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# BMJ Open

## Investigating Canadian parents' HPV vaccine knowledge, attitudes, and behaviour: A study protocol for a longitudinal national online survey

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## Investigating Canadian parents' HPV vaccine knowledge, attitudes, and behaviour: A study protocol for a longitudinal national online survey

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**Word Count:** 4,101

## ABSTRACT

**Introduction:** Human papillomavirus (HPV), a sexually transmitted infection, can cause anogenital warts and a number of cancers. To prevent morbidity and mortality, three vaccines have been licensed and are recommended by Canada's National Advisory Committee on Immunization (for females since 2007 and males since 2012). Nevertheless, HPV vaccine coverage in Canada remains suboptimal in many regions. This study will be the first to concurrently examine the correlates of HPV vaccine decision-making in parents of school-aged girls and boys, and evaluate changes in parental knowledge, attitudes and behaviours over time.

**Methods and analysis:** Using a national, online survey utilizing theoretically driven constructs and validated measures, this study will identify HPV vaccine coverage rates and correlates of vaccine decision-making in Canada at two time points (August-September, 2016; and June-July, 2017). 4606 participants will be recruited to participate in an online survey through a market research and polling firm using email invitations. Data cleaning methods will identify inattentive or unmotivated participants.

**Ethics and dissemination:** The study received research ethics board approval from the Research Review Office, Integrated Health and Social Services University Network for West-Central Montreal (CODIM-FLP-16-219). The study will adopt a multi-modal approach to disseminate the study's findings to researchers, clinicians, cancer and immunization organizations, and the public in Canada and internationally.

**Discussion:** This study will elucidate the factors that influence Canadian parents to vaccinate their sons or daughters. The results will provide public health officials with critical information about HPV vaccination programs, improve the fields' understanding of influencers of decision-making, improve and enhance the delivery of current publicly funded HPV vaccination program, facilitate HPV vaccine uptake, and in turn decrease Canada's cancer burden and the associated human and economic cost.

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**KEYWORDS**

Attitudes, behaviour, Canada, cancer prevention, decision-making, human papillomavirus, knowledge, sexually transmitted infections, parents, vaccination.

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## ARTICLE SUMMARY

### Article Focus:

- To explore the psychosocial factors that influence parents to vaccinate their sons or daughters with the HPV vaccine, and evaluate changes in parental vaccine knowledge, attitudes and behaviours over time.

### Key Messages:

- The oncogenic protection offered by the human papillomavirus (HPV) vaccines has been recognized. However, HPV vaccination programs in Canada are not reaching their target rates of immunization and vary considerably by region. Determining HPV vaccine coverage and understanding why parents are choosing not to vaccinate their children are research priorities of the National Advisory Committee on Immunization and Canadian Immunization Committee.
- This project aims to examine the psychosocial and behavioural factors associated with parents' decisions to consent to their child receiving the HPV vaccine. Specifically, this research will describe HPV vaccine coverage in boys and girls; assess the correlates of HPV vaccination in parents of boys and girls; identify parents' stage of decision-making by gender and region; and determine the impact of publicly funded HPV vaccine program initiation for boys on parents' HPV vaccine attitudes and knowledge.
- The findings of this research will have implications for the development of tailored and targeted interventions, program delivery including closing disparities in vaccination, and improving the field's theoretical understanding of vaccine decision making.

### Strengths and limitations of this study:

- Strengths of the study include a large sample size (n=4606), a nationally representative sample, use of psychometrically validated scales, the use of theoretical frameworks, a mixed methods approach, a wider range of constructs than in previous studies, and sophisticated data cleaning techniques to exclude inattentive or unmotivated responders.
- Limitations of this study include the reliance on self-reported data.

## INTRODUCTION

Human papillomavirus (HPV) is the most common sexually transmitted infection.<sup>1-4</sup> While most HPV infections are asymptomatic and do not progress to disease,<sup>5-7</sup> some infections can cause substantial morbidity and mortality.<sup>8-11</sup> It is estimated that 5.2% of all worldwide cancers are attributable to HPV.<sup>11-13</sup> HPV-associated cancers include cervical, oropharyngeal, anal, vaginal, vulvar, and penile.<sup>9 11</sup> Combined, HPV is responsible for over 4,000 new cancer cases annually in Canada.<sup>9</sup> Certain strains of HPV (e.g. HPV 6/11) also cause anogenital warts.<sup>14</sup> HPV-associated disease can impact quality of life and accrue substantial costs to the health care system.<sup>9 10 15</sup>

Three prophylactic vaccines that prevent against the oncogenic strains of HPV have been developed and recommended: the bivalent Cervarix<sup>®</sup>, quadrivalent Gardasil<sup>®</sup>, and nonavalent Gardasil<sup>®</sup>9.<sup>16</sup> These vaccines are safe and effective.<sup>17-23</sup> Canada's National Advisory Committee on Immunization (NACI) has recommended the HPV vaccines for females (since 2007) and males (since 2012) ages 9 to 26.<sup>16 2</sup> From 2007 to 2010, all Canadian provinces and territories implemented publicly funded, school-based vaccination programs for females, albeit at different ages (i.e. 9 to 13 years of age) and with different dosing schedules (i.e. two or three doses).<sup>24 25</sup> Vaccinating children at this age provides the highest level of immunogenicity and protects individuals before they are sexually active and thereby at risk of infection.<sup>9 20</sup> This approach is similar to the majority of countries that provide publicly funded HPV vaccination programs to females.<sup>26</sup>

To date, only a handful of countries have extended their publicly funded, school-based HPV vaccination programs to males.<sup>27 25 28</sup> Canada has been an international leader in providing gender-neutral HPV vaccination,<sup>25</sup> by September 2017, 10 of Canada's 13 regions will have commenced school-based HPV vaccination programs that include boys (Figure 1).<sup>29-36</sup> However, implementation of male HPV vaccination across Canada has been staggered, presenting a natural experiment to evaluate and compare the impact of the introduction of the HPV program on parents' attitudes, knowledge, and vaccine coverage.

Achieving high levels of vaccine coverage protects individuals and helps prevent transmission to unvaccinated partners, which maximizes population-level effectiveness (i.e. through herd protection).<sup>37</sup> HPV vaccination programs in Canada are not reaching their target

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3 rates of immunization.<sup>38 39</sup> HPV vaccine uptake rates in Canada vary considerably by region; in  
4 a national survey of parents of 12-14 year old girls, Gilbert et al. reported vaccination rates  
5 between 52.6% and 89.7% (2013 data).<sup>40</sup> On average, HPV vaccine uptake across Canada was  
6 72.3%.<sup>40</sup> Preliminary evidence for boys in P.E.I.'s school-based vaccination program indicates  
7 85.4% vaccine uptake (2013/2014 data).<sup>29</sup> However, a national survey of Canadian parents  
8 found uptake rates for boys in the context of (only one then two) publicly funded school-based  
9 programs, was extremely low (<3% nationwide; 2013 data).<sup>41</sup> The lack of a national  
10 immunization registry makes it difficult to compare HPV vaccine coverage rates, and no national  
11 survey has yet examined HPV vaccine coverage in boys and girls simultaneously.

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Given that parental consent is required for school-based immunisation programs for children in Canada, the NACI and Canadian Immunization Committee (CIC)<sup>9 24</sup> have made it a research priority to understand why parents delay or refuse to vaccinate their children. Accordingly, this study seeks to understand the sociodemographic, psychosocial, and behavioural correlates of HPV vaccine coverage. Over the last decade, a number of studies have identified factors associated with HPV vaccination decision making including demographics, knowledge, attitudes, social norms, logistics (e.g. time, effort), and cost.<sup>42-53</sup> The evidence has indicated some common themes (e.g. the importance of physician recommendation, perceived benefit, perceived safety, cost), and some contradictory evidence (e.g. knowledge has been found to correlate both negatively and positively with vaccine acceptance).<sup>48 49 54</sup> The degree to which each of these factors contributes (i.e. the effect size) and possible policy variations between jurisdictions remains largely unclear. In addition, despite several systematic reviews,<sup>48 49 51 53 55</sup> not all potentially relevant factors (e.g. the effect of vaccine conspiracy beliefs) have been identified or comprehensively investigated in large population-based studies, especially in the Canadian context.<sup>56</sup> Furthermore, the majority of studies addressing parental HPV vaccine decision-making have been primarily focused on parents of females,<sup>40 57</sup> with fewer studies evaluating and making comparisons with parental HPV vaccine decision-making for boys.<sup>58-60</sup>

The present study aims to address these research gaps. Using a national, online survey utilizing theoretically driven constructs and validated questionnaires, this study identifies HPV vaccine coverage and correlates of decision-making in Canada. It will be the first to study concurrently the correlates of decision-making in parents of eligible school-aged boys and girls. This study will administer a survey at two time points (August-September, 2016; and June-July,



2017) to capture important factors related to HPV vaccine hesitancy, acceptance and variation over time. Accordingly, this study will elucidate psychosocial factors that influence parents to vaccinate their sons or daughters contemporaneously and evaluate changes in parental knowledge, attitudes and behaviours over time.

## Study Objectives and Hypotheses

The main objectives of this study are:

### 1. *To describe HPV vaccine coverage in Canadian boys and girls*

In the absence of a national immunization registry,<sup>61</sup> current information on HPV vaccine coverage is unclear and continually evolving. We aim to determine HPV vaccine coverage in boys and girls nationally and across Canadian jurisdiction, and how rates change over time.

### 2. *To assess the correlates of HPV vaccination in parents of boys and girls*

In order to improve programs, it is important to understand the factors associated with HPV vaccine uptake. To date, Canadian studies have assessed the correlates of HPV vaccine uptake in parents of girls and parents of boys separately.<sup>52 58</sup> Because the HPV vaccine is available to girls and boys, we aim to understand the determinants of HPV vaccine uptake in both these groups, using constructs from the Health Belief Model (HBM), a commonly used theoretical model that includes core beliefs that are hypothesized to predict the adoption of new health behaviours.<sup>62</sup> The HBM has been used to examine various health-related behaviours, including cancer prevention and vaccination.<sup>63 64</sup> As applied to HPV vaccination, elements of the HBM include perceived benefits of, and barriers to, HPV vaccination; perceived severity of, and susceptibility to, HPV infection and disease; and external influences prompting HPV vaccine uptake (i.e. cues to action). This study will use HBM constructs and other important predictors to evaluate, compare, and contrast. We hypothesize that higher HPV vaccine uptake will be significantly related to greater HPV knowledge, HBM constructs (particularly lower 'barriers' and more 'cues to action'), non-HBM attitudinal constructs (e.g. lower vaccine conspiracy

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3 beliefs), and health care provider (HCP) recommendation. In parents of boys, a publicly funded  
4 program (that reduces barriers of cost and access) and HCP recommendation are hypothesized to  
5 be particularly important.  
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### 8 9 10 **3. To identify Canadian parents' stage of decision-making by gender and province**

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14 Few studies have examined the stages of parents' vaccine decision. Assessing differences  
15 in parents' HPV vaccine decision-making stage is important for identifying how best to intervene  
16 for parents at different stages.<sup>58 65</sup> Using the Precaution Adoption Process Model (PAPM), a  
17 stage-based theoretical model, we will classify parents according to their unique stage of HPV  
18 vaccine decision-making and examine the associated attitudes with that stage.<sup>65-67</sup> The PAPM, as  
19 applied to HPV vaccination, identifies individuals along six stages of decision-making: 1)  
20 *unaware* of the vaccine; 2) *unengaged* in the decision to vaccinate their child; 3) *undecided* about  
21 whether to vaccinate their child; 4) *decided not to act* (i.e. decided not to vaccinate their child);  
22 5) *decided to act* (i.e. decided to vaccinate their child); and 6) *acted* (i.e. vaccinated their child)  
23 (see Supplementary File). We will compare the stage of decision-making of parents of girls with  
24 boys, as well as the stages of parents in those regions that have publicly funded programs for  
25 boys (P.E.I., Alberta, Nova Scotia, Ontario, Quebec, Manitoba) with those that do not (i.e. British  
26 Columbia, New Brunswick, Newfoundland and Labrador, Northwest Territories, Nunavut,  
27 Saskatchewan, Yukon). We hypothesize that parents of boys will be in earlier PAPM stages  
28 compared to parents of girls, and that parents of boys in regions without an HPV vaccine  
29 program will be in earlier stages compared to parents of boys in regions with a program.  
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### 44 **4. To determine the impact of publicly funded HPV vaccine program initiation for boys**

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47 HPV vaccination programs for boys were implemented in Quebec, Ontario and Manitoba  
48 in the Fall of 2016, which is after Time 1 survey administration (August-September 2016), but  
49 before launching the Time 2 survey (June-July 2017). This natural experiment allows us to  
50 evaluate the impact of introducing a public school-based HPV vaccination program on parents'  
51 HPV vaccine knowledge, attitudes, and HPV vaccine coverage. Accordingly, we will evaluate  
52 whether these factors change from Time 1 to Time 2. We hypothesize that compared to programs  
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3 with no change to their public vaccination program, at Time 2 (post-intervention) parents of boys  
4 in Manitoba, Ontario and Quebec will have increased HPV vaccine knowledge, more positive  
5 HPV vaccine attitudes, be more likely to have received a HCP's recommendation, and be more  
6 likely to have received the HPV vaccine. British Columbia, Saskatchewan, New Brunswick, and  
7 Newfoundland and Labrador have announced that they would fund HPV vaccine for boys to  
8 begin in September 2017 (Figure 1); this research will therefore have value in predicting how  
9 parental attitudes regarding vaccinating their sons might change in those jurisdictions.  
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## 20 **METHODS AND ANALYSIS**

### 21 **Design**

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27 This study uses a longitudinal cross-sectional design to collect self-reported data through  
28 an online questionnaire from a large national sample of Canadian parents. Surveys are  
29 administered at two time points: Time 1 during August-September (2016) and Time 2 during  
30 June-July (2017).  
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### 35 **Sample**

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39 This study targets parents and guardians (hereafter referred to as "parents") of 9 to 16-  
40 year-old boys and girls across Canada. This population is targeted because, on the younger side  
41 (i.e. age 9), it includes the youngest children included in NACI's recommendation and, on the  
42 older side (i.e. age 16), it includes children who, generally speaking, require parental consent in  
43 Canada.<sup>68</sup> Parents will be recruited by Canada's largest market research and polling firm, Leger-  
44 *The Research Intelligence Group*. Leger maintains a national panel of 400,000 Canadians who  
45 have Internet access, reside in Canada, and are fluent in English or French. This study targeted  
46 parents who have a child between 9-16 years of age living in their household. Participants  
47 completing the questionnaire at Time 1 will be contacted again at Time 2.  
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55 Leger's panels include individuals of all profiles with regard to gender, age, education  
56 level, household composition and income for all regions, making it feasible to effectively target  
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3 specific participants.<sup>67</sup> The panel is constructed to be nationally, as well as regionally,  
4 representative. Leger uses proprietary software informed by Canada's census data in order to  
5 generate a representative sample of the population. Leger's software follows an interactive  
6 algorithm to invite participants according to specified eligibility criteria. In this study, Leger's  
7 software enables extraction of all active and available panellists who meet the screening criteria,  
8 random sorting of the selected sample pool, examination of the number of panellists who satisfy  
9 each target group (i.e. parents of a 9-16 year old boys or parents of a 9-16 year old girls), and  
10 recalculation and balancing of the sample across the target groups. To recruit participants, Leger  
11 sends an email invitation and survey link to selected panellists. Leger sends a maximum of three  
12 reminder emails to its selected panellists to complete the survey until the required numbers of  
13 participants are recruited.  
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23 This study's sample size calculation takes into account previous research indicating that  
24 approximately 15% of respondents are inattentive or unmotivated responders who would be  
25 excluded using rigorous data cleaning methods.<sup>66 69</sup> To evaluate different stages of decision  
26 making (objective 3), we are guided by previous research that found few individuals in particular  
27 stages (especially in less populated regions).<sup>66</sup> An attrition rate (of approximately 40-50%) from  
28 the first wave of data collection (Time 1, August-September 2016) to the second wave (Time 2,  
29 June-July 2017) is also expected.<sup>66</sup> Therefore, in order to attain a sufficient number of  
30 respondents to enable analyses of HPV vaccine decision-making by stage and region, this study  
31 recruits approximately 4,600 parents of school-aged children (ages 9-16) at Time 1, equally  
32 divided between parents of boys and parents of girls.  
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## 42 **Measures**

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46 We use an online questionnaire that incorporates intelligent programming, such that the  
47 child's first name is included in the survey questions and parents receive questions that are  
48 personalized for them. Questionnaire items include previously validated scales.<sup>56 70-73</sup>  
49 Participants will be asked to identify themselves as a parent or guardian, report the number of  
50 children they have, and their children's ages and genders. Parents with more than one child who  
51 meets the inclusion criteria will be asked to answer the questionnaire for the child who has had  
52 the most recent birthday, a randomization technique previously employed.<sup>66</sup> The questionnaire  
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3 assesses socio-demographics; HPV and HPV vaccine knowledge (using validated scales);<sup>71</sup>  
4 PAPM stage; HPV vaccine willingness; HPV vaccine coverage; HCP recommendation (including  
5 the strength of the recommendation); HPV attitudes (using validated scales);<sup>73 74</sup> motivation  
6 towards vaccination; vaccine hesitancy (using a developed scale);<sup>56</sup> and vaccine conspiracy  
7 beliefs (using a validated scale).<sup>70</sup> Items within validated questionnaires are administered in a  
8 random order to ameliorate any order effect and invariant responding.<sup>75</sup> Five open-ended  
9 qualitative questions will provide nuance in capturing details of parents' subjective perspectives  
10 on decision-making. A detailed description of the questionnaire's items can be found in the  
11 Supplementary File.  
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19 To take into account language and literacy level, the questionnaire was adjusted to a  
20 grade eight reading level. To ensure the questionnaire could be answered in either of Canada's  
21 national languages, the English questionnaire was translated into French using Asiatis, an  
22 international translation service company. Bilingual team members verified the French  
23 translation and back-translation.  
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### 30 **Data Collection and Management**

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33 Leger will facilitate data collection. Participants will be sent an email invitation to  
34 participate in a questionnaire and then assigned a unique access number. By accessing the  
35 questionnaire with this unique number, the respondent enters a secure account that ensures  
36 confidentiality. Moreover, if necessary, respondents may stop and resume the questionnaire  
37 where they left off so that they participate at a time that best suits them, allowing them to  
38 complete the questionnaire conscientiously.  
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44 Participants will be paid a modest cash amount in accordance with standard panel  
45 member compensation of Leger. Data collection at both time periods will be completed within  
46 four weeks. Missing data will not be an obstacle in this survey because participants will be  
47 required to answer all questions before moving from one page to the next. Once participants  
48 complete the questionnaire they will be debriefed, informed about HPV vaccination, and  
49 provided with informational resources. Leger will transfer the anonymized raw data file to our  
50 research team, which will be stored on a secure server at the Lady Davis Institute for Medical  
51 Research site of the Integrated Health and Social Services University Network for West-Central  
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## 7 **Data Cleaning Procedure**

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10 As recommended in the literature,<sup>69 75 76</sup> data cleaning methods will be used to identify  
11 participants who might not have used appropriate care while completing the questionnaire (i.e.  
12 inattentive or unmotivated responders). Consistent with DeSimone et al. (2015) and Perez et al.  
13 (2016), we will use data cleaning methods that are direct (i.e. bogus items) and statistical (i.e.  
14 psychometric synonyms and psychometric antonyms).<sup>66 75</sup>  
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19 Bogus items will be used to screen inattentive or unmotivated responders. Two bogus  
20 items on Likert scales were randomly inserted into the survey: “I have never met anyone younger  
21 than I am” and “I have been to every country in the world” (measured from ‘1-strongly disagree’  
22 to ‘7-strongly agree’). Incorrect answers (i.e. agreement) to both bogus items suggest inattentive  
23 or unmotivated responders. Incorrect responses are indicative of lack of attention. Respondents  
24 who answer at least one bogus item correctly will be retained.  
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30 Psychometric synonyms and antonyms data cleaning methods statistically examines  
31 response patterns.<sup>66</sup> Providing different responses to similar items suggests insufficient attention  
32 and accuracy in answering the questionnaire. Items measured on Likert scales will be selected  
33 and inter-item correlations will be calculated. Positively correlated pairs of items will constitute  
34 psychometric synonyms while negatively correlated pairs will constitute psychometric  
35 antonyms.<sup>75</sup> The number of pairs cannot be anticipated before beginning data analysis because it  
36 depends on the degree of correlation and the chosen cut-off value of the correlation coefficient.<sup>75</sup>  
37 We will use an inter-item Pearson correlation cut-off of 0.60 and -0.60 for selecting  
38 psychometric synonyms and psychometric antonyms pairs respectively, consistent with  
39 recommendations of Meade and Craig (2012).<sup>76</sup> Once the pairs have been identified, an index  
40 will be calculated for each respondent by correlating the responses to the first items of the pairs  
41 with the responses to the second items of the pairs.  
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51 Responders who meet both the bogus item and the psychometric synonyms/antonyms  
52 criteria will be considered attentive responders and retained.  
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## 56 **Data Analysis Plan**

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5 In line with the first research objective to provide an accurate description of HPV vaccine  
6 coverage, we will report HPV vaccination coverage as percentage of girls and boys in each  
7 region and age group whose parents report they have received one, two, or three doses of the  
8 HPV vaccine. To test for statistically significant differences in proportions, we will use  
9 Pearson's Chi square tests and two sample tests of proportions.  
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14 For the second objective, to assess the correlates of HPV vaccine uptake in Canada, HPV  
15 vaccine uptake (dependent variable) will be dichotomised into "vaccinated" (i.e. received at least  
16 one dose of the HPV vaccine) and "non-vaccinated". Logistic regressions will be used to  
17 estimate the odds of vaccine uptake based on the correlates of interest, including socio-  
18 demographics, attitudes (informed by the HBM), knowledge, and behaviours (e.g. discussion  
19 with HCP). Significant associations between the correlates and vaccine uptake will be tested  
20 using bivariate logistic regression analyses. Multivariate logistic regression modelling will then  
21 be performed with all correlates from the bivariate analysis entered simultaneously. The model  
22 will be tested for goodness of fit, discrimination capacity, and multicollinearity.  
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30 To identify Canadian parents' stage of decision-making by gender and region (objective  
31 3), we will report parents' HPV vaccine decision-making in percentages based on the six stages  
32 of the PAPM. For assessing significant differences in PAPM stage based on gender (at Time 1)  
33 and availability of publicly funded HPV vaccination programs for boys (at both Time 1 and  
34 Time 2), Pearson chi-square test and two sample tests of proportions will be used.  
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39 Lastly, to determine the impact of publicly funded HPV vaccine program initiation for  
40 boys in some regions, we will examine changes in parents' of boys (HPV and HPV vaccine)  
41 knowledge and attitudes (e.g. on the Human papillomavirus Attitudes and Beliefs Scale, Vaccine  
42 Conspiracy Beliefs Scale, and Vaccine Hesitancy Scale) before and after the introduction of the  
43 funded program. Parents of boys in provinces that introduced the program will be compared to  
44 parents of boys in regions with no change to their program. Significant differences from Time 1  
45 to Time 2 will be tested using paired T-tests.  
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## 55 **ETHICS AND DISSEMINATION**

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## Study Ethics

The study received research ethics board approval from the Research Review Office, Integrated Health and Social Services University Network for West-Central Montreal (CODIM-FLP-16-219). This is a university-affiliated teaching health care network where the coordinating center (Lady Davis Institute for Medical Research) is based. Study participants consented to Leger's terms of use and privacy policy, which indicates that their data will be used anonymously for the research study.

## Dissemination Plan

The study will adopt a multi-modal approach to disseminate the study's results to researchers, clinicians, cancer and vaccination organizations, and the public in Canada and internationally. Study findings will be published in peer-reviewed scientific journals (including open source). To assure wide availability of our results to the research community, journals will be selected that reach both research and health professional audiences.

Presentations will be made at national and international scientific meetings and symposia, such as the Canadian Immunization Conference, Canadian Association of Psychosocial Oncology, International Papillomavirus Society conference, and the International Psycho-Oncology Society. In addition, we will share the results with NACI, CIC, and provincial immunization advisory boards.

Given that the data is timely and could have immediate, direct implications for public education of Canadian parents, and more widespread influence on public health policy, we will prioritize analysis and dissemination of projects that have a potential for proximal public impact. We hope that sharing outcomes with non-profit organizations (e.g. the Canadian Cancer Society) will provide important platforms for innovative educational interventions based on this study's findings.

We will draft lay research summaries in media releases for dissemination to national media outlets and use such releases to help the public understand the importance of this research, bring the issues and challenges related to HPV vaccine acceptance to the public domain that will inform discussions about HPV vaccination.



## DISCUSSION

### Study Implications

By surveying a population-based representative sample of parents of eligible children, this study will provide current information about HPV vaccine coverage rates for both boys and girls nationally, and across Canadian jurisdictions (objective 1). Since HPV vaccine programs and policies are constantly evolving,<sup>25</sup> it is timely to evaluate comprehensively variations in program outcomes that target females and males, jurisdictions at a national and local level, and HPV vaccination by socio-demographic groups. For this reason, this study will be useful to policymakers in understanding where the HPV vaccination programs are meeting coverage targets, where disparities in vaccination exist, and which groups or jurisdictions may benefit from interventions designed to increase vaccination.

In order to improve the impact of publicly funded HPV vaccination programs, this study will examine the psychosocial and behavioural factors associated with parents' decisions to vaccinate their children and their decision-making stage (objectives 2 and 3). These theoretically driven investigations will enable policymakers to develop interventions to increase HPV vaccination that are evidence-based, tailored, and targeted towards parents' unique informational needs and their stage of decision-making, rather than providing all parents with the same messages.

Lastly, since Canada is one of the few countries that have implemented publicly-funded, national HPV vaccination programs, this research will make use of a natural experiment to evaluate the impact of the introduction of funded programs for boys on parents' vaccine knowledge, attitudes, and decision to vaccinate (objective 4). The results of this study will improve our understanding of the complex interplay of psychosocial and behavioural factors with policy decisions. By understanding this complexity, other countries can better anticipate that impact of policy changes.

The results generated by the study's four objectives will provide public health officials with critical information about HPV vaccination programs, improve the fields' understanding of

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3 influencers of decision-making, improve and enhance the delivery of current publicly funded  
4 HPV vaccination program, facilitate HPV vaccine uptake, and in turn decrease Canada's cancer  
5 burden and the associated human and economic cost.  
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### 10 **Methodological Strengths**

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14 The recruitment strategy of using a marketing company (Leger) that maintains a  
15 nationally representative panel for data collection enables the sampling of a large number of  
16 parents who answer the survey within a short time frame. The precise recruitment period allows  
17 for data collection to occur in a timely manner and the provision of a snapshot of responses  
18 before and after the implementation of the HPV vaccination program for boys in certain  
19 provinces.  
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24 In addition, we use an online survey methodology with intelligent programming, which  
25 increases the quality of collected data by personalizing and tailoring the survey for each  
26 participant. This study also avoids the problems associated with missing data. To avoid the  
27 limitation of inattentive or unmotivated responding that is often found in survey data, this study  
28 will utilize sophisticated data cleaning techniques to remove such responders.  
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33 Further, the measures used in this study include psychometrically validated scales (where  
34 possible), which increase the reliability and validity of our results. Our survey also assesses  
35 many and diverse constructs. By using theoretical frameworks (such as the HBM and PAPM),  
36 we will be able to better understand the vaccine acceptability process, which is important in  
37 nuanced targeting of interventions. Lastly, by including quantitative and qualitative (open-  
38 ended) questions, we will be able to conduct additional mixed-methods studies to examine in-  
39 depth explanations of HPV vaccine decision making at different stage levels.  
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### 47 **Foreseeable Limitations**

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51 One limitation is the reliance on parents' self-reports of vaccination status of their  
52 children. In order to minimize this limitation, parents are asked about their vaccination status  
53 before and after reading an informative statement (whereby parents are provided details about  
54 the HPV vaccine). The exact number of reported doses (two or three) could also be inaccurate.  
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3 A possible way to confirm immunisation status is to request parents to check the immunisation  
4 record, contact the family doctor, or link to provincial immunization records. However,  
5 requesting participants to access records was not feasible in our study as such a request would  
6 have significantly increased the data collection time and costs.  
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**Ethics approval:** The study received research ethics board approval from the Research Review Office, Integrated Health and Social Services University Network for West-Central Montreal (CODIM-FLP-16-219).

**Data sharing statement:** Please contact the corresponding author if you are interested in using our survey or data.

## REFERENCES

1. Shearer BD. HPV Vaccination: Understanding the Impact on HPV Disease. *Purple Paper* 2011; 34. [http://www.nccid.ca/files/Purple\\_Paper\\_Note\\_mauve/PP\\_34\\_EN.pdf](http://www.nccid.ca/files/Purple_Paper_Note_mauve/PP_34_EN.pdf).
2. National Advisory Committee on Immunization. Update on the recommended Human Papillomavirus vaccine immunization schedule 2015 [Available from: [http://publications.gc.ca/collections/collection\\_2015/aspc-phac/HP40-128-2014-eng.pdf](http://publications.gc.ca/collections/collection_2015/aspc-phac/HP40-128-2014-eng.pdf) accessed May 08 2017.
3. Crosbie EJ, Einstein MH, Franceschi S, et al. Human papillomavirus and cervical cancer. *Lancet* 2013;382(9895):889-99. doi: 10.1016/S0140-6736(13)60022-7
4. Moore RA, Ogilvie G, Fornika D, et al. Prevalence and type distribution of human papillomavirus in 5,000 British Columbia women--implications for vaccination. *Cancer Causes Control* 2009;20(8):1387-96. doi: 10.1007/s10552-009-9365-4
5. Little KQ, Ogilvie G, Mirwaldt P. Human papillomavirus awareness, knowledge, and vaccination status in a diverse population of male postsecondary students in Greater Vancouver. *British Columbia Medical Journal* 2015;57(2)
6. Parkin DM, Bray F. The burden of HPV-related cancers. *Vaccine* 2006;24:S11-S25.
7. Steben M, Duarte-Franco E. Human papillomavirus infection: epidemiology and pathophysiology. *Gynecol Oncol* 2007;107(2 Suppl 1):S2-5. doi: 10.1016/j.ygyno.2007.07.067
8. Bouvard V, Baan R, Straif K, et al. A review of human carcinogens - Part B: biological agents. *The Lancet Oncol* 2009;10(4):321-22.
9. National Advisory Committee on Immunization. Update On Human Papillomavirus Vaccines. *Canada Communicable Disease Report* 2012;38
10. Forman D, de Martel C, Lacey CJ, et al. Global burden of human papillomavirus and related diseases. *Vaccine* 2012;30 Suppl 5:F12-23. doi: 10.1016/j.vaccine.2012.07.055
11. de Martel C, Ferlay J, Franceschi S, et al. Global burden of cancers attributable to infections in 2008: a review and synthetic analysis. *Lancet Oncol* 2012;13(6):607-15. doi: 10.1016/S1470-2045(12)70137-7
12. Parkin DM. The global health burden of infection-associated cancers in the year 2002. *Int J Cancer* 2006;118(12):3030-44. doi: 10.1002/ijc.21731
13. Oh JK, Weiderpass E. Infection and cancer: global distribution and burden of diseases. *Ann Glob Health* 2014;80(5):384-92. doi: 10.1016/j.aogh.2014.09.013
14. Ball SL, Winder DM, Vaughan K, et al. Analyses of human papillomavirus genotypes and viral loads in anogenital warts. *J Med Virol* 2011;83(8):1345-50. doi: 10.1002/jmv.22111
15. Marra F, Ogilvie G, Colley L, et al. Epidemiology and costs associated with genital warts in Canada. *Sex Transm Infect* 2009;85(2):111-5. doi: 10.1136/sti.2008.030999
16. An Advisory Committee Statement (ACS) National Advisory Committee on Immunization (NACI). Updated Recommendations on Human Papillomavirus (HPV) vaccines: 9-valent HPV vaccine and clarification of minimum intervals between doses in the HPV immunization schedules Ontario, Canada 2016 [Available from: <http://www.healthycanadians.gc.ca/publications/healthy-living-vie-saine/human-papillomavirus-9-valent-vaccine-update-recommendation-mises-a-jour->

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- [recommandations-papillome-humain-vaccin-nonavalent/alt/hpv-phv-eng.pdf](https://www.bmj.com/lookup/otherid/doi/10.1136/bmj.c3493) accessed February 14 2017.
17. Szarewski A, Poppe WA, Skinner SR, et al. Efficacy of the human papillomavirus (HPV)-16/18 AS04-adjuvanted vaccine in women aged 15-25 years with and without serological evidence of previous exposure to HPV-16/18. *Int J Cancer* 2012;131(1):106-16. doi: 10.1002/ijc.26362
  18. Kjaer SK, Sigurdsson K, Iversen OE, et al. A pooled analysis of continued prophylactic efficacy of quadrivalent human papillomavirus (Types 6/11/16/18) vaccine against high-grade cervical and external genital lesions. *Cancer Prev Res (Phila)* 2009;2(10):868-78. doi: 10.1158/1940-6207.CAPR-09-0031
  19. Group FIIS, Dillner J, Kjaer SK, et al. Four year efficacy of prophylactic human papillomavirus quadrivalent vaccine against low grade cervical, vulvar, and vaginal intraepithelial neoplasia and anogenital warts: randomised controlled trial. *BMJ* 2010;341:c3493. doi: 10.1136/bmj.c3493
  20. Ferris D, Samakoses R, Block SL, et al. Long-term study of a quadrivalent human papillomavirus vaccine. *Pediatrics* 2014;134(3):e657-65. doi: 10.1542/peds.2013-4144
  21. Munoz N, Kjaer SK, Sigurdsson K, et al. Impact of human papillomavirus (HPV)-6/11/16/18 vaccine on all HPV-associated genital diseases in young women. *J Natl Cancer Inst* 2010;102(5):325-39. doi: 10.1093/jnci/djp534
  22. Stillo M, Carrillo Santistevé P, Lopalco PL. Safety of human papillomavirus vaccines: a review. *Expert Opin Drug Saf* 2015;14(5):697-712. doi: 10.1517/14740338.2015.1013532
  23. Ogilvie GS, Naus M, Money DM, et al. Reduction in cervical intraepithelial neoplasia in young women in British Columbia after introduction of the HPV vaccine: An ecological analysis. *Int J Cancer* 2015;137(8):1931-7. doi: 10.1002/ijc.29508
  24. Canadian Immunization Committee. Recommendations for human papillomavirus immunization programs. *Canada Communicable Disease Report* 2014;40(8)
  25. Shapiro GK, Guichon J, Prue G, et al. A Multiple Streams analysis of the decisions to fund gender-neutral HPV vaccination in Canada. *Prev Med* 2017;100:123-31. doi: 10.1016/j.ypmed.2017.04.016
  26. Bonanni P, Bechini A, Donato R, et al. Human papilloma virus vaccination: impact and recommendations across the world. *Ther Adv Vaccines* 2015;3(1):3-12. doi: 10.1177/2051013614557476
  27. Marsh K, Chapman R, Baggaley RF, et al. Mind the gaps: what's missing from current economic evaluations of universal HPV vaccination? *Vaccine* 2014;32(30):3732-9. doi: 10.1016/j.vaccine.2014.05.007
  28. Patel C, Macartney K. Supporting the call for a gender-neutral human papillomavirus vaccination in Canada. *Cmaj* 2017;189(3):E118. doi: 10.1503/cmaj.732446
  29. McClure CA, MacSwain MA, Morrison H, et al. Human papillomavirus vaccine uptake in boys and girls in a school-based vaccine delivery program in Prince Edward Island, Canada. *Vaccine* 2015;33(15):1786-90. doi: 10.1016/j.vaccine.2015.02.047
  30. Public Health Agency of Canada. Canada's Provincial and Territorial Routine (and Catch-up) Vaccination Programs for Infants and Children. 2017 [Available from: <http://www.phac-aspc.gc.ca/im/ptimprog-progimpt/table-1-eng.php> accessed May 08 2017.



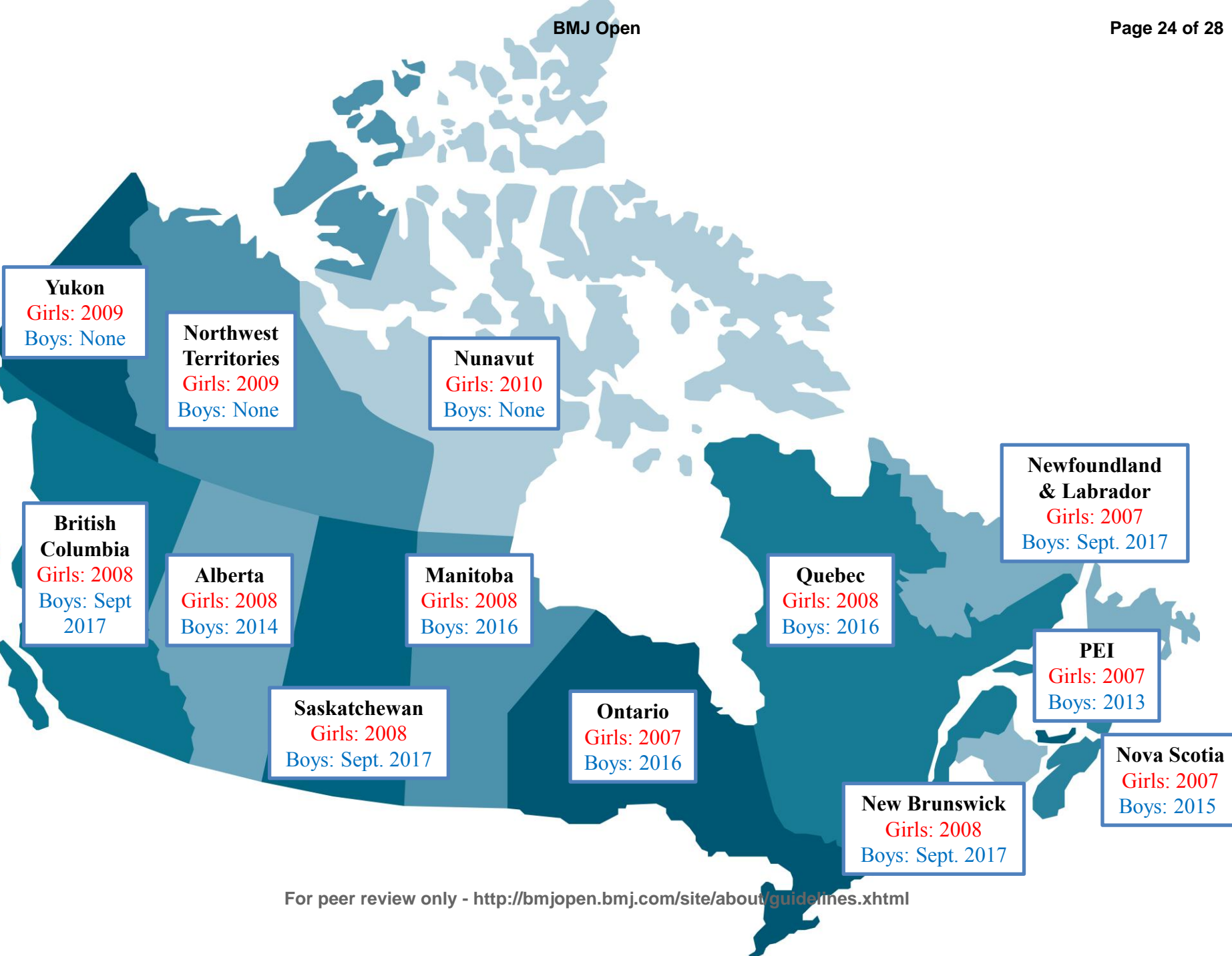
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31. Colbert Y. HPV vaccine for Nova Scotia boys called 'groundbreaking': CBC News; 2015 [Available from: <http://www.cbc.ca/news/canada/nova-scotia/hpv-vaccine-for-nova-scotia-boys-called-groundbreaking-1.3031169> accessed May 07 2017.
32. Shapiro GK, Perez S, Rosberger Z. Including males in Canadian human papillomavirus vaccination programs: a policy analysis. *Cmaj* 2016;188(12):881-6. doi: 10.1503/cmaj.150451
33. Ghossoub M. B.C. extends free HPV vaccinations to Grade 6 boys - British Columbia 2017 [updated Jan 06, 2017. Available from: <http://www.cbc.ca/news/canada/british-columbia/b-c-extends-free-hpv-vaccinations-to-grade-6-boys-1.3925212>.
34. Cover JK, Nghi NQ, LaMontagne DS, et al. Acceptance patterns and decision-making for human papillomavirus vaccination among parents in Vietnam: an in-depth qualitative study post-vaccination. *BMC Public Health* 2012;12:629. doi: 10.1186/1471-2458-12-629
35. Fong K. Grade 6 boys to start receiving HPV vaccination in Saskatchewan 2017 [updated March 23, 2017. Available from: <http://globalnews.ca/news/3331430/grade-6-boys-to-start-receiving-hpv-vaccinations-in-sask/> accessed May 08 2017.
36. Boone M. Boys too: HPV vaccination to be offered to all N.L. students in Grade 6 2017 [updated May 04, 2017. Available from: <http://www.cbc.ca/news/canada/newfoundland-labrador/hpv-vaccine-boys-newfoundland-1.4098941> accessed May 08 2017.
37. Drolet M, Benard E, Boily MC, et al. Population-level impact and herd effects following human papillomavirus vaccination programmes: a systematic review and meta-analysis. *Lancet Infect Dis* 2015;15(5):565-80. doi: 10.1016/S1473-3099(14)71073-4
38. Ministère de la Santé et des Services Sociaux. Programme National de Santé Publique. 2008. <http://publications.msss.gouv.qc.ca/acrobat/f/documentation/2008/08-216-01.pdf>.
39. Bogaards JA, Wallinga J, Brakenhoff RH, et al. Direct benefit of vaccinating boys along with girls against oncogenic human papillomavirus: bayesian evidence synthesis. *BMJ* 2015;350:h2016. doi: 10.1136/bmj.h2016
40. Gilbert NL, Gilmour H, Dube E, et al. Estimates and determinants of HPV non-vaccination and vaccine refusal in girls 12 to 14 y of age in Canada: Results from the Childhood National Immunization Coverage Survey, 2013. *Hum Vaccin Immunother* 2016;12(6):1484-90. doi: 10.1080/21645515.2016.1153207
41. Perez S, Shapiro GK, Brown CA, et al. 'I didn't even know boys could get the vaccine': Parents' reasons for human papillomavirus (HPV) vaccination decision making for their sons. *Psychooncology* 2015;24(10):1316-23. doi: 10.1002/pon.3894
42. Ogilvie GS, Remple VP, Marra F, et al. Parental intention to have daughters receive the human papillomavirus vaccine. *Cmaj* 2007;177(12):1506-12. doi: 10.1503/cmaj.071022
43. Allen JD, Coronado GD, Williams RS, et al. A systematic review of measures used in studies of human papillomavirus (HPV) vaccine acceptability. *Vaccine* 2010;28(24):4027-37. doi: 10.1016/j.vaccine.2010.03.063
44. Krawczyk AL, Perez S, Lau E, et al. Human papillomavirus vaccination intentions and uptake in college women. *Health Psychol* 2012;31(5):685-93. doi: 10.1037/a0027012
45. Ogilvie GS, Remple VP, Marra F, et al. Intention of parents to have male children vaccinated with the human papillomavirus vaccine. *Sex Transm Infect* 2008;84(4):318-23. doi: 10.1136/sti.2007.029389

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46. Lee A, Ho M, Cheung CK, et al. Factors influencing adolescent girls' decision in initiation for human papillomavirus vaccination: a cross-sectional study in Hong Kong. *BMC Public Health* 2014;14:925. doi: 10.1186/1471-2458-14-925
  47. Zimet GD, Rosberger Z, Fisher WA, et al. Beliefs, behaviors and HPV vaccine: correcting the myths and the misinformation. *Prev Med* 2013;57(5):414-8. doi: 10.1016/j.ypmed.2013.05.013
  48. Hendry M, Lewis R, Clements A, et al. "HPV? Never heard of it!": a systematic review of girls' and parents' information needs, views and preferences about human papillomavirus vaccination. *Vaccine* 2013;31(45):5152-67. doi: 10.1016/j.vaccine.2013.08.091
  49. Holman DM, Benard V, Roland KB, et al. Barriers to human papillomavirus vaccination among US adolescents: a systematic review of the literature. *JAMA Pediatr* 2014;168(1):76-82. doi: 10.1001/jamapediatrics.2013.2752
  50. Patel PR, Berenson AB. Sources of HPV vaccine hesitancy in parents. *Hum Vaccin Immunother* 2013;9(12):2649-53. doi: 10.4161/hv.26224
  51. Walhart T. Parents, adolescents, children and the human papillomavirus vaccine: a review. *Int Nurs Rev* 2012;59(3):305-11. doi: 10.1111/j.1466-7657.2012.00991.x
  52. Krawczyk A, Knauper B, Gilca V, et al. Parents' decision-making about the human papillomavirus vaccine for their daughters: I. Quantitative results. *Hum Vaccin Immunother* 2015;11(2):322-9. doi: 10.1080/21645515.2014.1004030
  53. Trim K, Nagji N, Elit L, et al. Parental Knowledge, Attitudes, and Behaviours towards Human Papillomavirus Vaccination for Their Children: A Systematic Review from 2001 to 2011. *Obstet Gynecol Int* 2012;2012:921236. doi: 10.1155/2012/921236
  54. Gowda C, Dempsey AF. The rise (and fall?) of parental vaccine hesitancy. *Hum Vaccin Immunother* 2013;9(8):1755-62. doi: 10.4161/hv.25085
  55. Garcini LM, Galvan T, Barnack-Tavlaris JL. The study of human papillomavirus (HPV) vaccine uptake from a parental perspective: a systematic review of observational studies in the United States. *Vaccine* 2012;30(31):4588-95. doi: 10.1016/j.vaccine.2012.04.096
  56. Larson HJ, Jarrett C, Eckersberger E, et al. Understanding vaccine hesitancy around vaccines and vaccination from a global perspective: a systematic review of published literature, 2007-2012. *Vaccine* 2014;32(19):2150-9. doi: 10.1016/j.vaccine.2014.01.081
  57. Forster AS, Rockliffe L, Chorley AJ, et al. A qualitative systematic review of factors influencing parents' vaccination decision-making in the United Kingdom. *SSM Popul Health* 2016;2:603-12. doi: 10.1016/j.ssmph.2016.07.005
  58. Perez S, Tatar O, Gilca V, et al. Untangling the psychosocial predictors of HPV vaccination decision-making stages among parents of boys. *Vaccine* 2017;Forthcoming
  59. Lindley MC, Jeyarajah J, Yankey D, et al. Comparing human papillomavirus vaccine knowledge and intentions among parents of boys and girls. *Hum Vaccin Immunother* 2016;12(6):1519-27. doi: 10.1080/21645515.2016.1157673
  60. Radisic G, Chapman J, Flight I, et al. Factors associated with parents' attitudes to the HPV vaccination of their adolescent sons : A systematic review. *Prev Med* 2017;95:26-37. doi: 10.1016/j.ypmed.2016.11.019
  61. Government of Canada. Immunization coverage and registries 2016 [Available from: <https://www.canada.ca/en/public-health/services/immunization-coverage-registries.html#a3> accessed February 07 2017.



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62. Champion VL, Skinner CS. The Health Belief Model. In: Glanz K, Rimer BK, Viswanath KE, eds. Health behavior and health education: theory, research, and practice. 4th ed: John Wiley & Sons 2008:45-65.
63. Brewer NT, Fazekas KI. Predictors of HPV vaccine acceptability: a theory-informed, systematic review. *Prev Med* 2007;45(2-3):107-14. doi: 10.1016/j.ypmed.2007.05.013
64. Cunningham MS, Davison C, Aronson KJ. HPV vaccine acceptability in Africa: a systematic review. *Prev Med* 2014;69:274-9. doi: 10.1016/j.ypmed.2014.08.035
65. Prue G, Santin O. HPV vaccine acceptance in male adolescents. *Psychooncology* 2015;24(10):1327-29. doi: 10.1002/pon.3961
66. Perez S, Tatar O, Shapiro GK, et al. Psychosocial determinants of parental human papillomavirus (HPV) vaccine decision-making for sons: Methodological challenges and initial results of a pan-Canadian longitudinal study. *BMC Public Health* 2016;16(1):1223. doi: 10.1186/s12889-016-3828-9
67. Weinstein ND. The precaution adoption process. *Health Psychol* 1988;7(4):355-86.
68. Court of Appeal of Alberta. J.S.C. v. Wren, 1986 ABCA 249 (CanLII) 31-12-1986 [March 21, 2017]. Available from: <http://www.canlii.org/en/ab/abca/doc/1986/1986abca249/1986abca249.html>.
69. Osborne JW. Best practices in data cleaning: A complete guide to everything you need to do before and after collecting your data: Sage Publications 2012.
70. Shapiro GK, Holding A, Perez S, et al. Validation of the vaccine conspiracy beliefs scale. *Papillomavirus Research* 2016;2:167-72. doi: 10.1016/j.pvr.2016.09.001
71. Perez S, Tatar O, Ostini R, et al. Extending and validating a human papillomavirus (HPV) knowledge measure in a national sample of Canadian parents of boys. *Prev Med* 2016;91:43-49. doi: 10.1016/j.ypmed.2016.07.017
72. Waller J, Ostini R, Marlow LA, et al. Validation of a measure of knowledge about human papillomavirus (HPV) using item response theory and classical test theory. *Prev Med* 2013;56(1):35-40.
73. McRee AL, Brewer NT, Reiter PL, et al. The Carolina HPV immunization attitudes and beliefs scale (CHIAS): scale development and associations with intentions to vaccinate. *Sex Transm Dis* 2010;37(4):234-9. doi: 10.1097/OLQ.0b013e3181c37e15
74. Perez S, Shapiro GK, Tatar O, et al. Development and Validation of the Human Papillomavirus Attitudes and Beliefs Scale in a National Canadian Sample. *Sex Transm Dis* 2016;43(10):626-32. doi: 10.1097/OLQ.0000000000000506
75. DeSimone JA, Harms PD, DeSimone AJ. Best practice recommendations for data screening. *Journal of Organizational Behavior* 2015;36(2):171-81.
76. Meade AW, Craig SB. Identifying careless responses in survey data. *Psychol Methods* 2012;17(3):437-55. doi: 10.1037/a0028085
77. Larson HJ, Jarrett C, Schulz WS, et al. Measuring vaccine hesitancy: The development of a survey tool. *Vaccine* 2015;33(34):4165-75. doi: 10.1016/j.vaccine.2015.04.037
78. LaClair BJ, Smith S, Woodward J. Attitudes and concerns of Kansas parents related to childhood immunization. *Immunize Kansas Kids* 2014

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## Supplementary File: Study Questionnaire

Variables	Number of items	Sample items	Response choices	Instructions
Eligibility	5	Do you personally have a child between 9-16 years of age living in your household? <sup>a</sup>	Yes; No	
Socio-Demographics	18	In which province do you currently live?  Which of the following ethnicities best describes you?	Categories derived from those commonly used by Statistics Canada. Prefer not to answer was an option for some items.	Select only one.
Precaution Adoption Process Model	1	Which of the following best described your thoughts about the human papillomavirus (HPV) vaccine for [CHILD]? <sup>c</sup>	<b>Stage 1:</b> I am <i>unaware</i> that the HPV vaccine could be given to [CHILD name]; <b>Stage 2:</b> I am aware that the HPV vaccine could be given to [CHILD name], but I have <i>never thought about</i> vaccinating [CHILD name] against HPV; <b>Stage 3:</b> I am <i>undecided</i> about vaccinating [CHILD name] against HPV; <b>Stage 4:</b> I have decided I <i>DO NOT</i> want to vaccinate [CHILD name] against HPV; <b>Stage 5:</b> I have decided I <i>DO</i> want to vaccinate [CHILD name] against HPV; <b>Stage 6:</b> [CHILD name] has <i>already received</i> the HPV vaccine. <sup>c</sup>	Select only one.
HPV & HPV Vaccine Perceived Knowledge	2	Before today, how much would you say you knew about the human papillomavirus (HPV)?	Nothing – A lot (5-point Likert scale)	Please answer the following questions to the best of your ability.
HPV Knowledge <sup>71 72</sup>	23 <sup>b</sup>	HPV always has visible signs or symptoms (F)  HPV can be passed on during sexual intercourse (T)	True; False; Don't know	Please answer the following questions about human papillomavirus (HPV) to the best of your ability.
HPV Vaccine Knowledge <sup>71 72</sup>	13 <sup>b</sup>	The HPV vaccine offers protection against most cervical cancers (T)  Girls who have had the HPV vaccine do not need a Pap test when they are older (F)	True; False; Don't know	Please answer the following questions about the human papillomavirus (HPV) vaccine to the best of your ability.
Information Sources	2	Where have you heard about the HPV vaccine?	Categories include: Not applicable, I	Check all answers that

Variables	Number of items	Sample items	Response choices	Instructions
		From which source <i>would you most prefer</i> to receive information about the HPV vaccine?	have never heard about the HPV vaccine before today; <sup>d</sup> Public health brochures, pamphlets, flyers, or posters; Commercials or advertisements from pharmaceutical companies; Doctor, nurse, or other health care provider; Family member(s); Friend, peer, or co-worker; Information from my child or children's school; Newspapers or magazines; TV or the radio; The internet (e.g., health related websites, news); Social media (Facebook/Twitter).	apply to you.
<b>HPV Vaccine Coverage</b>	6	Did [CHILD] receive the HPV vaccine? <sup>c</sup>	Yes; No; I don't know	Please answer the following questions to the best of your ability
<b>Health Care Provider Recommendation</b>	4	Has [CHILD] seen a health care provider (e.g. a family doctor, paediatrician, or nurse) within the last 12 months? <sup>c</sup>  Have you discussed [CHILD] receiving the HPV vaccine with a health care provider (e.g. a doctor, paediatrician, or nurse) within the last 12 months? <sup>c</sup>	Yes; No	
<b>HPV Attitudes and Beliefs</b> <sup>74</sup>	71 <sup>b</sup>	<b>Benefits (10):</b> I feel that the HPV vaccine is effective in preventing HPV-related cancers. <b>Accessibility (4):</b> I feel that the process of actually getting the HPV vaccine for [CHILD] would be easy. <sup>c</sup> <b>Affordability (3):</b> I feel that the HPV vaccine cost more than I can afford. <b>Harms (8):</b> I feel that the HPV vaccine is unsafe. <b>Barriers Additional Items (4):</b> I feel that I am concerned that the HPV vaccine might cause short term problems like pain or discomfort. <b>Severity/Perceived Threat (3):</b> I feel that it would be serious if [CHILD] contracted genital warts later in life. <sup>c</sup>	Strongly Disagree – Strongly Agree (7-point Likert scale)	Please select the answer that best reflects your attitude/belief.

Variables	Number of items	Sample items	Response choices	Instructions
		<p><b>Susceptibility/Risk (3):</b> I feel that without the HPV vaccine, [CHILD] would be at risk of getting genital warts later in life.<sup>c</sup></p> <p><b>Social Norms/Influence (8):</b> I feel that my friends are getting their children vaccinated with the HPV vaccine.</p> <p><b>Self-Efficacy (4):</b> I feel that I am competent to make decisions about the vaccines [CHILD] receives.<sup>c</sup></p> <p><b>Gender (3):</b> I feel that HPV vaccine is important for girls.</p> <p><b>Trust (4):</b> I feel that I trust the information I receive about vaccines.</p> <p><b>Communication (5):</b> I feel that I am uncomfortable talking to [CHILD] about the HPV vaccine.<sup>c</sup></p> <p><b>Risk Denial (1):</b> HPV vaccination is not really necessary because Pap smears can be done to make sure cervical cancer doesn't develop.</p> <p><b>Additional Vaccine Items (7):</b> I feel that child vaccinations should be mandatory.</p>		
<b>Motivation</b>	8	Please rate the following reasons for why you would AGREE with your child receiving the HPV vaccine. Because I want [CHILD] to receive the HPV vaccine. <sup>c</sup>	Strongly Disagree – Strongly Agree (7-point Likert scale)	Please select the answer that best reflects your attitude/ belief. Please respond to the following statements to the best of your ability.
<b>Vaccine Hesitancy</b> <sup>77</sup>	10 <sup>b</sup>	Childhood vaccines are important for my child's health.	Strongly Disagree – Strongly Agree (5-point Likert scale)	How much do you agree with the each of the following statement on vaccinations?
<b>Vaccine Refusal</b>	3	<p>Have you ever refused vaccinating [CHILD] with the human papillomavirus (HPV) vaccine?<sup>c</sup></p> <p>Have you ever refused vaccinating [CHILD] with any childhood vaccine other than the human papillomavirus (HPV) vaccine?<sup>c</sup></p>	Yes; No	
<b>Vaccine Conspiracy Beliefs Scale</b> <sup>70</sup>	11 <sup>b</sup>	Vaccine safety data is often fabricated	Strongly Disagree – Strongly Agree (7-point Likert scale)	Please respond to the following statements to the best of your ability.

Variables	Number of items	Sample items	Response choices	Instructions
<b>Open Ended Qualitative Items</b>	5	What immediately comes to mind when thinking of childhood immunization? <sup>78</sup>  What would influence your decision to have [CHILD] vaccinated or not against HPV? <sup>c</sup>	Free-text responses	

**Note.** <sup>a</sup>Survey is terminated if participant selects option “No”; <sup>b</sup>Items were administered in a random order; <sup>c</sup>Participants were asked at the beginning of the questionnaire to provide a name, nickname, initials or abbreviations for their child who is between the ages of 9 and 16 and who has had the *most recent birthday*. Using intelligence programming, parents’ child initials, name, nickname (e.g., Alex, PT, Jess) was then replaced for “[CHILD]” in all items, making the questionnaire individualized for each participant; <sup>d</sup>If the respondent selected the option of ‘Not applicable I have never heard about the HPV vaccine before today’ then all other options will disappear.

# BMJ Open

## Investigating Canadian parents' HPV vaccine knowledge, attitudes, and behaviour: A study protocol for a longitudinal national online survey

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## Investigating Canadian parents' HPV vaccine knowledge, attitudes, and behaviour: A study protocol for a longitudinal national online survey

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## ABSTRACT

**Introduction:** Human papillomavirus (HPV), a sexually transmitted infection, can cause anogenital warts and a number of cancers. To prevent morbidity and mortality, three vaccines have been licensed and are recommended by Canada's National Advisory Committee on Immunization (for girls since 2007 and boys since 2012). Nevertheless, HPV vaccine coverage in Canada remains suboptimal in many regions. This study will be the first to concurrently examine the correlates of HPV vaccine decision-making in parents of school-aged girls and boys, and evaluate changes in parental knowledge, attitudes and behaviours over time.

**Methods and analysis:** Using a national, online survey utilizing theoretically driven constructs and validated measures, this study will identify HPV vaccine coverage rates and correlates of vaccine decision-making in Canada at two time points (August-September, 2016; and June-July, 2017). 4606 participants will be recruited to participate in an online survey through a market research and polling firm using email invitations. Data cleaning methods will identify inattentive or unmotivated participants.

**Ethics and dissemination:** The study received research ethics board approval from the Research Review Office, Integrated Health and Social Services University Network for West-Central Montreal (CODIM-FLP-16-219). The study will adopt a multi-modal approach to disseminate the study's findings to researchers, clinicians, cancer and immunization organizations, and the public in Canada and internationally.

## KEYWORDS

Attitudes, behaviour, Canada, cancer prevention, decision-making, human papillomavirus, knowledge, sexually transmitted infections, parents, vaccination.

## ARTICLE SUMMARY

### Strengths and limitations of this study:

- Strengths of the study include a large sample size (n=4606), a nationally representative sample, use of psychometrically validated scales, the use of theoretical frameworks, a mixed methods approach, a wider range of constructs than in previous studies, and sophisticated data cleaning techniques to exclude inattentive or unmotivated responders.
- Limitations of this study include relying on self-reported data.

## INTRODUCTION

Human papillomavirus (HPV) is the most common sexually transmitted infection.<sup>1-4</sup> While most HPV infections are asymptomatic and do not progress to disease,<sup>5-7</sup> some infections can cause substantial morbidity and mortality.<sup>8-11</sup> It is estimated that 5.2% of all worldwide cancers are attributable to HPV.<sup>11-13</sup> HPV-associated cancers include cervical, oropharyngeal, anal, vaginal, vulvar, and penile.<sup>9,11</sup> Combined, HPV is responsible for over 4,000 new cancer cases annually in Canada.<sup>9</sup> Certain strains of HPV (e.g. HPV 6/11) also cause anogenital warts.<sup>14</sup> HPV-associated disease can impact quality of life and accrue substantial costs to the health care system.<sup>9,10,15</sup>

Three prophylactic vaccines that prevent against the oncogenic strains of HPV have been developed and recommended: the bivalent Cervarix<sup>®</sup>, quadrivalent Gardasil<sup>®</sup>, and nonavalent Gardasil<sup>®</sup>9.<sup>16</sup> These vaccines are safe and effective.<sup>17-23</sup> Canada's National Advisory Committee on Immunization (NACI) has recommended the HPV vaccines for girls (since 2007) and boys (since 2012) ages 9 to 26.<sup>16,2</sup> From 2007 to 2010, all Canadian provinces and territories implemented publicly funded, school-based vaccination programs for girls, albeit at different ages (i.e. 9 to 13 years of age) and with different dosing schedules (i.e. two or three doses).<sup>24,25</sup> Vaccinating children at this age provides the highest level of immunogenicity and protects individuals before they are sexually active and thereby at risk of infection.<sup>9,20</sup> This approach is similar to the majority of countries that provide publicly funded HPV vaccination programs to girls.<sup>26</sup>

To date, only a handful of countries have extended their publicly funded, school-based HPV vaccination programs to boys.<sup>27,25,28</sup> Canada has been an international leader in providing gender-neutral HPV vaccination,<sup>25</sup> by September 2017, 10 of Canada's 13 regions will have commenced school-based HPV vaccination programs that include boys (Figure 1).<sup>29-36</sup> However, implementation of male HPV vaccination across Canada has been staggered, presenting a natural experiment to evaluate and compare the impact of the introduction of the HPV program on parents' attitudes, knowledge, and vaccine coverage.

Achieving high levels of vaccine coverage protects individuals and helps prevent transmission to unvaccinated partners, which maximizes population-level effectiveness (i.e. through herd protection).<sup>37</sup> HPV vaccination programs in Canada are not reaching their target

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3 rates of immunization.<sup>38 39</sup> HPV vaccine uptake rates in Canada vary considerably by region; in  
4 a national survey of parents of 12-14 year old girls, Gilbert et al. reported vaccination rates  
5 between 52.6% and 89.7% (2013 data).<sup>40</sup> On average, HPV vaccine uptake across Canada was  
6 72.3%.<sup>40</sup> Preliminary evidence for boys in P.E.I.'s school-based vaccination program indicates  
7 85.4% vaccine uptake (2013/2014 data).<sup>29</sup> However, a national survey of Canadian parents  
8 found uptake rates for boys in the context of (only one then two) publicly funded school-based  
9 programs, was extremely low (<3% nationwide; 2013 data).<sup>41</sup> The lack of a national  
10 immunization registry makes it difficult to compare HPV vaccine coverage rates, and no national  
11 survey has yet examined HPV vaccine coverage in boys and girls simultaneously.

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Given that parental consent is required for school-based immunisation programs for children in Canada, the NACI and Canadian Immunization Committee (CIC) have made it a research priority to understand why parents delay or refuse to vaccinate their children.<sup>9 24</sup> Accordingly, this study seeks to understand the sociodemographic, psychosocial, and behavioural correlates of HPV vaccine coverage. Over the last decade, a number of studies have identified factors associated with HPV vaccination decision making including demographics, knowledge, attitudes, social norms, logistics (e.g. time, effort), and cost.<sup>42-53</sup> The evidence has indicated some common themes (e.g. the importance of physician recommendation, perceived benefit, perceived safety, cost), and some contradictory evidence (e.g. knowledge has been found to correlate both negatively and positively with vaccine acceptance).<sup>48 49 54</sup> The degree to which each of these factors contributes (i.e. the effect size) and possible policy variations between jurisdictions remains largely unclear. In addition, despite several systematic reviews,<sup>48 49 51 53 55</sup> not all potentially relevant factors (e.g. the effect of vaccine conspiracy beliefs) have been identified or comprehensively investigated in large population-based studies, especially in the Canadian context.<sup>56</sup> Furthermore, the majority of studies addressing parental HPV vaccine decision-making have been primarily focused on parents of girls,<sup>40 57</sup> with fewer studies evaluating and making comparisons with parental HPV vaccine decision-making for boys.<sup>58-60</sup>

The present study aims to address these research gaps. Using a national, online survey utilizing theoretically driven constructs and validated questionnaires, this study identifies HPV vaccine coverage and correlates of decision-making in Canada. It will be the first to study concurrently the correlates of decision-making in Canadian parents of eligible school-aged boys and girls. This study will administer a survey at two time points (August-September, 2016; and

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3 June-July, 2017) to capture important factors related to HPV vaccine hesitancy, acceptance and  
4 variation over time. Accordingly, this study will elucidate psychosocial factors that influence  
5 parents to vaccinate their sons or daughters contemporaneously and evaluate changes in parental  
6 knowledge, attitudes and behaviours over time.  
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## 10 11 12 **Study Objectives and Hypotheses**

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16 The main objectives of this study are:

### 17 18 19 **1. To describe HPV vaccine coverage in Canadian boys and girls**

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23 In the absence of a national immunization registry,<sup>61</sup> current information on HPV vaccine  
24 coverage is unclear and continually evolving. We aim to determine HPV vaccine coverage in  
25 boys and girls nationally and across Canadian jurisdiction, and how rates change over time.  
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### 29 30 31 **2. To assess the correlates of HPV vaccination in parents of boys and girls**

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34 In order to improve programs, it is important to understand the factors associated with  
35 HPV vaccine uptake. To date, Canadian studies have assessed the correlates of HPV vaccine  
36 uptake in parents of girls and parents of boys separately.<sup>52 58</sup> Because the HPV vaccine is  
37 available to girls and boys of varying ages, we aim to understand the determinants of HPV  
38 vaccine uptake in these groups, using constructs from the Health Belief Model (HBM), a  
39 commonly used theoretical model that includes core beliefs that are hypothesized to predict the  
40 adoption of new health behaviours.<sup>62</sup> The HBM has been used to examine various health-related  
41 behaviours, including cancer prevention and vaccination.<sup>63 64</sup> As applied to HPV vaccination,  
42 elements of the HBM include perceived benefits of, and barriers to, HPV vaccination; perceived  
43 severity of, and susceptibility to, HPV infection and disease; and external influences prompting  
44 HPV vaccine uptake (i.e. cues to action). This study will use HBM constructs and other  
45 important predictors to evaluate, compare, and contrast. We hypothesize that higher HPV  
46 vaccine uptake will be significantly related to greater HPV knowledge, HBM constructs  
47 (particularly lower 'barriers' and more 'cues to action'), non-HBM attitudinal constructs (e.g.  
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3 lower vaccine conspiracy beliefs), and health care provider (HCP) recommendation. In parents  
4 of boys, a publicly funded program (that reduces barriers of cost and access) and HCP  
5 recommendation are hypothesized to be particularly important.  
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### 10 **3. To identify Canadian parents' stage of decision-making by gender and province**

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14 Few studies have examined the stages of parents' vaccine decision. Assessing differences  
15 in parents' HPV vaccine decision-making stage is important for identifying how best to intervene  
16 for parents at different stages.<sup>58 65</sup> Using the Precaution Adoption Process Model (PAPM), a  
17 stage-based theoretical model, we will classify parents according to their unique stage of HPV  
18 vaccine decision-making and examine the associated attitudes with that stage.<sup>65-67</sup> The PAPM, as  
19 applied to HPV vaccination, identifies individuals along six stages of decision-making: 1)  
20 *unaware* of the vaccine; 2) *unengaged* in the decision to vaccinate their child; 3) *undecided* about  
21 whether to vaccinate their child; 4) *decided not to act* (i.e. decided not to vaccinate their child);  
22 5) *decided to act* (i.e. decided to vaccinate their child); and 6) *acted* (i.e. vaccinated their child)  
23 (see Supplementary File). We will compare the stage of decision-making of parents of girls with  
24 boys, as well as the stages of parents in those regions that have publicly funded programs for  
25 boys (P.E.I., Alberta, Nova Scotia, Ontario, Quebec, Manitoba) with those that do not (i.e. British  
26 Columbia, New Brunswick, Newfoundland and Labrador, Northwest Territories, Nunavut,  
27 Saskatchewan, Yukon). We hypothesize that parents of boys will be in earlier PAPM stages  
28 compared to parents of girls, and that parents of boys in regions without an HPV vaccine  
29 program will be in earlier stages compared to parents of boys in regions with a program.  
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### 44 **4. To determine the impact of publicly funded HPV vaccine program initiation for boys**

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47 HPV vaccination programs for boys were implemented in Quebec, Ontario and Manitoba  
48 in the Fall of 2016, which is after Time 1 survey administration (August-September 2016), but  
49 before launching the Time 2 survey (June-July 2017). This natural experiment allows us to  
50 evaluate the impact of introducing a public school-based HPV vaccination program on parents'  
51 HPV vaccine knowledge, attitudes, and HPV vaccine coverage. Accordingly, we will assess  
52 whether these factors change from Time 1 to Time 2. We hypothesize that compared to programs  
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3 with no change to their public vaccination program, at Time 2 (post-intervention) parents of boys  
4 in Manitoba, Ontario and Quebec will have increased HPV vaccine knowledge, more positive  
5 HPV vaccine attitudes, be more likely to have received a HCP's recommendation, and be more  
6 likely to have received the HPV vaccine. British Columbia, Saskatchewan, New Brunswick, and  
7 Newfoundland and Labrador have announced that they would fund HPV vaccine for boys to  
8 begin in September 2017 (Figure 1); this research will therefore have value in predicting how  
9 parental attitudes regarding vaccinating their sons might change in those jurisdictions.  
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## 20 **METHODS AND ANALYSIS**

### 21 **Study Design**

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27 This study uses a longitudinal design to collect self-reported data through an online  
28 questionnaire from a large national sample of Canadian parents. Surveys are administered at two  
29 time points: Time 1 during August-September (2016) and Time 2 during June-July (2017).  
30 Participants who responded to the survey at Time 1 were contacted again at Time 2 using the  
31 same questionnaire.  
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### 37 **Sample**

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41 This study targets parents and guardians (hereafter referred to as "parents") of 9 to 16-  
42 year-old boys and girls across Canada. This population is targeted because, on the younger side  
43 (i.e. age 9), it includes the youngest children included in NACI's recommendation and, on the  
44 older side (i.e. age 16), it includes children who, generally speaking, require parental consent in  
45 Canada.<sup>68</sup> Parents will be recruited by Canada's largest market research and polling firm, Leger-  
46 *The Research Intelligence Group*. Leger maintains a national panel of 400,000 Canadians who  
47 have Internet access, reside in Canada, and are fluent in English or French. This study targeted  
48 parents who have a child between 9-16 years of age living in their household. Participants  
49 completing the questionnaire at Time 1 will be contacted again at Time 2.  
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57 Leger's panels include individuals of all profiles with regard to gender, age, education  
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3 level, household composition and income for all regions, making it feasible to effectively target  
4 specific participants.<sup>67</sup> The panel is constructed to be nationally, as well as regionally,  
5 representative. Leger uses proprietary software informed by Canada's census data in order to  
6 generate a representative sample of the population. Leger's software follows an interactive  
7 algorithm to invite participants according to specified eligibility criteria. In this study, Leger's  
8 software enables extraction of all active and available panellists who meet the screening criteria,  
9 random sorting of the selected sample pool, examination of the number of panellists who satisfy  
10 each target group (i.e. parents of a 9-16 year old boys or parents of a 9-16 year old girls), and  
11 recalculation and balancing of the sample across the target groups. To recruit participants, Leger  
12 sends an email invitation and survey link to selected panellists. Leger sends a maximum of three  
13 reminder emails to its selected panellists to complete the survey until the required numbers of  
14 participants are recruited.

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16 This study's sample size calculation takes into account previous research indicating that  
17 approximately 15% of respondents are inattentive or unmotivated responders who would be  
18 excluded using rigorous data cleaning methods.<sup>66 69</sup> To evaluate different stages of decision  
19 making (objective 3), we are guided by previous research that found few individuals in particular  
20 stages (especially in less populated regions).<sup>66</sup> An attrition rate (of approximately 40-50%) from  
21 the first wave of data collection (Time 1, August-September 2016) to the second wave (Time 2,  
22 June-July 2017) is also expected.<sup>66</sup> Therefore, in order to attain a sufficient number of  
23 respondents to enable analyses of HPV vaccine decision-making by stage and region, this study  
24 recruits approximately 4,600 parents of school-aged children (ages 9-16) at Time 1, equally  
25 divided between parents of boys and parents of girls.

## 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 **Measures**

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47 We use an online questionnaire that incorporates intelligent programming, such that the  
48 child's first name is included in the survey questions and parents receive questions that are  
49 personalized for them. Questionnaire items include previously validated scales.<sup>70-74</sup> Participants  
50 will be asked to identify themselves as a parent or guardian, report the number of children they  
51 have, and their children's ages and genders. Parents with more than one child who meets the  
52 inclusion criteria will be asked to answer the questionnaire for the child who has had the most  
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3 recent birthday, a randomization technique previously employed.<sup>66</sup> The questionnaire assesses  
4 socio-demographics; HPV and HPV vaccine knowledge (using validated scales);<sup>71</sup> PAPM stage;  
5 HPV vaccine willingness; HPV vaccine coverage; HCP recommendation (including the strength  
6 of the recommendation); HPV attitudes (using validated scales);<sup>73 75</sup> motivation towards  
7 vaccination; vaccine hesitancy (using a developed scale);<sup>74</sup> and vaccine conspiracy beliefs (using  
8 a validated scale).<sup>70</sup> Items within validated questionnaires are administered in a random order to  
9 ameliorate any order effect and invariant responding.<sup>76</sup> Five open-ended qualitative questions  
10 will provide nuance in capturing details of parents' subjective perspectives on decision-making.<sup>77</sup>  
11 A detailed description of the questionnaire's items can be found in the Supplementary File.  
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14 To take into account language and literacy level, the questionnaire was adjusted to a  
15 grade eight reading level. To ensure the questionnaire could be answered in either of Canada's  
16 national languages, the English questionnaire was translated into French using Asiatis, an  
17 international translation service company. Bilingual team members verified the French  
18 translation and back-translation.  
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## 20 21 22 23 24 25 26 27 28 29 30 **Data Collection and Management**

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33 Leger will facilitate data collection. Participants will be sent an email invitation to  
34 participate in a questionnaire and then assigned a unique access number. By accessing the  
35 questionnaire with this unique number, the respondent enters a secure account that ensures  
36 confidentiality. Moreover, if necessary, respondents may stop and resume the questionnaire  
37 where they left off so that they participate at a time that best suits them, allowing them to  
38 complete the questionnaire conscientiously.  
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44 Participants will be paid a modest cash amount in accordance with standard panel  
45 member compensation of Leger. Data collection at both time periods will be completed within  
46 four weeks. Missing data will not be an obstacle in this survey because participants will be  
47 required to answer all questions before moving from one page to the next. Once participants  
48 complete the questionnaire they will be debriefed, informed about HPV vaccination, and  
49 provided with informational resources. Leger will transfer the anonymized raw data file to our  
50 research team, which will be stored on a secure server at the Lady Davis Institute for Medical  
51 Research site of the Integrated Health and Social Services University Network for West-Central  
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## 7 **Data Cleaning Procedure**

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10 As recommended in the literature,<sup>69 76 78</sup> data cleaning methods will be used to identify  
11 participants who might not have used appropriate care while completing the questionnaire (i.e.  
12 inattentive or unmotivated responders). Consistent with DeSimone et al. (2015) and Perez et al.  
13 (2016), we will use data cleaning methods that are direct (i.e. bogus items) and statistical (i.e.  
14 psychometric synonyms and psychometric antonyms).<sup>66 76</sup>  
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19 Bogus items will be used to screen inattentive or unmotivated responders. Two bogus  
20 items on Likert scales were randomly inserted into the survey: “I have never met anyone younger  
21 than I am” and “I have been to every country in the world” (measured from ‘1-strongly disagree’  
22 to ‘7-strongly agree’). Incorrect answers (i.e. agreement) to both bogus items suggest inattentive  
23 or unmotivated responders. Incorrect responses are indicative of lack of attention. Respondents  
24 who answer at least one bogus item correctly will be retained.  
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30 Psychometric synonyms and antonyms data cleaning methods statistically examines  
31 response patterns.<sup>66</sup> Providing different responses to similar items suggests insufficient attention  
32 and accuracy in answering the questionnaire. Items measured on Likert scales will be selected  
33 and inter-item correlations will be calculated. Positively correlated pairs of items will constitute  
34 psychometric synonyms while negatively correlated pairs will constitute psychometric  
35 antonyms.<sup>76</sup> The number of pairs cannot be anticipated before beginning data analysis because it  
36 depends on the degree of correlation and the chosen cut-off value of the correlation coefficient.<sup>76</sup>  
37 We will use an inter-item Pearson correlation cut-off of 0.60 and -0.60 for selecting  
38 psychometric synonyms and psychometric antonyms pairs respectively, consistent with  
39 recommendations of Meade and Craig (2012).<sup>78</sup> Once the pairs have been identified, an index  
40 will be calculated for each respondent by correlating the responses to the first items of the pairs  
41 with the responses to the second items of the pairs.  
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51 Responders who meet both the bogus item and the psychometric synonyms/antonyms  
52 criteria will be considered attentive responders and retained.  
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## 56 **Data Analysis Plan**

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5 In line with the first research objective to provide an accurate description of HPV vaccine  
6 coverage, we will report HPV vaccination coverage as percentage of girls and boys in each  
7 region and age group whose parents report they have received one, two, or three doses of the  
8 HPV vaccine. To test for statistically significant differences in proportions, we will use  
9 Pearson's Chi square tests and two sample tests of proportions.  
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14 For the second objective, to assess the correlates of HPV vaccine uptake in Canada, HPV  
15 vaccine uptake (dependent variable) will be dichotomised into "vaccinated" (i.e. received at least  
16 one dose of the HPV vaccine) and "non-vaccinated". Logistic regressions will be used to  
17 estimate the odds of vaccine uptake based on the correlates of interest, including socio-  
18 demographics, attitudes (informed by the HBM), knowledge, and behaviours (e.g. discussion  
19 with HCP). Significant associations between the correlates and vaccine uptake will be tested  
20 using bivariate logistic regression analyses. Multivariate logistic regression modelling will then  
21 be performed with all correlates from the bivariate analysis entered simultaneously. The model  
22 will be tested for goodness of fit, discrimination capacity, and multicollinearity.  
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30 To identify Canadian parents' stage of decision-making by gender and region (objective  
31 3), we will report parents' HPV vaccine decision-making in percentages based on the six stages  
32 of the PAPM. For assessing significant differences in PAPM stage based on gender (at Time 1)  
33 and availability of publicly funded HPV vaccination programs for boys (at both Time 1 and  
34 Time 2), Pearson chi-square test and two sample tests of proportions will be used.  
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39 Lastly, to determine the impact of publicly funded HPV vaccine program initiation for  
40 boys in some regions, we will examine changes in parents' of boys (HPV and HPV vaccine)  
41 knowledge and attitudes (e.g. on the Human papillomavirus Attitudes and Beliefs Scale, Vaccine  
42 Conspiracy Beliefs Scale, and Vaccine Hesitancy Scale) before and after the introduction of the  
43 funded program. Parents of boys in provinces that introduced the program will be compared to  
44 parents of boys in regions with no change to their program. Significant differences from Time 1  
45 to Time 2 will be tested using paired T-tests.  
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## 55 **ETHICS AND DISSEMINATION**

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## Study Ethics

The study received research ethics board approval from the Research Review Office, Integrated Health and Social Services University Network for West-Central Montreal (CODIM-FLP-16-219). This is a university-affiliated teaching health care network where the coordinating centre (Lady Davis Institute for Medical Research) is based. Study participants consented to Leger's terms of use and privacy policy, which indicates that their data will be used anonymously for the research study.

## Dissemination Plan

The study will adopt a multi-modal approach to disseminate the study's results to researchers, clinicians, cancer and vaccination organizations, and the public in Canada and internationally. Study findings will be published in peer-reviewed scientific journals (including open source). To assure wide availability of our results to the research community, journals will be selected that reach both research and health professional audiences.

Presentations will be made at national and international scientific meetings and symposia, such as the Canadian Immunization Conference, Canadian Association of Psychosocial Oncology, International Papillomavirus Society conference, and the International Psycho-Oncology Society. In addition, we will share the results with NACI, CIC, and provincial immunization advisory boards.

Given that the data is timely and could have immediate, direct implications for public education of Canadian parents, and more widespread influence on public health policy, we will prioritize analysis and dissemination of projects that have a potential for proximal public impact. We hope that sharing outcomes with non-profit organizations (e.g. the Canadian Cancer Society) will provide important platforms for innovative educational interventions based on this study's findings.

We will draft lay research summaries in media releases for dissemination to national media outlets and use such releases to help the public understand the importance of this research, bring the issues and challenges related to HPV vaccine acceptance to the public domain that will inform discussions about HPV vaccination.

## DISCUSSION

### Study Implications

By surveying a population-based representative sample of parents of eligible children, this study will provide current information about HPV vaccine coverage rates for both boys and girls nationally, and across Canadian jurisdictions (objective 1). Since HPV vaccine programs and policies are constantly evolving,<sup>25</sup> it is timely to evaluate comprehensively variations in program outcomes that target girls and boys, jurisdictions at a national and local level, and HPV vaccination by socio-demographic groups. For this reason, this study will be useful to policymakers in understanding where the HPV vaccination programs are meeting coverage targets, where disparities in vaccination exist, and which groups or jurisdictions may benefit from interventions designed to increase vaccination.

In order to improve the impact of publicly funded HPV vaccination programs, this study will examine the psychosocial and behavioural factors associated with parents' decisions to vaccinate their children and their decision-making stage (objectives 2 and 3). These theoretically driven investigations will enable policymakers to develop interventions to increase HPV vaccination that are evidence-based, tailored, and targeted towards parents' unique informational needs and their stage of decision-making, rather than providing all parents with the same messages.

Lastly, since Canada is one of the few countries that have implemented publicly-funded, national HPV vaccination programs, this research will make use of a natural experiment to evaluate the impact of the introduction of funded programs for boys on parents' vaccine knowledge, attitudes, and decision to vaccinate (objective 4). The results of this study will improve our understanding of the complex interplay of psychosocial and behavioural factors with policy decisions. By understanding this complexity, other countries can better anticipate that impact of policy changes.

The results generated by the study's four objectives will provide public health officials with critical information about HPV vaccination programs, improve the fields' understanding of

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3 influencers of decision-making, improve and enhance the delivery of current publicly funded  
4 HPV vaccination program, facilitate HPV vaccine uptake, and in turn decrease Canada's cancer  
5 burden and the associated human and economic cost.  
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### 10 **Methodological Strengths**

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14 The recruitment strategy of using a marketing company (Leger) that maintains a  
15 nationally representative panel for data collection enables the sampling of a large number of  
16 parents who answer the survey within a short time frame. The precise recruitment period allows  
17 for data collection to occur in a timely manner and the provision of a snapshot of responses  
18 before and after the implementation of the HPV vaccination program for boys in certain  
19 provinces.  
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24 In addition, we use an online survey methodology with intelligent programming, which  
25 increases the quality of collected data by personalizing and tailoring the survey for each  
26 participant. This study also avoids the problems associated with missing data. To avoid the  
27 limitation of inattentive or unmotivated responding that is often found in survey data, this study  
28 will utilize sophisticated data cleaning techniques to remove such responders.  
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33 Further, the measures used in this study include psychometrically validated scales (where  
34 possible), which increase the reliability and validity of our results. Our survey also assesses  
35 diverse constructs. By using theoretical frameworks (such as the HBM and PAPM), we will be  
36 able to better understand the vaccine acceptability process, which is important in nuanced  
37 targeting of interventions. Lastly, by including quantitative and qualitative (open-ended)  
38 questions, we will be able to conduct additional mixed-methods studies to examine in-depth  
39 explanations of HPV vaccine decision making at different stage levels.  
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### 48 **Foreseeable Limitations**

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51 One limitation of this study is the reliance on parents' self-reports of vaccination status  
52 for their children. In order to minimize this limitation, parents are asked about their vaccination  
53 status before and after reading an informative statement (whereby parents are provided details  
54 about the HPV vaccine). The exact number of reported doses (two or three) could also be  
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3 inaccurate. A possible way to confirm immunisation status is to request parents to check the  
4 immunisation record, contact the family doctor, or link to provincial immunization records.  
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6 However, requesting participants to access records was not feasible in our study as such a request  
7 would have significantly increased the data collection time and costs. Another limitation of this  
8 study's design is that because we assess the same population at two time points, this study does  
9 not control for knowledge changes that occur as a result of the first survey. As our study's  
10 objective (objective four) is to compare provinces with and without provincial funding, this study  
11 makes the assumption that knowledge changes as a result of the first survey effects individuals  
12 from all provinces equally.  
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4 **Figure 1 Legend:** This figure identifies the year that publicly funded school based HPV vaccine  
5 programs were initiated for girls and boys by Canadian jurisdiction.  
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9 **Acknowledgements:** The authors appreciate the guidance and expertise of Dr. Eve Dubé, Dr.  
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15 manuscript. AN and OT participated in designing the study, assisted in drafting the manuscript,  
16 and provided critical feedback on manuscript revisions. SP, JG, GZ, RA provided critical  
17 feedback on manuscript revisions. ZR conceived and designed the study, developed the survey,  
18 and provided critical feedback on manuscript revisions. All authors read and approved the final  
19 manuscript.  
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36 during the conduct of the study, and personal fees from Merck outside the submitted work. GZ  
37 reports grants from Merck, and personal fees from Sanofi Pasteur, outside the submitted work.  
38 The remaining authors declare no conflict of interest.  
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44 **Ethics approval:** The study received research ethics board approval from the Research Review  
45 Office, Integrated Health and Social Services University Network for West-Central Montreal  
46 (CODIM-FLP-16-219).  
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50 **Data sharing statement:** Please contact the corresponding author if you are interested in using  
51 our survey or data.  
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## REFERENCES

1. Shearer BD. HPV Vaccination: Understanding the Impact on HPV Disease. *Purple Paper* 2011; 34. [http://www.nccid.ca/files/Purple\\_Paper\\_Note\\_mauve/PP\\_34\\_EN.pdf](http://www.nccid.ca/files/Purple_Paper_Note_mauve/PP_34_EN.pdf).
2. National Advisory Committee on Immunization. Update on the recommended Human Papillomavirus vaccine immunization schedule 2015 [Available from: [http://publications.gc.ca/collections/collection\\_2015/aspc-phac/HP40-128-2014-eng.pdf](http://publications.gc.ca/collections/collection_2015/aspc-phac/HP40-128-2014-eng.pdf) accessed May 08 2017.
3. Crosbie EJ, Einstein MH, Franceschi S, et al. Human papillomavirus and cervical cancer. *Lancet* 2013;382(9895):889-99. doi: 10.1016/S0140-6736(13)60022-7
4. Moore RA, Ogilvie G, Fornika D, et al. Prevalence and type distribution of human papillomavirus in 5,000 British Columbia women--implications for vaccination. *Cancer Causes Control* 2009;20(8):1387-96. doi: 10.1007/s10552-009-9365-4
5. Little KQ, Ogilvie G, Mirwaldt P. Human papillomavirus awareness, knowledge, and vaccination status in a diverse population of male postsecondary students in Greater Vancouver. *British Columbia Medical Journal* 2015;57(2)
6. Parkin DM, Bray F. The burden of HPV-related cancers. *Vaccine* 2006;24:S11-S25.
7. Steben M, Duarte-Franco E. Human papillomavirus infection: epidemiology and pathophysiology. *Gynecol Oncol* 2007;107(2 Suppl 1):S2-5. doi: 10.1016/j.ygyno.2007.07.067
8. Bouvard V, Baan R, Straif K, et al. A review of human carcinogens - Part B: biological agents. *The Lancet Oncol* 2009;10(4):321-22.
9. National Advisory Committee on Immunization. Update On Human Papillomavirus Vaccines. *Canada Communicable Disease Report* 2012;38
10. Forman D, de Martel C, Lacey CJ, et al. Global burden of human papillomavirus and related diseases. *Vaccine* 2012;30 Suppl 5:F12-23. doi: 10.1016/j.vaccine.2012.07.055
11. de Martel C, Ferlay J, Franceschi S, et al. Global burden of cancers attributable to infections in 2008: a review and synthetic analysis. *Lancet Oncol* 2012;13(6):607-15. doi: 10.1016/S1470-2045(12)70137-7
12. Parkin DM. The global health burden of infection-associated cancers in the year 2002. *Int J Cancer* 2006;118(12):3030-44. doi: 10.1002/ijc.21731
13. Oh JK, Weiderpass E. Infection and cancer: global distribution and burden of diseases. *Ann Glob Health* 2014;80(5):384-92. doi: 10.1016/j.aogh.2014.09.013
14. Ball SL, Winder DM, Vaughan K, et al. Analyses of human papillomavirus genotypes and viral loads in anogenital warts. *J Med Virol* 2011;83(8):1345-50. doi: 10.1002/jmv.22111
15. Marra F, Ogilvie G, Colley L, et al. Epidemiology and costs associated with genital warts in Canada. *Sex Transm Infect* 2009;85(2):111-5. doi: 10.1136/sti.2008.030999
16. An Advisory Committee Statement (ACS) National Advisory Committee on Immunization (NACI). Updated Recommendations on Human Papillomavirus (HPV) vaccines: 9-valent HPV vaccine and clarification of minimum intervals between doses in the HPV immunization schedules Ontario, Canada 2016 [Available from: <http://www.healthycanadians.gc.ca/publications/healthy-living-vie-saine/human-papillomavirus-9-valent-vaccine-update-recommendation-mises-a-jour->

- [recommandations-papillome-humain-vaccin-nonavalent/alt/hpv-phv-eng.pdf](#) accessed February 14 2017.
17. Szarewski A, Poppe WA, Skinner SR, et al. Efficacy of the human papillomavirus (HPV)-16/18 AS04-adjuvanted vaccine in women aged 15-25 years with and without serological evidence of previous exposure to HPV-16/18. *Int J Cancer* 2012;131(1):106-16. doi: 10.1002/ijc.26362
  18. Kjaer SK, Sigurdsson K, Iversen OE, et al. A pooled analysis of continued prophylactic efficacy of quadrivalent human papillomavirus (Types 6/11/16/18) vaccine against high-grade cervical and external genital lesions. *Cancer Prev Res (Phila)* 2009;2(10):868-78. doi: 10.1158/1940-6207.CAPR-09-0031
  19. Group FIIS, Dillner J, Kjaer SK, et al. Four year efficacy of prophylactic human papillomavirus quadrivalent vaccine against low grade cervical, vulvar, and vaginal intraepithelial neoplasia and anogenital warts: randomised controlled trial. *BMJ* 2010;341:c3493. doi: 10.1136/bmj.c3493
  20. Ferris D, Samakoses R, Block SL, et al. Long-term study of a quadrivalent human papillomavirus vaccine. *Pediatrics* 2014;134(3):e657-65. doi: 10.1542/peds.2013-4144
  21. Munoz N, Kjaer SK, Sigurdsson K, et al. Impact of human papillomavirus (HPV)-6/11/16/18 vaccine on all HPV-associated genital diseases in young women. *J Natl Cancer Inst* 2010;102(5):325-39. doi: 10.1093/jnci/djp534
  22. Stillo M, Carrillo Santistevé P, Lopalco PL. Safety of human papillomavirus vaccines: a review. *Expert Opin Drug Saf* 2015;14(5):697-712. doi: 10.1517/14740338.2015.1013532
  23. Ogilvie GS, Naus M, Money DM, et al. Reduction in cervical intraepithelial neoplasia in young women in British Columbia after introduction of the HPV vaccine: An ecological analysis. *Int J Cancer* 2015;137(8):1931-7. doi: 10.1002/ijc.29508
  24. Canadian Immunization Committee. Recommendations for human papillomavirus immunization programs. *Canada Communicable Disease Report* 2014;40(8)
  25. Shapiro GK, Guichon J, Prue G, et al. A Multiple Streams analysis of the decisions to fund gender-neutral HPV vaccination in Canada. *Prev Med* 2017;100:123-31. doi: 10.1016/j.ypmed.2017.04.016
  26. Bonanni P, Bechini A, Donato R, et al. Human papilloma virus vaccination: impact and recommendations across the world. *Ther Adv Vaccines* 2015;3(1):3-12. doi: 10.1177/2051013614557476
  27. Marsh K, Chapman R, Baggaley RF, et al. Mind the gaps: what's missing from current economic evaluations of universal HPV vaccination? *Vaccine* 2014;32(30):3732-9. doi: 10.1016/j.vaccine.2014.05.007
  28. Patel C, Macartney K. Supporting the call for a gender-neutral human papillomavirus vaccination in Canada. *Cmaj* 2017;189(3):E118. doi: 10.1503/cmaj.732446
  29. McClure CA, MacSwain MA, Morrison H, et al. Human papillomavirus vaccine uptake in boys and girls in a school-based vaccine delivery program in Prince Edward Island, Canada. *Vaccine* 2015;33(15):1786-90. doi: 10.1016/j.vaccine.2015.02.047
  30. Public Health Agency of Canada. Canada's Provincial and Territorial Routine (and Catch-up) Vaccination Programs for Infants and Children. 2017 [Available from: <http://www.phac-aspc.gc.ca/im/ptimprog-progimpt/table-1-eng.php> accessed May 08 2017.

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  - 52
  - 53
  - 54
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31. Colbert Y. HPV vaccine for Nova Scotia boys called 'groundbreaking': CBC News; 2015 [Available from: <http://www.cbc.ca/news/canada/nova-scotia/hpv-vaccine-for-nova-scotia-boys-called-groundbreaking-1.3031169> accessed May 07 2017.
32. Shapiro GK, Perez S, Rosberger Z. Including males in Canadian human papillomavirus vaccination programs: a policy analysis. *Cmaj* 2016;188(12):881-6. doi: 10.1503/cmaj.150451
33. Ghossoub M. B.C. extends free HPV vaccinations to Grade 6 boys - British Columbia 2017 [updated Jan 06, 2017. Available from: <http://www.cbc.ca/news/canada/british-columbia/b-c-extends-free-hpv-vaccinations-to-grade-6-boys-1.3925212>.
34. Cover JK, Nghi NQ, LaMontagne DS, et al. Acceptance patterns and decision-making for human papillomavirus vaccination among parents in Vietnam: an in-depth qualitative study post-vaccination. *BMC Public Health* 2012;12:629. doi: 10.1186/1471-2458-12-629
35. Fong K. Grade 6 boys to start receiving HPV vaccination in Saskatchewan 2017 [updated March 23, 2017. Available from: <http://globalnews.ca/news/3331430/grade-6-boys-to-start-receiving-hpv-vaccinations-in-sask/> accessed May 08 2017.
36. Boone M. Boys too: HPV vaccination to be offered to all N.L. students in Grade 6 2017 [updated May 04, 2017. Available from: <http://www.cbc.ca/news/canada/newfoundland-labrador/hpv-vaccine-boys-newfoundland-1.4098941> accessed May 08 2017.
37. Drolet M, Benard E, Boily MC, et al. Population-level impact and herd effects following human papillomavirus vaccination programmes: a systematic review and meta-analysis. *Lancet Infect Dis* 2015;15(5):565-80. doi: 10.1016/S1473-3099(14)71073-4
38. Ministère de la Santé et des Services Sociaux. Programme National de Santé Publique. 2008. <http://publications.msss.gouv.qc.ca/acrobat/f/documentation/2008/08-216-01.pdf>.
39. Bogaards JA, Wallinga J, Brakenhoff RH, et al. Direct benefit of vaccinating boys along with girls against oncogenic human papillomavirus: bayesian evidence synthesis. *BMJ* 2015;350:h2016. doi: 10.1136/bmj.h2016
40. Gilbert NL, Gilmour H, Dube E, et al. Estimates and determinants of HPV non-vaccination and vaccine refusal in girls 12 to 14 y of age in Canada: Results from the Childhood National Immunization Coverage Survey, 2013. *Hum Vaccin Immunother* 2016;12(6):1484-90. doi: 10.1080/21645515.2016.1153207
41. Perez S, Shapiro GK, Brown CA, et al. 'I didn't even know boys could get the vaccine': Parents' reasons for human papillomavirus (HPV) vaccination decision making for their sons. *Psychooncology* 2015;24(10):1316-23. doi: 10.1002/pon.3894
42. Ogilvie GS, Remple VP, Marra F, et al. Parental intention to have daughters receive the human papillomavirus vaccine. *Cmaj* 2007;177(12):1506-12. doi: 10.1503/cmaj.071022
43. Allen JD, Coronado GD, Williams RS, et al. A systematic review of measures used in studies of human papillomavirus (HPV) vaccine acceptability. *Vaccine* 2010;28(24):4027-37. doi: 10.1016/j.vaccine.2010.03.063
44. Krawczyk AL, Perez S, Lau E, et al. Human papillomavirus vaccination intentions and uptake in college women. *Health Psychol* 2012;31(5):685-93. doi: 10.1037/a0027012
45. Ogilvie GS, Remple VP, Marra F, et al. Intention of parents to have male children vaccinated with the human papillomavirus vaccine. *Sex Transm Infect* 2008;84(4):318-23. doi: 10.1136/sti.2007.029389

- 1
- 2
- 3
- 4 46. Lee A, Ho M, Cheung CK, et al. Factors influencing adolescent girls' decision in
- 5 initiation for human papillomavirus vaccination: a cross-sectional study in Hong Kong.
- 6 *BMC Public Health* 2014;14:925. doi: 10.1186/1471-2458-14-925
- 7
- 8 47. Zimet GD, Rosberger Z, Fisher WA, et al. Beliefs, behaviors and HPV vaccine:
- 9 correcting the myths and the misinformation. *Prev Med* 2013;57(5):414-8. doi:
- 10 10.1016/j.yjmed.2013.05.013
- 11
- 12 48. Hendry M, Lewis R, Clements A, et al. "HPV? Never heard of it!": a systematic review
- 13 of girls' and parents' information needs, views and preferences about human
- 14 papillomavirus vaccination. *Vaccine* 2013;31(45):5152-67. doi:
- 15 10.1016/j.vaccine.2013.08.091
- 16
- 17 49. Holman DM, Benard V, Roland KB, et al. Barriers to human papillomavirus vaccination
- 18 among US adolescents: a systematic review of the literature. *JAMA Pediatr*
- 19 2014;168(1):76-82. doi: 10.1001/jamapediatrics.2013.2752
- 20
- 21 50. Patel PR, Berenson AB. Sources of HPV vaccine hesitancy in parents. *Hum Vaccin*
- 22 *Immunother* 2013;9(12):2649-53. doi: 10.4161/hv.26224
- 23
- 24 51. Walhart T. Parents, adolescents, children and the human papillomavirus vaccine: a
- 25 review. *Int Nurs Rev* 2012;59(3):305-11. doi: 10.1111/j.1466-7657.2012.00991.x
- 26
- 27 52. Krawczyk A, Knauper B, Gilca V, et al. Parents' decision-making about the human
- 28 papillomavirus vaccine for their daughters: I. Quantitative results. *Hum Vaccin*
- 29 *Immunother* 2015;11(2):322-9. doi: 10.1080/21645515.2014.1004030
- 30
- 31 53. Trim K, Nagji N, Elit L, et al. Parental Knowledge, Attitudes, and Behaviours towards
- 32 Human Papillomavirus Vaccination for Their Children: A Systematic Review from 2001
- 33 to 2011. *Obstet Gynecol Int* 2012;2012:921236. doi: 10.1155/2012/921236
- 34
- 35 54. Gowda C, Dempsey AF. The rise (and fall?) of parental vaccine hesitancy. *Hum Vaccin*
- 36 *Immunother* 2013;9(8):1755-62. doi: 10.4161/hv.25085
- 37
- 38 55. Garcini LM, Galvan T, Barnack-Tavlaris JL. The study of human papillomavirus (HPV)
- 39 vaccine uptake from a parental perspective: a systematic review of observational studies
- 40 in the United States. *Vaccine* 2012;30(31):4588-95. doi: 10.1016/j.vaccine.2012.04.096
- 41
- 42 56. Larson HJ, Jarrett C, Eckersberger E, et al. Understanding vaccine hesitancy around
- 43 vaccines and vaccination from a global perspective: a systematic review of published
- 44 literature, 2007-2012. *Vaccine* 2014;32(19):2150-9. doi: 10.1016/j.vaccine.2014.01.081
- 45
- 46 57. Forster AS, Rockliffe L, Chorley AJ, et al. A qualitative systematic review of factors
- 47 influencing parents' vaccination decision-making in the United Kingdom. *SSM Popul*
- 48 *Health* 2016;2:603-12. doi: 10.1016/j.ssmph.2016.07.005
- 49
- 50 58. Perez S, Tatar O, Gilca V, et al. Untangling the psychosocial predictors of HPV
- 51 vaccination decision-making stages among parents of boys. *Vaccine* 2017;Forthcoming
- 52
- 53 59. Lindley MC, Jeyarajah J, Yankey D, et al. Comparing human papillomavirus vaccine
- 54 knowledge and intentions among parents of boys and girls. *Hum Vaccin Immunother*
- 55 2016;12(6):1519-27. doi: 10.1080/21645515.2016.1157673
- 56
- 57 60. Radisic G, Chapman J, Flight I, et al. Factors associated with parents' attitudes to the
- 58 HPV vaccination of their adolescent sons : A systematic review. *Prev Med* 2017;95:26-
- 59 37. doi: 10.1016/j.yjmed.2016.11.019
- 60
61. Government of Canada. Immunization coverage and registries 2016 [Available from:
- <https://www.canada.ca/en/public-health/services/immunization-coverage-registries.html#a3> accessed February 07 2017.



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62. Champion VL, Skinner CS. The Health Belief Model. In: Glanz K, Rimer BK, Viswanath KE, eds. Health behavior and health education: theory, research, and practice. 4th ed: John Wiley & Sons 2008:45-65.
63. Brewer NT, Fazekas KI. Predictors of HPV vaccine acceptability: a theory-informed, systematic review. *Prev Med* 2007;45(2-3):107-14. doi: 10.1016/j.ypmed.2007.05.013
64. Cunningham MS, Davison C, Aronson KJ. HPV vaccine acceptability in Africa: a systematic review. *Prev Med* 2014;69:274-9. doi: 10.1016/j.ypmed.2014.08.035
65. Prue G, Santin O. HPV vaccine acceptance in male adolescents. *Psychooncology* 2015;24(10):1327-29. doi: 10.1002/pon.3961
66. Perez S, Tatar O, Shapiro GK, et al. Psychosocial determinants of parental human papillomavirus (HPV) vaccine decision-making for sons: Methodological challenges and initial results of a pan-Canadian longitudinal study. *BMC Public Health* 2016;16(1):1223. doi: 10.1186/s12889-016-3828-9
67. Weinstein ND. The precaution adoption process. *Health Psychol* 1988;7(4):355-86.
68. Court of Appeal of Alberta. J.S.C. v. Wren, 1986 ABCA 249 (CanLII) 31-12-1986 [March 21, 2017]. Available from: <http://www.canlii.org/en/ab/abca/doc/1986/1986abca249/1986abca249.html>.
69. Osborne JW. Best practices in data cleaning: A complete guide to everything you need to do before and after collecting your data: Sage Publications 2012.
70. Shapiro GK, Holding A, Perez S, et al. Validation of the vaccine conspiracy beliefs scale. *Papillomavirus Research* 2016;2:167-72. doi: 10.1016/j.pvr.2016.09.001
71. Perez S, Tatar O, Ostini R, et al. Extending and validating a human papillomavirus (HPV) knowledge measure in a national sample of Canadian parents of boys. *Prev Med* 2016;91:43-49. doi: 10.1016/j.ypmed.2016.07.017
72. Waller J, Ostini R, Marlow LA, et al. Validation of a measure of knowledge about human papillomavirus (HPV) using item response theory and classical test theory. *Prev Med* 2013;56(1):35-40.
73. McRee AL, Brewer NT, Reiter PL, et al. The Carolina HPV immunization attitudes and beliefs scale (CHIAS): scale development and associations with intentions to vaccinate. *Sex Transm Dis* 2010;37(4):234-9. doi: 10.1097/OLQ.0b013e3181c37e15
74. Larson HJ, Jarrett C, Schulz WS, et al. Measuring vaccine hesitancy: The development of a survey tool. *Vaccine* 2015;33(34):4165-75. doi: 10.1016/j.vaccine.2015.04.037
75. Perez S, Shapiro GK, Tatar O, et al. Development and Validation of the Human Papillomavirus Attitudes and Beliefs Scale in a National Canadian Sample. *Sex Transm Dis* 2016;43(10):626-32. doi: 10.1097/OLQ.0000000000000506
76. DeSimone JA, Harms PD, DeSimone AJ. Best practice recommendations for data screening. *Journal of Organizational Behavior* 2015;36(2):171-81.
77. LaClair BJ, Smith S, Woodward J. Attitudes and concerns of Kansas parents related to childhood immunization. *Immunize Kansas Kids* 2014
78. Meade AW, Craig SB. Identifying careless responses in survey data. *Psychol Methods* 2012;17(3):437-55. doi: 10.1037/a0028085

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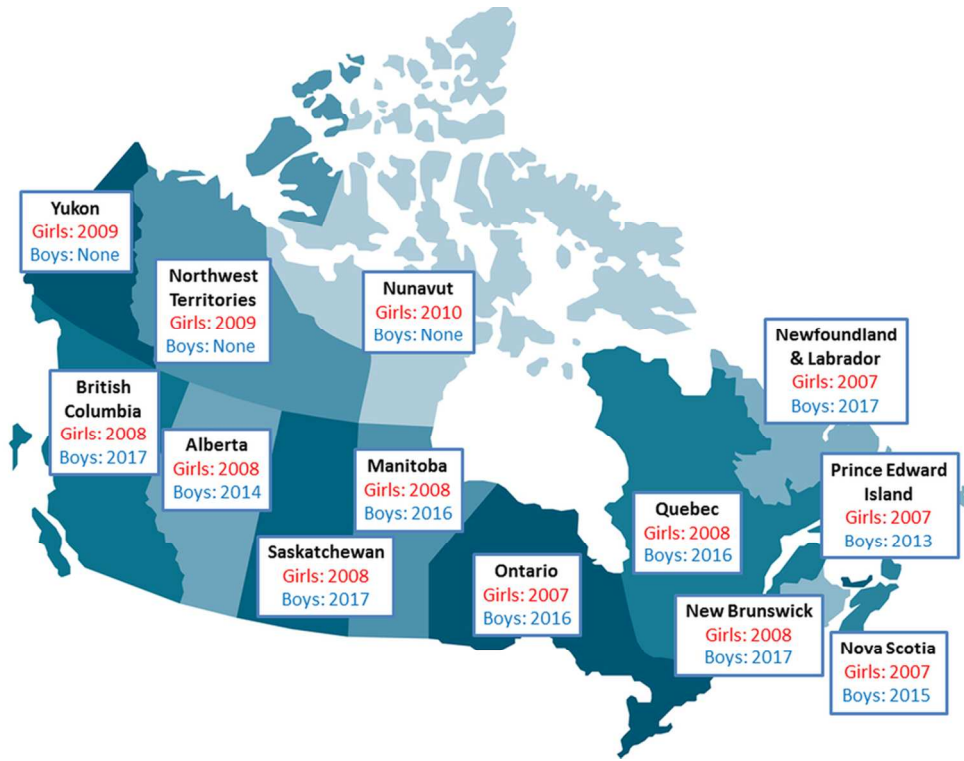


Figure 1. Publicly funded school based HPV vaccine programs in Canada

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## Supplementary File: Study Questionnaire

Variables	Number of items	Sample items	Response choices	Instructions
Eligibility	5	Do you personally have a child between 9-16 years of age living in your household? <sup>a</sup>	Yes; No	
Socio-Demographics	18	In which province do you currently live?  Which of the following ethnicities best describes you?	Categories derived from those commonly used by Statistics Canada. Prefer not to answer was an option for some items.	Select only one.
Precaution Adoption Process Model	1	Which of the following best described your thoughts about the human papillomavirus (HPV) vaccine for [CHILD]? <sup>c</sup>	<b>Stage 1:</b> I am <i>unaware</i> that the HPV vaccine could be given to [CHILD name]; <b>Stage 2:</b> I am aware that the HPV vaccine could be given to [CHILD name], but I have <i>never thought about</i> vaccinating [CHILD name] against HPV; <b>Stage 3:</b> I am <i>undecided</i> about vaccinating [CHILD name] against HPV; <b>Stage 4:</b> I have decided I <i>DO NOT</i> want to vaccinate [CHILD name] against HPV; <b>Stage 5:</b> I have decided I <i>DO</i> want to vaccinate [CHILD name] against HPV; <b>Stage 6:</b> [CHILD name] has <i>already received</i> the HPV vaccine. <sup>c</sup>	Select only one.
HPV & HPV Vaccine Perceived Knowledge	2	Before today, how much would you say you knew about the human papillomavirus (HPV)?	Nothing – A lot (5-point Likert scale)	Please answer the following questions to the best of your ability.
HPV Knowledge <sup>1,2</sup>	23 <sup>b</sup>	HPV always has visible signs or symptoms (F)  HPV can be passed on during sexual intercourse (T)	True; False; Don't know	Please answer the following questions about human papillomavirus (HPV) to the best of your ability.
HPV Vaccine Knowledge <sup>1,2</sup>	13 <sup>b</sup>	The HPV vaccine offers protection against most cervical cancers (T)  Girls who have had the HPV vaccine do not need a Pap test when they are older (F)	True; False; Don't know	Please answer the following questions about the human papillomavirus (HPV) vaccine to the best of your ability.

Variables	Number of items	Sample items	Response choices	Instructions
<b>Information Sources</b>	2	Where have you heard about the HPV vaccine?  From which source <i>would you most prefer</i> to receive information about the HPV vaccine?	Categories include: Not applicable, I have never heard about the HPV vaccine before today; <sup>d</sup> Public health brochures, pamphlets, flyers, or posters; Commercials or advertisements from pharmaceutical companies; Doctor, nurse, or other health care provider; Family member(s); Friend, peer, or co-worker; Information from my child or children's school; Newspapers or magazines; TV or the radio; The internet (e.g., health related websites, news); Social media (Facebook/Twitter).	Check all answers that apply to you.
<b>HPV Vaccine Coverage</b>	6	Did [CHILD] receive the HPV vaccine? <sup>c</sup>	Yes; No; I don't know	Please answer the following questions to the best of your ability
<b>Health Care Provider Recommendation</b>	4	Has [CHILD] seen a health care provider (e.g. a family doctor, paediatrician, or nurse) within the last 12 months? <sup>c</sup>  Have you discussed [CHILD] receiving the HPV vaccine with a health care provider (e.g. a doctor, paediatrician, or nurse) within the last 12 months? <sup>c</sup>	Yes; No	
<b>HPV Attitudes and Beliefs<sup>3</sup></b>	71 <sup>b</sup>	<b>Benefits (10):</b> I feel that the HPV vaccine is effective in preventing HPV-related cancers. <b>Accessibility (4):</b> I feel that the process of actually getting the HPV vaccine for [CHILD] would be easy. <sup>c</sup> <b>Affordability (3):</b> I feel that the HPV vaccine cost more than I can afford. <b>Harms (8):</b> I feel that the HPV vaccine is unsafe. <b>Barriers Additional Items (4):</b> I feel that I am concerned that the HPV vaccine might cause short term problems like pain or discomfort. <b>Severity/Perceived Threat (3):</b> I feel that it would be serious if [CHILD] contracted genital warts later	Strongly Disagree – Strongly Agree (7-point Likert scale)	Please select the answer that best reflects your attitude/belief.

Variables	Number of items	Sample items	Response choices	Instructions
		<p>in life.<sup>c</sup></p> <p><b>Susceptibility/Risk (3):</b> I feel that without the HPV vaccine, [CHILD] would be at risk of getting genital warts later in life.<sup>c</sup></p> <p><b>Social Norms/Influence (8):</b> I feel that my friends are getting their children vaccinated with the HPV vaccine.</p> <p><b>Self-Efficacy (4):</b> I feel that I am competent to make decisions about the vaccines [CHILD] receives.<sup>c</sup></p> <p><b>Gender (3):</b> I feel that HPV vaccine is important for girls.</p> <p><b>Trust (4):</b> I feel that I trust the information I receive about vaccines.</p> <p><b>Communication (5):</b> I feel that I am uncomfortable talking to [CHILD] about the HPV vaccine.<sup>c</sup></p> <p><b>Risk Denial (1):</b> HPV vaccination is not really necessary because Pap smears can be done to make sure cervical cancer doesn't develop.</p> <p><b>Additional Vaccine Items (7):</b> I feel that child vaccinations should be mandatory.</p>		
<b>Motivation</b>	8	Please rate the following reasons for why you would AGREE with your child receiving the HPV vaccine. Because I want [CHILD] to receive the HPV vaccine. <sup>c</sup>	Strongly Disagree – Strongly Agree (7-point Likert scale)	Please select the answer that best reflects your attitude/ belief. Please respond to the following statements to the best of your ability.
<b>Vaccine Hesitancy<sup>4</sup></b>	10 <sup>b</sup>	Childhood vaccines are important for my child's health.	Strongly Disagree – Strongly Agree (5-point Likert scale)	How much do you agree with the each of the following statement on vaccinations?
<b>Vaccine Refusal</b>	3	<p>Have you ever refused vaccinating [CHILD] with the human papillomavirus (HPV) vaccine?<sup>c</sup></p> <p>Have you ever refused vaccinating [CHILD] with any childhood vaccine other than the human papillomavirus (HPV) vaccine?<sup>c</sup></p>	Yes; No	

Variables	Number of items	Sample items	Response choices	Instructions
<b>Vaccine Conspiracy Beliefs Scale<sup>5</sup></b>	11 <sup>b</sup>	Vaccine safety data is often fabricated	Strongly Disagree – Strongly Agree (7-point Likert scale)	Please respond to the following statements to the best of your ability.
<b>Open Ended Qualitative Items</b>	5	What immediately comes to mind when thinking of childhood immunization? <sup>6</sup>  What would influence your decision to have [CHILD] vaccinated or not against HPV? <sup>c</sup>	Free-text responses	

**Note.** <sup>a</sup> Survey is terminated if participant selects option “No”; <sup>b</sup> Items were administered in a random order; <sup>c</sup> Participants were asked at the beginning of the questionnaire to provide a name, nickname, initials or abbreviations for their child who is between the ages of 9 and 16 and who has had the *most recent birthday*. Using intelligence programming, parents’ child initials, name, nickname (e.g., Alex, PT, Jess) was then replaced for “[CHILD]” in all items, making the questionnaire individualized for each participant; <sup>d</sup> If the respondent selected the option of ‘Not applicable I have never heard about the HPV vaccine before today’ then all other options will disappear.

## References

1. Waller J, Ostini R, Marlow LA, et al. Validation of a measure of knowledge about human papillomavirus (HPV) using item response theory and classical test theory. *Prev Med* 2013;56(1):35-40.
2. Perez S, Tatar O, Ostini R, et al. Extending and validating a human papillomavirus (HPV) knowledge measure in a national sample of Canadian parents of boys. *Prev Med* 2016;91:43-49. doi: 10.1016/j.ypmed.2016.07.017
3. Perez S, Shapiro GK, Tatar O, et al. Development and Validation of the Human Papillomavirus Attitudes and Beliefs Scale in a National Canadian Sample. *Sex Transm Dis* 2016;43(10):626-32. doi: 10.1097/OLQ.0000000000000506
4. Larson HJ, Jarrett C, Schulz WS, et al. Measuring vaccine hesitancy: The development of a survey tool. *Vaccine* 2015;33(34):4165-75. doi: 10.1016/j.vaccine.2015.04.037
5. Shapiro GK, Holding A, Perez S, et al. Validation of the vaccine conspiracy beliefs scale. *Papillomavirus Research* 2016;2:167-72. doi: 10.1016/j.pvr.2016.09.001
6. LaClair BJ, Smith S, Woodward J. Attitudes and concerns of Kansas parents related to childhood immunization. *Immunize Kansas Kids* 2014