Parental consent is required and parental beliefs are likely a fundamental limiting factor in uptake rates. Several studies have looked at parental acceptability for HPV vaccination in boys [2,29,32]. In the United States, it has been shown that HPV vaccination recommendation from a healthcare provider is the key to having boys vaccinated [2]. Feeling that HPV vaccine was not needed, no provider recommendation, lack of knowledge, son not sexually active, male, and safety and side effects (in that order) were the main reasons given for not opting to vaccinate [2]. To address these parental concerns, the HPV vaccination program administered by PEI Public Health Nursing, outlines the benefits of the vaccine and any safety and side effects issues. The program also offers an opportunity for parents to ask questions to a public health nurse if they feel that their child should not be vaccinated. All components of this education were found to have a positive relationship with HPV vaccine initiation and completion for girls in a school-based survey in Canada [25]. A survey from the United States demonstrated that only 54% of parents intended to vaccinate their boys against HPV even when there were no transportation or financial barriers [30]. Those decisions were made based on perceived benefit of HPV vaccine, general benefit of immunizations, and spousal agreement.

The main strength of this prevalence study is that it is a census study which included all children attending public schools in PEI in grade 6. Individual vaccine records were accessible if there were suspected data entry errors. It is estimated that only 25 additional children of the appropriate age attend private school or are home-schooled. They are not included in the analysis as it was not possible to acquire their identifiable health information. One weakness of the study was that there were only a small number of students who attended schools in the French Language School Board (5.2%). This study was able to identify that boys and students attending schools in the French Language School Board were at higher risk of not being fully vaccinated for HPV. This fact will allow for a review of the vaccine program with specific aims to increase uptake in these groups. However, the reasons why these groups had lower uptakes were not determined. If attempts to increase uptake in these two groups are not successful, perhaps group discussions led by public health with parents of unvaccinated boys and unvaccinated children in the French Language School Board may be beneficial in determining the knowledge gaps or hesitancy around the vaccine.

5. Conclusions

HPV vaccination for boys in PEI has had a successful launch. With improved programming, uptake of vaccination in the boys should surpass the recommendations of >80% in the early years of the program. PEI has a highly organized Public Health Nursing program that is involved in all childhood and school-based vaccinations in PEI. Opportunities to speak with nurses educated in HPV vaccination likely contributed to increased uptake and will continue. Investigation into ways of improving uptake will continue as well. In addition, program evaluation should continue to monitor changing incidence of HPV associated conditions.

PEI, similar to other provinces, will be considering a two-dose HPV vaccination program in the future. If this significant change is made, increased uptake for grade 6 children may be realized.

Conflict of interest statement

There are no conflicts of interest declared by any of the authors.

Acknowledgements

The authors wish to thank the PEI Public Health Nursing nurses and staff responsible for administering the HPV vaccination program for their valuable input. In addition, we would also like to express our gratitude to Sara Townsend and Sherri-Lynn Lavery for their help with data validation. Dr. Lamont Sweet, Dr. Mitch Zelman, and Anne Neatby are graciously acknowledged for their contributions in the development of vaccination programs in PEI.

References


Contributions to the study

Initial concept: HM, CS. Study design: CM, MM, CS. Data collection and data preparation: MM. Analysis: CM, MM, CS. Interpretation of results: CM, MM, CS. Wrote the manuscript: CM, MM, CS. Critically reviewed the manuscript: all authors.