FACTORS AFFECTING HUMAN PAPILLOMAVIRUS VACCINATION UPTAKE AMONGST ELIGIBLE CANADIAN YOUTH

by

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ABSTRACT

Human papillomaviruses (HPV) and their associated complications are major public health issues in Canada and across the globe. There is significant data to support immunization against HPV in youth as an effective method to prevent the spread of HPV. However, despite a well-established school-based and gender-neutral program, HPV immunization rates remain largely below targeted goals across Canada. This integrative review sought to examine the factors influencing and inhibiting uptake amongst Canadian youth eligible for the vaccine. These factors included parental influence, cultural and personal beliefs, societal attitudes, and structural factors (e.g. access to healthcare services, geographic location, and socioeconomic status). Understanding these factors is critical for developing effective interventions aimed at improving vaccine coverage and protecting youth from HPV-related diseases.

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GLOSSARY OF TERMS

Anti-vax movement: A non-scientific movement of individuals who are vaccine-resistant or vaccine-hesitant. Identified by the WHO as one of the top 10 threats to public health (WHO, 2019)

Anthropophilic: "Pertaining to an insect's preference for feeding on humans even when nonhuman hosts are available" (Oxford Reference, 2025)

Gender-neutral program: A gender-neutral vaccine program, particularly for HPV, aims to protect both boys and girls from HPV-related cancers, promoting broader community protection and reducing HPV transmission (Drolet et al., 2024)

Human papillomavirus: A non-enveloped double-stranded DNA virus causing infections in the cutaneous and mucosal epithelial cells linked to several different types of cancer (Burd & Dean, 2016)

Human papillomavirus vaccine: Gardasil-9 (nonavalent) or cervarix (bivalent)

School-based immunization: the routine administration of vaccines in schools that exclude those vaccinations carried out during community or mass campaigns (Adedzi & Dubé, 2021)

Vaccine hesitant: Parents unsure of vaccinating their children (Dionne et al., 2022)

Vaccine resistant: Parents unwilling to vaccinate their children (Dionne et al., 2022)

Vaccine uptake: the absolute number of people who received a specified vaccine dose (s) (MacDonald et al., 2019)

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Introduction

Human papillomaviruses (HPV) and their associated complications are a major public health issue in both Canada and across the globe (Government of Canada, 2024a). It is estimated that nearly every person will be infected at least once in their lifetime, and infection is a significant predisposing factor in the development of 3,800 new cancer cases each year in Canada (Canadian Partnership Against Cancer, 2024; Centers for Disease Control and Prevention, 2024). These numbers are expected to nearly double by the year 2042 and include cervical and oropharyngeal cancers, and carcinomas of the anus, vulva, vagina, and penis (Canadian Partnership Against Cancer, 2024; Constable et al., 2022). Furthermore, there is ongoing research focused on the correlation between HPV and other cancers and even other illnesses such as inflammatory bowel disease (Feng et al., 2023; Ohadian Moghadam et al., 2020).

HPV is the second leading cause of cancer by infectious agents (31.1%), only surpassed by Helicobacter pylori (36.3%), and is responsible for 7% of cancers worldwide (Szymonowicz & Chen, 2020; Wu et al., 2021). HPV is often considered a disease that primarily affects women because of its association with cervical cancer; however, it causes many different types of cancers in men, and males also develop genital warts and pass the virus to partners (Government of Canada, 2012). Several strains of HPV infection can be prevented through immunization, such as the Gardasil-9 vaccine, and identified through other public health interventions, such as cervical screening (Government of Canada, 2024a; Merck & Co., 2025). However, despite well-developed and robust public health measures aimed at improving vaccination rates, uptake rates remain largely below targeted goals (Government of Canada, 2024a). This review seeks to

answer the research question: In Canadian youth eligible for the HPV vaccine, what are the factors influencing uptake?

CHAPTER ONE: Background and Context

This section will provide context for each component of the research question: what HPV is, the Canadian public health care system, HPV vaccination, and HPV vaccination as a public health strategy.

What is HPV?

HPV is a non-enveloped double-stranded DNA virus causing infections in the cutaneous and mucosal epithelial cells (Burd & Dean, 2016). As the name implies, HPV viruses are strictly anthropophilic (Palefsky, 2024). HPV viruses have a propensity to infect different body sites and thus cause different conditions, including common warts, plantar warts, Bowen's Disease, and multiple different types of cancers (Palefsky, 2024). HPV is spread by skin-to-skin contact and is extensively found throughout the general population (Palefsky, 2024). In many cases, it is spread through sexual contact and is often identified as a sexually transmitted infection (BC Centre for Disease Control, 2024; Wu et al., 2021). HPV is the most common sexually transmitted infection, with an estimated 75% of Canadians expected to have the virus at some point in their lifetime (Government of Canada, 2024a); however, global institutions estimate that this number could be as high as 100% (Centers for Disease Control and Prevention, 2024; World Health Organization [WHO], 2024). Although condoms provide some protection, they do not fully cover the skin and thus are not completely effective in protecting against infection (WHO, 2024). Due to the high prevalence, and difficulty with testing and contact tracing, HPV is not a notifiable disease (Government of Canada, 2012).

Subtypes

HPV is categorized into over 200 subtypes which are defined as low-risk or high-risk based on their ability to cause cancers (American Cancer Society, 2024). High-risk strains

include HPV 16, 18, 31, 35, 45, 51, 52, 56, 58, and 59 with most HPV-related cancers linked to strains 16 and 18 (National Cancer Institute, 2023; Wu et al., 2021). Low-risk strains such as 6 or 11 are associated with non-malignant lesions like anogenital warts and recurrent respiratory papillomatosis (Wu et al., 2021). Cancers that are linked to the HPV virus include carcinoma of the cervix and squamous cell carcinomas of the vagina, vulva, penis, anus, rectum, and oropharynx (Szymonowicz & Chen, 2020). Over 99% of cervical cancers are linked to HPV (Wu et al. 2021), thus making its eradication through immunization critical in the reduction of cancer rates.

Global burden

Worldwide, HPV was associated with nearly 700,000 new cases of cancer in 2019, affecting both men and women (WHO, 2024). The highest rates of incidence and mortality are associated with low- and middle-income countries, most likely due to a lack of established health systems with access to immunization, screening, and treatment (WHO, 2024). Due to the significant health burden associated with HPV, the WHO has adopted a public health strategy aimed at eliminating cervical cancer through immunization, screening, and disease treatment (WHO, 2024).

Infection

Most HPV infections will resolve after 12 months, and the virus is usually cleared by the body's immune system without intervention (Palefsky, 2024). However, cytological abnormalities may be detectable during this period ~~(Palefsky, 2024)~~. Those infections that remain persistent beyond these 12 months increase the likelihood of both precancerous and cancerous lesions (Palefsky, 2024). In approximately 10% of individuals, the body’s immune system will not clear the virus as it is dependent upon individual DNA repair pathways and

differentiation (Centers for Disease Control and Prevention, 2024; Wu et al, 2021). Risk factors associated with ineffective clearance include immunosuppression, exposure to tobacco or second-hand smoke, obesity, and reproductive risk factors such as a multiparous woman or the use of oral contraception (National Cancer Institute, 2024). Currently, there is no treatment available for HPV infections. (WHO, 2024); however, there are several options available for screening.

Screening

Cervical cancer screening is an essential public health program for the early identification of lesions. In 2013, the Canadian Task Force on Preventive Healthcare (2013) recommended changing the age for cervical cancer screening from age 18 (or the onset of sexual activity, whichever comes first) to age 25 (Popadiuk et al., 2019). This change was made for many reasons including the low rates of cervical cancer in women in their early reproductive years and the over-treatment of benign lesions which can hold major reproductive implications later in life (Popadiuk et al., 2019). A consideration associated with this age change was that an HPV immunization program had already been established in Canada for over 6 years, which likely resulted in a reduction of HPV infections (Popadiuk et al., 2019). More recently, another major change within cervical cancer screening is that Canada is moving towards PCR testing for high-risk strains of HPV (Delpero & Selk, 2022). This service moves away from cytology testing of cervical cells, also known as a pap smear which has been part of cervical screening since the 1960s (Delpero & Selk, 2022). Screening, despite its advantages in identifying and treating pre-cancerous lesions, is not a measure to prevent HPV transmission and ~~screening~~ can lead to overtreatment and unnecessary medical procedures (Canadian Cancer Society, 2025).

Canadian Public Health Care System

To effectively understand the unique aspects and challenges of the Canadian Public Health Care system, it is important to consider the factors and complexity of delivering equitable healthcare services across the country. Canada is a geographically large country with a population of 41.5 million people (Statistics Canada, 2024). It has 10 provinces and 3 territories; the most populated is Ontario with over 16 million inhabitants and the least populated is Nunavut with just over 40,000 (Statistics Canada, 2024). Approximately 16% of the population of Canada lives rurally but this number varies greatly from province to province (Statistics Canada, 2018). For example, over 50% of residents in both Nunavut and Prince Edward Island live in a rural area (Statistics Canada, 2018). Canada is consistently one of the most well-educated countries in the world with 32.4% of Canadians aged 25-64 reporting to have obtained a Baccalaureate degree or higher (OECD, 2024). Furthermore, Canada is often compared to other commonwealth countries such as New Zealand and Australia due to its health care system, high quality of living, relationship with Indigenous peoples, abundance of natural resources, and economics (Pong et al., 2019).

How the Canadian Public Health Care System Works

Canada has a publicly funded healthcare system in which childhood vaccines are provided for free through provincial and territorial funding; however, vaccine schedules may differ by province or territory as they have autonomy in these decisions (Government of Canada, 2024e). All vaccinations are approved by Health Canada, a federal department responsible for protecting and promoting the health of Canadians, and are reviewed for safety, efficacy, and quality (Public Health Agency of Canada, 2021). Health Canada also provides continued regulation after authorization. Following approval by Health Canada, the National Advisory Committee on Immunization (NACI; Government of Canada, 2024f; Public Health Agency of

Canada, 2021) in conjunction with the Public Health Agency of Canada (PHAC) provides recommendations based on ongoing and timely medical, scientific, and public health advice relating to immunization (Government of Canada, 2024d). Provinces and territories create their own immunization schedule and programs, which are informed by PHAC and the NACI, with consideration for the needs of their communities (Government of Canada, 2024e; PHAC, 2021).

General Challenges

While vaccination is a cornerstone of the Canadian public health system, like many other developed countries, Canada faces a multitude of challenges when providing immunizations. Vaccinations are considered one of the most effective public health interventions in history (PHAC, 2024). Immunization has led to the eradication of smallpox, significantly reduced child morbidity and mortality, and is estimated to save over 5 million lives a year from protection against diseases like measles, tetanus, and pertussis (Greenwood, 2014; WHO, n.d.). Despite the obvious benefits of immunization, there remain multiple challenges and barriers such as misinformation spread through channels such as social media, inequities in reaching marginalized populations, increased strain on the healthcare system from the COVID-19 pandemic, an aging population, and a lack of qualified healthcare professionals (PHAC, 2024).

Due to the set-up of the Canadian healthcare system through provincial and territorial funding and autonomy, it lacks a federal vaccination surveillance program or overseeing body to programs (Goyette et al., 2021). Recent studies examining routine immunization coverage have identified that vaccination rates are yet to return to pre-pandemic levels, as demonstrated by the coverage rates for measles dropping from 86% in what year? to 60% in what year? amongst 7-year-olds (Government of Canada, 2024b; Public Health Ontario, 2024). However, these estimates are not provided in real-time, are often subject to bias and are not subject to

standardized reporting, making their interpretation difficult (Canadian Partnership Against Cancer, 2019; Sathiyamoorthy et al., 2024).

HPV Vaccine Overview

HPV vaccines have become a key primary prevention tool against cervical cancer and other HPV-related diseases. Since 2006, HPV vaccines have been licensed in over 100 countries, with nearly 40 of those creating a national immunization program by 2012 (Markowitz et al., 2012). Today, four HPV vaccines are recognized by the WHO including two bivalent, one quadrivalent, and one nonavalent (WHO, 2024). All HPV vaccinations are made using recombinant DNA and cell culture technology (WHO, 2024). Gardasil-9 includes protection against strains 6, 11, 16, 18, 31, 33, 45, 52, and 58 (WHO, 2024). Other vaccines are aimed at protecting against strains 16 and 18 which are associated with 70% of all cervical cancers (WHO, 2024; Ahmed et al., 2017). In Canada, there are currently two vaccines authorized for use which include Gardasil-9 and a bivalent called Cervarix (Government of Canada, 2024). Initial program delivery began with Cervarix and Gardasil-4 (since discontinued) in 2007 and later moved to Gardasil-9 in 2015 (Canadian Pediatric Society, 2018). Current products available are considered extremely effective with nearly 100% efficacy against strains 16 and 18 among women aged 16-26 (Government of Canada, 2024c). It has similar efficacy (95% and greater) amongst other strains (6, 11, 31, 33, 45, 52, 58) in the nonavalent vaccine (Government of Canada, 2024c).

HPV Vaccine in Canada

In 2007, the Canadian Immunization Committee (CIC) and National Advisory Committee on Immunization (NACI) recommended the implementation of a school-based immunization program for females (Government of Canada, 2007). This was done based on the

evaluation and success of other programs implemented in countries such as Australia, the United States, and several countries in Western Europe (Government of Canada, 2007). The initial recommendations included a goal of –80% vaccination rates for females in grades 4, 5, 6, 7, or 8 within 2 years of the program introduction and 90% within 5 years. Due to the ~~multitude~~ independent healthcare organizational structures of each ~~of~~ province~~s~~ and territory~~ies~~, this led to 13 different vaccine schedules with some programs starting as early as 2007 in Ontario and others much later such as Nunavut in 2010 (Goyette et al., 2021). See Table 1.~~–~~

Since its introduction into routine school-age vaccination, the HPV school-based program has undergone a multitude of changes. In 2010, the NACI recommended the program to include boys aged 9-26 with significant data supporting this revision to make the program gender-neutral (Government of Canada, 2012). Vaccine development has evolved from a bivalent or quadrivalent vaccine in 2007 (Cervarix, Gardasil-4) to a nonavalent in 2015 (Gardasil-9) and from a three-dose series to a two-dose series (Goyette et al., 2021). The implementation of a publicly funded school-based program varied greatly from province and territory with some male programs being introduced as early as 2013 in Prince Edward Island and five years later in 2018 in Nunavut (Shapiro et al., 2022). Several provinces and territories have offered catch-up programs as well but not all (Goyette et al., 2022).

Table 1

Introduction of Publicly Funded HPV Vaccination Programs in Canada

Province/Territory	Year HPV Vaccination Introduced	Year Gender-Neutral Program Introduced
Alberta	2008	2014
British Columbia	2008	2017
Manitoba	2008	2016
New Brunswick	2008	2017
Newfoundland and Labrador	2007	2017

Nova Scotia	2007	2015
Ontario	2007	2016
Prince Edward Island	2007	2013
Quebec	2008	2016
Saskatchewan	2008	2017
Northwest Territories	2009	2018
Nunavut	2010	2018
Yukon	2009	2018

Note. Adapted from Shapiro et al. (2022). By 2018, all Canadian provinces and territories had publicly funded, school-based HPV vaccination programs for both girls and boys.

Public Health Importance of HPV Vaccination

In 2022, the NACI ~~has~~ set a goal of achieving 90% vaccination coverage amongst school-aged youth by 2025 (National Advisory Committee on Immunization, 2024). It is estimated that high HPV immunization coverage coupled with routine screening will prevent 6810 new cases of cervical cancer and over 1750 deaths in Canada by the year 2050 (Canadian Partnership Against Cancer, 2024). Consistently, studies have shown that the most economical and effective vaccine strategy includes targeting the population before the onset of sexual activity (American College of Obstetricians and Gynecologists, 2017; Government of Canada, 2024a; Kim et al., 2009; Umar et al., 2022). A cohort study in Sweden by Leval et al. (2013) including more than 2 million participants showed vaccine efficacy rates to be 93% in those females that received the vaccine between ages 10-13 versus 43% and less for those who received the vaccine in their 20s. A multitude of studies have shown similar results (American College of Obstetricians and Gynecologists; Government of Canada, 2024). However, HPV vaccination following the onset of sexual activity is still recommended in Canada with the rationale that it is unlikely that the individual has been infected with all strains (Government of Canada, 2024c). This means there is still some benefit to administering the vaccine to youth after the onset of sexual activity.

Problem Statement: Low HPV Vaccine Uptake Among Youth

Despite a well-established school-based immunization program, immunization rates in Canada remain largely below targeted goals. Among six provinces and territories (Alberta, Saskatchewan, Manitoba, New Brunswick, Nova Scotia, and the Yukon) coverage rates among 14-year-olds were 66.8% in 2023 which was consistent with the previous year at 69.1% (Government of Canada, 2024, July). Furthermore, vaccine uptake has been variable depending on region with some rates as low as 57% and some areas as high as target goals.

As public health priorities trend away from the emergency phase of the COVID-19 pandemic, there is an opportunity to focus on other pressing public health matters. In 2024, both the WHO (2024) and the NACI (2024) have updated their strategies surrounding HPV. Despite an abundance of research supporting vaccination against HPV including recommendations from key global and national institutions, vaccination rates remain far below the goal of 90% among youth in Canada. Identifying and understanding the factors associated with uptake is critical to improving vaccination rates and reducing HPV disease-related barriers. This review seeks to answer the research question: In Canadian youth eligible for the HPV vaccine, what are the factors affecting uptake?

CHAPTER TWO: Methods

An integrative review provides a comprehensive overview of a topic through the synthesis of both qualitative and quantitative research (Dhollande et al., 2021). An important part of this process includes creating an audit trail to ensure results are reproducible. The next section will discuss the methods undertaken to complete this integrative review.

Databases

Cumulated Index in Nursing and Allied Health Literature (CINAHL) and MEDLINE were selected for their relevance to the topic. CINAHL is a comprehensive database that covers literature related to nursing and other allied professions and has access to multiple journals that MEDLINE is not privileged to (Sezgin et al., 2023). MEDLINE is a database with access to over 31 million articles related to biomedicine (National Library of Medicine, 2024). Both of these databases were accessed via the University of Northern British Columbia and through EBSCO. Lastly, a search of Google Scholar was completed manually to ensure no articles were missed through database searches. Assistance from the University of Northern British Columbia's librarian team was also utilized to improve search strategies.

Search Terms

The search terms used for this review were as follows: Canad* OR "British Columbia" OR Alberta* OR Saskatchewan OR Manitoba* OR Ontario OR Quebec OR "New Brunswick" OR "Nova Scotia" OR "Prince Edward Island" OR Newfoundland OR Labrador OR Nunavut OR NWT OR "Northwest Territories" OR Yukon

AND

HPV vaccin* OR cancer vaccin* OR human papillomavirus vaccin* OR HPV immuniz* OR

MH papillomavirus vaccine

Inclusion/Exclusion Criteria

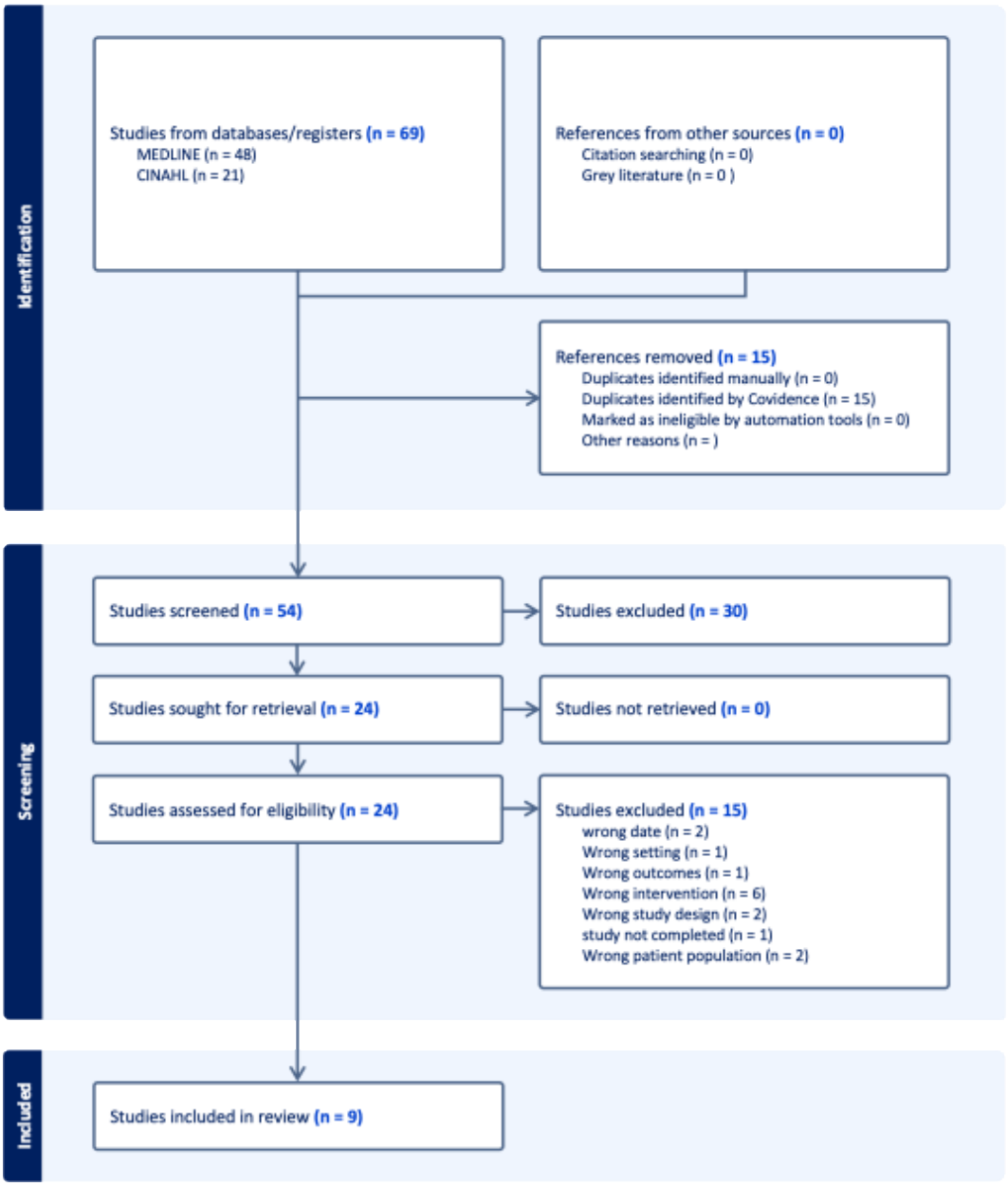
Inclusion and exclusion criteria were selected to ensure data reviewed was both relevant to the review and recent. Inclusion criteria included articles that only were conducted in Canada. There is other literature and research surrounding barriers to HPV vaccination, however, much of the research is situated in the United States. As the Canadian context is vastly different in terms of population and geography, ethnicities, and publicly funded healthcare it was decided to only include Canadian-based studies. Articles must have been published within the last 5 years as the HPV vaccination program has undergone multiple changes in the last decade and to ensure a portion of the articles would address barriers in a post-emergency pandemic era. Articles must have discussed barriers or other identifiers contributing to reduced vaccination rates among youth eligible for the vaccine. Furthermore, "youth eligible for the vaccine" for the scope of this review includes youth aged 9 to 18 years. This was selected as the NACI recommends immunizations beginning at age 9 and most provinces include publicly funded programs until at least age 18 (BC Centre for Disease Control, 2023; Government of Canada, 2024; Government of Nunavut, 2020). Only articles that were published in the English language were included as the scope of this project does not include a translator. One outlier, published in 2019, was eliminated as it included data before 2015 when it was not a gender-neutral program. Articles were excluded if they pertained to a specific population as generalizability to the Canadian population may not have been possible. Peer-reviewed public articles were included and excluded were non-peer-reviewed articles, opinion publications, and case studies. See Appendix B for more details.

PRISMA

An adapted version of the PRISMA flow diagram was utilized and created using the program Covidence (Covidence, n.d.). See Figure 1.

Figure 1

PRISMA



Note. Adapted from Moher et al. (2009).

Data Analysis

Data analysis included a data extraction table (Appendix C) and thematic analysis. Data extraction included salient information such as authors, research methodology, sample size, limitations, and findings (Toronto & Remington, 2020). The critical appraisal skills program (CASP, 2025) was used to evaluate research articles for relevance, trustworthiness, and results (see Appendix E). The "grade approach" was utilized to assign the research a score of very low, low, moderate, or high. See Table 2.

Table 2

GRADE Score Table

Article Title	Overall Quality
Dionne et al. (2023)	Low-moderate
Dubé et al. (2019)	Low-moderate
Dubé et al. (2021)	Low
Dubé et al. (2024)	Low-moderate
Khan et al. (2024)	Low-moderate
Lawal et al. (2024)	Moderate
Malkin et al. (2024)	Moderate
Sathiyamoorthy et al. (2024)	Moderate
Shapiro et al. (2023)	Moderate

Note. GRADE is an acronym that stands for grading of recommendations, assessment, development, and evaluations (BMJ, 2025). This method has been endorsed by over 100 organizations to assess research for quality of evidence through analysis of bias, imprecision, inconsistency, and indirection.

Braun and Clarke's (2006) framework for thematic analysis was used to apply an inductive approach to further synthesize findings. This framework includes a six-step process: familiarization with data, generating initial codes, developing themes, reviewing themes, defining and naming themes, and writing a narrative analysis (Toronto & Remington, 2020).

CHAPTER THREE: Findings/Results

Overall, nine articles were chosen for data synthesis based on their quality and selection criteria. Five articles were qualitative and four were quantitative. Selected research was conducted in the provinces of Alberta (Dubé et al., 2024; Malkin et al., 2024), Ontario (Dubé et al., 2021), British Columbia (BC; Dubé et al., 2024; Lawal et al., 2024), Quebec (Dionne et al., 2023; Dubé et al., 2019), Nova Scotia (Dubé et al., 2024), and Saskatchewan (Khan et al., 2024), as well as Canada-wide (Sathiyamoorthy et al., 2024; Shapiro et al., 2022). Using the GRADE method (BMJ, 2025), all articles except for one were found to be of low-moderate or moderate quality (see Table 2). The remaining article was assessed as low quality due to the limited number of respondents (n=18/35; Dubé et al., 2021). The study populations and respondents included public health units (n=1), parents (n=5), nurses (n=4), school staff (n=2), students (n=2), and medical health officers (MHOs; n=1), making for robust data with perspectives that include individual, interpersonal, organizational, and policy-level factors. All data was collected after several years of the introduction of a gender-neutral program, except for one study which was conducted in the year that the program was introduced (Dubé et al., 2019). The primary contributing author in three of the studies was the same which could introduce potential bias (Dubé et al., 2019; Dubé et al., 2021; Dubé et al., 2024). However, Dubé's research provides a comprehensive examination of barriers to HPV vaccine uptake, exploring the issue across multiple provinces and diverse populations through each study. Six major themes were identified concerning the factors affecting the uptake of HPV vaccine among eligible Canadian youth. These included enhancing relationships through collaboration, educational gaps, vaccine objectors, integrated policy and resource constraints, underserved populations, and the COVID-19 pandemic.

Enhancing Collaboration for Vaccine Uptake

Across the research, there was a theme of relationships and collaboration affecting vaccine uptake. This included nurse-school employee relationships, nurse-parent relationships and the relationship between primary care providers and parents (Dubé et al., 2019; Dubé et al. 2024; Khan et al., 2024; Malkin et al., 2024; Shapiro et al., 2022).

Nurse-School Employee Relationships

There was overwhelming support for enhancing relationships with public health nurses and the school staff including principals, teachers, and administrative staff. Through focus group interviews with parents, school staff and public health nurses, Dubé et al. (2019) and Dubé et al. (2021) found that there were often competing school priorities with some principals questioning why immunization needed to be completed in a school setting. Both studies found that a lack of collaboration between the public health system and schools in Ontario and Quebec led to difficulty with the consent process such as having consent forms returned. Public health nurses (PHN) interview respondents also identified that it was difficult to find space to complete immunizations with confidentiality, which creates a positive experience for the youth and decreases vaccine anxiety (Dubé et al., 2019). Furthermore, the school's staff's negative perception of the HPV vaccine was a barrier to uptake with multiple staff members expressing that they were uncomfortable with talking about the vaccine, to promote its use or answer questions (Dubé et al., 2019; Dubé et al., 2021). The researchers also identified that teachers play an instrumental role in vaccine acceptance and ensuring that consent forms are signed, as well as managing vaccine anxiety. Therefore, Dubé et al., (2019) concluded that collaboration between school staff and PHNs ensures the smooth operation of vaccination days. Dubé et al. (2019) also

found that the involvement and dedication of school nurses in their schools and communities built trust with the public. Khan et al. (2024) conducted semi-structured interviews with directors, managers, supervisors, and PHNs in Saskatchewan and found that engaging school staff through educational workshops would further help improve this relationship.

Nurse-Parent Relationships

PHNs have often been identified as critical for improving vaccination rates (Dubé et al., 2019). Interviews with parent participants revealed that they felt that a PHN was a trustworthy source of information (Dionne et al., 2023; Dubé et al., 2019). Khan et al. (2024) conducted interviews, with provider and system-level stakeholders in Saskatchewan, and found that PHNs often felt that they had a lack of access to parents which made developing a therapeutic relationship difficult. Furthermore, focus group discussions from vaccine-hesitant and vaccine-resistant parents conducted by Dionne et al. (2023) reported that having an approachable nurse, who was recognized in school activities, would promote vaccine uptake. However, some parents perceived pressure from PHNs to say yes to vaccination (Dionne et al., 2023). Other parents reported in semi-structured interviews that feeling a "business-like" approach from immunizers was a barrier to acceptance (Dubé et al., 2024). Dionne et al. (2023) suggested that trust and better communication could improve uptake, especially amongst the vaccine-resistant and vaccine-hesitant populations.

Family Practitioner-Parent Relationships

Several articles identified that parents trusted their primary care provider for vaccination information (Dionne et al., 2023; Dubé et al., 2019, Dubé et al. 2024). Studies by Shapiro et al. (2022) and Malkin et al. (2024) examined sociodemographic characteristics through online questionnaires and provincial health administration data. Both studies concluded that there was

improved HPV vaccine uptake amongst those who had recent access to a primary care provider (Malkin et al., 2024; Shapiro et al., 2022). Furthermore, parents reported that they wanted more time to discuss immunizations with their primary care provider, and multiple stakeholders felt that there was inadequate physician support to promote the vaccine (Dubé et al., 2019; Khan et al., 2024).

Education Gaps

The most reported barrier across the literature was misconceptions about HPV vaccination stemming from misinformation and a lack of education about the vaccine (Dionne et al., 2023; Dubé et al., 2019; Dubé et al., 2021; Dubé et al., 2024; Khan et al., 2024). Dionne et al. (2023) reported that parent respondents in their study in Quebec often knew nothing about what HPV causes or the vaccine schedule. School staff and parental respondents felt that HPV immunization was "a new vaccine," (Dube et al., 2019) was controversial and were concerned about the potential side effects (Dionne et al., 2023; Dubé et al., 2019; Dubé et al., 2021; Khan et al., 2024). Both parents and school staff respondents in several studies felt that students were too young to be receiving an STI-related vaccination and that there were other methods of protection available such as screening and awareness (Dubé et al., 2019; Dionne et al., 2023; Khan et al. 2024). Compounding this issue, parents and school staff felt uncomfortable discussing an STI-related vaccine with their children and students (Dubé et al., 2019; Dubé et al., 2024). This was further highlighted as an issue by some schools not allowing PHNs to speak with students about HPV immunization (Dubé et al., 2021). Furthermore, some parents felt that immunization for HPV would lead to an increase in promiscuous behaviour (Khan et al., 2024). Suggestions to combat these education gaps included more interactive educational tools either online or provided by nurses within the school setting (Dionne et al., 2023).

Social media was identified as a factor in HPV vaccination rates and plays a significant role in the dissemination of misinformation regarding vaccinations (Dubé et al., 2019; Dubé et al., 2021; Dubé et al., 2024; Khan et al., 2024; Malkin et al., 2024). PHNs surveyed identified that non-evidence-based information on social media was influencing parents' decisions surrounding HPV vaccination (Dubé et al., 2019; Dubé et al., 2021; Dubé et al., 2024; Khan et al., 2024). However, minimal parents admitted to finding social media to be a credible source for their information and instead stated they would seek out the opinion of a nurse, doctor, or pharmacist (Dionne et al., 2023). Dubé et al. (2024) highlight that while social media can contribute to misinformation, it also plays a key role in promoting vaccine acceptance, and further research is needed to explore how information can be presented on these platforms to improve HPV vaccine uptake.

An additional, less frequently identified educational gap pertains to PHNs. Due to various factors, including workload demands and the impacts of the COVID-19 pandemic (which will be further explored in subsequent sections), challenges have emerged in maintaining up-to-date knowledge of the continually evolving vaccination program and effectively communicating key messages to the public (Khan et al., 2024). PHN respondents in the Khan et al. (2024) study suggested dedicated time should be given to nurses to improve their knowledge about this HPV vaccination and new recommendations and guidelines. Furthermore, training about HPV vaccination for healthcare professionals was identified as a solution by Dionne et al. (2023).

Vaccine Objectors

Vaccine objectors were a common barrier to uptake (Dubé et al., 2021, Dubé et al. 2024; Khan et al., 2024; Shapiro et al., 2022). This included objectors due to religious and cultural beliefs, as well as the *anti-vax* movement (WHO, 2019). Some vaccine-hesitant and vaccine-

resistant parents felt that government websites are too overwhelmingly in support of vaccines and do not accurately display harms and side effects (Dionne et al., 2023). Other stakeholders noted that routine health literacy, including immunizations, is not incorporated into the Canadian school curriculum and may help address these concerns (Khan et al., 2024). Notably, the study by Dionne et al. (2023) provided a unique perspective into the thoughts of parents who are vaccine-hesitant and resistant, as this population is generally underreported and difficult to interact with. Sathiyamoorthy et al. (2024), who conducted a cross-sectional study using self-completed questionnaires for parents of 14-year-olds, also reported that having a vaccine-hesitant caregiver was associated with lower rates of immunization. To combat this, it has been suggested to target vaccine education and campaigns at youth and incorporate vaccine education into school curriculum to allow for teenagers to make an informed decision and provide their own consent (Dubé et al., 2024). Furthermore, PHNs respondents felt there were many challenges associated with providing school-based programming for religious schools and independent schools (Dubé et al., 2021), and the quantitative data supported this, demonstrating that immunization rates were lower in religious and independent schools (Lawal et al., 2024). This was thought to be partially related to religious beliefs impacting vaccine acceptance and no recommendations were made on how to improve this (Dubé et al., 2021).

Integrated Policy and Resource Constraints

There was a multitude of barriers to the organizational and system level of the Canadian HPV vaccination program, including the consent process, jurisdictional vaccine delivery organization, and general challenges with staffing.

Consent Process

The consent process was identified by multiple studies as a barrier to HPV vaccine uptake (Dionne et al., 2023; Dubé et al., 2019; Dubé et al., 2021; Dubé et al., 2024; Khan et al., 2024). The consent process for school-based immunizations generally involves consent forms with information packages provided to students to bring home and return after being reviewed by parents or guardians (HealthLink BC, 2024). Both PHNs and parents described the information forms provided with the consent package as too complicated and lengthy or too simple (Dionne et al., 2023; Dubé et al., 2019; Khan et al., 2024). Furthermore, having consent forms returned was identified as a barrier, with one study reporting that sometimes less than 20% of forms are returned (Dubé et al., 2021). Teachers were found to be of great assistance in this area to ensure consent forms were sent home and returned on time (Khan et al., 2024). In most cases, the consent forms are sent home in English or French, which further marginalizes people for whom neither language is their first (Dubé et al, 2019; Dubé et al., 2024). However, Lawal et al. (2024) found in the Vancouver Coastal Health (VCH) areas with visible minorities were more likely to be vaccinated. More data is needed to evaluate the consent process in VCH and know if consent forms are provided in languages other than English or French. Although vaccine information is often available in multiple languages through provincial services such as Healthlink BC (2024), the individual consent process might be dependent on the nurse or practices within the area (Dubé et al., 2021). Dubé et al. (2021) suggest a consistent strategy to mitigate this. Furthermore, they also suggested utilizing automated reminder and recall systems which have shown to be effective in the United States (Dubé et al., 2021).

Vaccine Roll Out

The implementation of the publicly funded HPV vaccination program in Canada has had several shortcomings and major changes that have negatively impacted its reception. Initial

marketing and promotion of the HPV vaccine was directed towards preventing cervical cancer, making parents question why males were later included in the program (Dionne et al., 2021; Khan et al., 2024). To further this stereotype the initial vaccine used in Canada was called "Cervarix" (Khan et al., 2024). Unsurprisingly, male sex was consistently reported as a characteristic of lower vaccine uptake (Lawal et al., 2024; Sathiyamoorthy et al., 2024). However, the Alberta-based Malkin et al. (2024) study found that males were more likely to be fully immunized compared to females. These findings may be accounted for by the timing of the gender-neutral program in Alberta as it was one of the earliest provinces to include boys in school-based immunization (Shapiro et al., 2022). Throughout the country, there was a lack of standardization and consistent introduction of the gender-neutral program with some being introduced as late as 2018 (Shapiro et al., 2022). Although discussed as a barrier in multiple articles, no authors stated solutions that would address these concerns while considering the unique challenges in Canada's Public Health System.

Staffing Challenges

Staffing challenges, including high workload, time constraints, staff turnover, catch-up clinics, burnout, lack of appreciation, and early retirement, were identified as barriers to uptake by PHNs, supervisory staff, and managers (Dubé et al., 2019; Dubé et al., 2021; Dubé et al., 2024; Khan et al., 2024). Further compounding the consent process, PHN respondents felt there were inadequate resources to be able to perform catch-up clinics for those who did not complete the initial consent or were absent from school (Dubé et al., 2019; Dubé et al., 2021; Dubé et al., 2024; Khan et al., 2024;). However, catch-up clinics are an effective way to reach students who previously missed doses of HPV vaccines (Lawal et al., 2024). Reasoning for this may include the older age of the students making parents less concerned about their children receiving a

vaccine that has been incorrectly labelled as a "sex vaccine" or a second chance at the consent form process which was identified as a barrier across multiple studies (Lawal et al., 2024). PHN respondents in these studies also felt that there were inadequate resources for staffing in the context of the COVID-19 pandemic, which will be further elaborated on in later sections.

Underserved Populations

Consistent with other literature, rural residents and those from material and resource-deprived neighbourhoods had lower rates of HPV immunization (Lawal et al., 2024; Malkin et al., 2024; Sathiyamoorthy et al., 2024). The cross-sectional study examining sociodemographic characteristics of nearly 18,000 students by Lawal et al. (2024) found that individuals residing in rural areas demonstrated significantly lower vaccination rates compared to their urban counterparts. Similarly, youth from neighbourhoods characterized by social and material deprivation were reported to have lower rates of HPV vaccine uptake (Lawal et al., 2024; Malkin et al., 2024). Lawal et al. (2024) describes social deprivation as the “level of deprivation of relationships among individuals in the family, workplace and community” (p. 3); whereas material deprivation refers to “average household income, unemployment rate and high school education” (p. 3). Both social and material deprivation were identified as barriers to vaccine uptake across multiple studies (Lawal et al., 2024; Malkin et al., 2024; Sathiyamoorthy et al., 2024). Lawal et al. (2024) found that vaccination rates in neighbourhoods with higher deprivation had a 30% lower likelihood of being immunized than those in more affluent neighbourhoods. This was also consistent with data from lower household incomes (Lawal et al., 2024). These findings highlight the interplay of geographic and socioeconomic factors in shaping vaccine uptake behaviours among Canadian youth, with rural residency, lower household incomes, and neighbourhood-level deprivation emerging as key predictors of reduced HPV

vaccine coverage. These factors are complex and multifactorial, therefore more focused studies on the factors influencing HPV vaccine uptake in these populations are needed (Malkin et al. 2024).

COVID-19 Pandemic

The COVID-19 pandemic disrupted routine public health activities and further exacerbated an already stretched healthcare system. Many of the factors discussed in the previous sections, including vaccine hesitancy and resource scarcity, were significantly intensified during the pandemic (Khan et al., 2024). The COVID-19 pandemic revealed the fragility of the Canadian public health system with most efforts focused on COVID-19. This led to widespread disruption of routine school immunization programs and additional interests and duties for the public health system (Khan et al., 2024). Furthermore, the COVID-19 pandemic has led to more skepticism and questioning of the routine immunization program (Dionne et al., 2023; Khan et al., 2024). Multiple parental study respondents described an overall feeling of "vaccine fatigue" (p. 6657; Dionne et al., 2023; Khan et al., 2024). Other parents felt that children were receiving too many vaccines and questioned how the COVID-19 vaccine would interact with the HPV vaccine (Dionne et al., 2023; Khan et al. 2024). Additionally, the pandemic led to parents wanting to be present for immunizations and fewer students receiving them through school-based programs. This has created an increased workload for nurses and health units as clinic appointments are timely, costly, and difficult to coordinate over school-based immunization programs (Canadian Vaccination Evidence Resource and Exchange Centre, 2020; Khan et al., 2024).

Post-pandemic vaccination rates are difficult to track in real time. However, data in the Vancouver Coastal region of British Columbia suggests 65-68% coverage for HPV vaccination

amongst grade 6 students (Lawal et al., 2024), which is significantly short of the goal of 90% (Canadian Partnership Against Cancer, 2024). Khan et al. (2024) suggest utilizing public health strategies learned during the COVID-19 pandemic to target HPV immunization rates through public messaging, and both provincial and educational campaigns. However, it will likely take time to rebuild the trust between the public and some of the short-term misfit policies that occurred during the COVID-19 pandemic (Khan et al., 2024).

CHAPTER FOUR: Discussion

HPV vaccination is a critical public health tool in Canada to reduce rates of HPV and its associated complications. Despite a robust and well-established public immunization program across the country, uptake rates amongst Canadian youth continue to fall short of national and international targets (Canadian Partnership Against Cancer, 2024; WHO, 2024). Several structural, organizational, and social barriers contribute to these challenges. This discussion synthesizes key findings from this integrative review and highlights how recent policy changes, systemic barriers, and vaccine resistance continue to influence uptake.

Policy Shifts and Their Impact on Vaccination Rates

This review identified several organizational barriers to vaccine uptake such as staffing shortages, workload constraints, and the need for catch-up clinics. Evidence-based policy change has the potential to address many of these factors. Recently, the WHO (2024) recommended transitioning to a one- or two-dose from a two- or three-dose vaccination schedule for younger individuals. This shift is expected to reduce logistical challenges and increase vaccine coverage rates worldwide. Echoing these recommendations, in July 2024, the NACI advocated for a single-dose schedule for immunocompetent individuals aged 9–20 years (Government of Canada, 2024). However, as of February 2025, it has only been adopted by Quebec and the Yukon (Government of Canada, 2025). Other provincial and territorial governments will likely implement these changes gradually over the coming years which is expected to improve workload for PHNs (Government of Canada, 2025). However, further research is needed to determine whether this shift will result in vaccine uptake, especially within under-immunized populations.

Gender Disparities in Vaccine Uptake

Gender disparities in HPV vaccination uptake have evolved since the introduction of the program in 2007. Unsurprisingly, rates of uptake have been higher among females than males historically, which was largely attributed to the staggered rollout of school-based programs across provinces and territories (Samthiyamoorthy et al., 2024). However, several studies in this review found that males are now equally or more likely to be vaccinated, contradicting earlier trends. Further supporting this, national data, although limited and conducted through third parties, also suggest that uptake rates between genders are now comparable (Government of Canada, 2024). This shift is likely due to the expansion of public immunization programs to include boys which has eliminated both cost and access as a barrier for male populations (Goyette et al., 2021). As discussed in the findings for Integrated Policy and Resource Constraints, the date of the gender-neutral programming in each province and territory was highly variable ranging from 2013 to 2018. As much of the programming over the last several years has been focused on catch-up programs and messaging encouraging males to receive vaccination (Goyette et al., 2022), future vaccine campaigns might need to be more gender-neutral.

The Need for a Coordinated National Strategy

A major systems-level challenge in Canada's immunization strategy is the lack of a centralized coordinating authority; this was highlighted by stressors such as the COVID-19 pandemic and the increasing *anti-vax* movement. Unlike other high-income countries with national immunization programs and surveillance, the structure of the Canadian healthcare system results in thirteen autonomous vaccination programs. Each program has its eligibility criteria, dosing schedules, and public health initiatives (Goyette et al., 2021; Smith et al., 2011). Although there is some benefit in this approach for provinces and territories being able to tailor

their programs to their population and unique needs, this disjointed system complicates vaccine delivery and is a barrier to national data collection (Goyette et al., 2021).

Immunization rates are primarily assessed through national surveys, such as the Childhood National Immunization Coverage Survey (CNICS). However, these surveys rely on self-reported data, which is often subject to recall bias and underreporting (Khan et al., 2024). The CNICS is conducted every 2 years, and the most recent survey identified persistent gaps in vaccine coverage (Government of Canada, 2022). However, due to limited surveillance and real-time tracking, national-level analyses remain challenging. As vaccine hesitancy continues to gain followers globally, the implementation of a centralized immunization authority could enhance surveillance, improve coordination, and facilitate targeted interventions to address multiple barriers. These vaccine-resistant and vaccine-hesitant populations are often challenging to reach which may lead to misrepresentations on national surveys (Dionne et al., 2023). An effective, coordinated and accurate centralized authority, that could provide real-time surveillance, may improve HPV vaccination uptake.

Furthermore, the 2020-2030 Action Plan for the Elimination of Cervical Cancer identified data reporting as a major barrier to vaccination uptake (Canadian Partnership Against Cancer, 2019). They recommended improving data reporting by school-based HPV immunization programs establishing standardized measures for data collection and publicly reporting on HPV vaccination coverage rates across all jurisdictions (Canadian Partnership Against Cancer, 2019). However, the Action Plan fails to provide details on how this will be accomplished (Canadian Partnership Against Cancer, 2019).

Vaccine Hesitancy and the Role of Healthcare Providers

Education gaps and relationships between healthcare providers and other stakeholders were identified as major factors in HPV vaccine uptake. Vaccine hesitancy has been a barrier to immunization since the introduction of vaccines (Nuwarda et al., 2022). The 2017 CNICS reported that 13% of parents believed alternative health practices such as chiropractic care or homeopathy could replace vaccines (Government of Canada, 2019). While vaccine confidence improved during the early stages of the COVID-19 pandemic, more recent trends suggest a resurgence in vaccine hesitancy, fueled by misinformation from sources such as social media and declining trust in public health institutions (Harrison et al., 2020; Khan et al., 2024).

Primary care providers play a critical role in addressing HPV vaccine hesitancy. Despite declining trust in public health institutions, many parents identify their family physician or nurse practitioner as a trusted source of vaccine information (Government of Canada, 2022). The Canadian Pediatric Society (2024) has developed new guidelines to help practitioners navigate discussions around vaccine hesitancy in a post-pandemic world. However, nearly 6.5 million Canadians are currently without a regular family care provider, creating a significant gap in access to reliable and evidence-based vaccine counselling (Canadian Medical Association, 2025). While there are many national and provincial strategies targeting improving patient attachment to primary care practitioners it will likely take time to improve these numbers and establish provider-patient rapport.

Additionally, PHNs have been removed from the school setting in many places over the past several decades due to persistent healthcare funding cuts (Buduhan & Woodgate, 2021). The lack of a formalized curriculum in school that emphasizes health literacy and education surrounding the importance of vaccinations could be mitigated by the presence of a school nurse. The absence of school-based health professionals has been identified as a barrier to HPV vaccine

uptake in multiple studies (Dionne et al., 2021; Khan et al., 2024), and therefore, further research is needed to assess how reintroducing PHNs into schools may enhance vaccine delivery and reduce vaccine hesitancy as a cost-effective upstream approach. Some provinces, such as Ontario, have already allocated funding for hiring PHNs back into the school setting (National Collaborating Centre for Determinants of Health, 2022).

Equity in Vaccine Access and Delivery

This review revealed the gaps in HPV vaccine uptake amongst underserved populations such as those living in material- and resource-deprived neighbourhoods and rural residents. These findings are consistent with trends observed in other healthcare services, where geographic isolation limits access to resources such as vaccination clinics and public health outreach programs (Spencer et al., 2024). While this integrative review included studies from six provinces and national data sources, significant gaps in data remain. Most notably, marginalized populations including Indigenous communities and residents of remote regions such as Yukon, Northwest Territories, and Nunavut were significantly underrepresented, omitted, or absent in available studies (Lawal et al. 2024; Sathiyamoorthy et al., 2024). Healthcare access and programming are generally limited in these regions (Young & Chatwood, 2017), and future research must prioritize data collection in these communities to help guide vaccine policy development. This was also identified as one of the priorities of the 2020-2030 Action Plan for the Elimination of Cervical Cancer (Canadian Partnership Against Cancer, 2019). Currently, the Urban Public Health Network (UPN) has programs underway to co-develop, implement, and evaluate education and program delivery strategies aimed at increasing HPV immunization for under-immunized youth populations (UPN, 2024). Ensuring equitable access to HPV vaccination for marginalized youth is crucial, as they face a higher burden of HPV-related

complications due to systemic healthcare disparities, geographic barriers, and historical inequities in access to preventive care (Spencer et al., 2024).

Strengthening Catch-Up Programs

Catch-up vaccination initiatives have proven effective in increasing overall HPV vaccine coverage. For example, Alberta's Grade 9 catch-up program successfully immunized an additional 10% of students who had missed their initial doses (Malkin et al., 2024). Similarly, targeted vaccine re-offering programs for Grade 6 and 9 students living in materially deprived neighbourhoods have been suggested as an effective intervention (Lawal et al., 2024). Lawal et al. (2024) thought that the success of catch-up programs is likely because of the older age of the students or a second chance at the consent form process. Although evidence supports the implementation of a catch-up program to improve vaccination rates, such programs have not been consistently adopted across all provinces and territories (Goyette et al., 2022). Research from the early years of the school-based HPV immunization program found that catch-up initiatives were effective in improving vaccine uptake (Dubé et al., 2021; Shapiro et al., 2017). Despite this evidence, not all provinces and territories have incorporated formal catch-up programs into their policies (Goyette et al., 2022). This ongoing gap highlights a persistent barrier to optimizing coverage, even in the presence of well-documented benefits.

Limitations

The findings of this review should be interpreted recognizing potential limitations, including the study populations, research methods, and timing of this review. Despite including multiple viewpoints and stakeholders, such as parents, school administrators, public health officials, PHNs, and policymakers, this review found no studies focused on primary care providers. Primary care providers often have established rapport with patients (Murray &

McCrone, 2015), which makes them key advocates for vaccine acceptance. Therefore, their perspectives and experiences should be examined surrounding HPV immunization. Future research should focus on examining primary care provider's experiences and challenges to enhance their role in addressing HPV vaccine hesitancy and improving immunization rates.

During the process of this review, there was a significant effort to capture relevant literature through multiple methods, search strategies and the assistance of a university librarian; however, key pieces of research may have been missed. Furthermore, many of these studies failed to fully examine the barriers to uptake amongst those youth residing in Indigenous communities and those in rural and remote areas. This gap results in an inability to generalize these results to the entire Canadian youth population, especially across these marginalized populations. Lastly, the COVID-19 pandemic had a substantial impact on the Canadian public health system and vaccination uptake (Khan et al., 2024). Despite the known impacts, due to the recency of the pandemic, we are likely unaware of their extent and their impact on the population's perception of vaccinations.

CHAPTER FIVE: Conclusion

The uptake of the HPV vaccine among Canadian youth remains below national targets, despite its proven effectiveness in preventing cancer-causing HPV strains (Government of Canada, 2024a). Understanding the factors influencing uptake is critical to strengthening immunization efforts. While Canada has a longstanding school-based, gender-neutral immunization program, coverage remains impacted by multiple complex barriers at individual, interpersonal, organizational, and policy levels.

Misinformation and education gaps persist, with many parents unaware of HPV risks, vaccine effectiveness, and even eligibility (Dionne et al., 2023; Dubé et al., 2021; Dubé et al., 2024; Khan et al., 2024). Social media has amplified vaccine hesitancy, while limited access to trusted healthcare providers reduces opportunities for vaccine counselling (Buduhan & Woodgate, 2021; Khan et al., 2024; Lawal et al., 2024). Canada's decentralized healthcare system has further contributed to inconsistent HPV vaccine policies across provinces and territories, creating gaps in implementation and school-health partnerships. These challenges are exacerbated by public health nursing shortages, which make catch-up programs and consent processes more difficult (Dionne et al., 2023; Dubé et al., 2021; Dubé et al., 2024). Vaccine inequities also persist, particularly in rural, remote, and socioeconomically disadvantaged communities, where logistical barriers limit access (Sathiyamoorthy et al., 2024; Lawal et al., 2024). The COVID-19 pandemic further strained the system, delaying routine immunization programs and increasing vaccine hesitancy (Khan et al., 2024). Although there are some policies targeted at addressing these concerns more must be done to meet uptake goals.

Moving forward, Canada needs a coordinated national strategy that incorporates stronger public health programs and messaging, better provider engagement, streamlined consent processes, and targeted outreach for underserved populations. Although there is an Action Plan targeted at HPV immunization as a strategy for the eradication of cervical cancer, there lacks concrete steps to achieve these goals. Furthermore, additional research is needed to explore healthcare provider perspectives and vaccine uptake in marginalized communities. Without these changes targeted at Canadian youth, HPV vaccine rates will remain below target, leaving thousands at risk of preventable cancers.

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Appendix A

Search Strategy Table for Integrative Review

Database	Search Terms	Boolean Operators	Filters Applied	Date of Search
PubMed	Canad* or "British Columbia" or Alberta* or Saskatchewan or Manitoba* or Ontario or Quebec or "New Brunswick" or "Nova Scotia" or "Prince Edward Island" or Newfoundland or Labrador or Nunavut or NWT or "Northwest Territories" or Yukon AND HPV vaccin* OR cancer vaccin* OR human papillomavirus vaccin* OR HPV immuniz* OR MH papillomavirus vaccine	AND, OR	English, last 5 years	2024-11-23
CINAHL	Canad* or "British Columbia" or Alberta* or Saskatchewan or Manitoba* or Ontario or Quebec or "New Brunswick" or "Nova Scotia" or "Prince Edward Island" or Newfoundland or Labrador or Nunavut or NWT or "Northwest Territories" or Yukon AND HPV vaccin* OR cancer vaccin* OR human	AND, OR	English, last 5 years	2024-11-23

papillomavirus vaccin* OR HPV immuniz*

OR MH papillomavirus vaccine

Appendix B

Inclusion and Exclusion Criteria

Inclusion Criteria	Exclusion Criteria
Studies conducted in Canada	Studies conducted outside Canada
Published within the last 5 years	Published more than 5 years ago
Discussed barriers or factors contributing to reduced vaccination rates among youth	Did not discuss barriers or factors contributing to vaccination rates
Included youth aged 9 to 18 years	Focused on populations outside the 9 to 18-year range
Published in English	Published in non-English languages
Peer-reviewed articles	Non-peer-reviewed articles, opinion pieces, or case studies
Addressed HPV vaccine uptake	Did not address HPV vaccine uptake
Gender-neutral program data (date was dependent upon province)	Data prior to when the program was not gender neutral
Focused on the general population	Focused on a specific population (ie. CF, HIV+)

Appendix C

Data Extraction Tables

Challenges and opportunities of school-based HPV vaccination in Canada	
Author and date of publication	Dubé et al. (2019)
Province, country	Quebec, Canada
Aim of study	Identify and understand the factors influencing the acceptance and uptake of the human papillomavirus (HPV) vaccine within school-based programs across Canada
Study Design	Qualitative
Start Date	2015
End Date	2016
Funding Source	Quebec ministry of health and the Canadian Immunization Research Network
Conflicts	None declared
Population description	nurses, school principals, grade 4 teachers and parents of grade 4 students
Inclusion criteria	Not detailed
Exclusion criteria	Not detailed
Method of recruitment	Voluntary
Total number of participants	70
Strengths	*Comprehensive Analysis:* examines individual, interpersonal, community, organizational, and policy-level factors, providing a holistic understanding of the determinants affecting vaccine uptake. *Diverse Participant Perspectives:* immunization managers, school nurses, principals, teachers, and parents
Limitations	*Geographical Scope:* The study focuses on Quebec, which may limit the generalizability of the findings *Potential Recall Bias:* Participants' recollections of events and experiences *Lack of Quantitative Data:* The qualitative nature of the study provides in-depth insights but does not offer statistical data to measure the extent of identified challenges and opportunities. Male program: the gender-neutral program was introduced the same year that this study was conducted
Key Findings	Antivax information on social media and the internet -Cultural and linguists barriers with immigrant populations -Perceptions that it is a new vaccine -No consistent education provided to schools and parents by nursing/public health -Vaccine supply at the school (supplies, availability)

	-Information disseminated to parents to aid in decisions insufficient or inadequate (too complex or too simple) -School administration questioning the need for school-based vaccine -Parents feeling rushed to make a decision (short time between consents and due date) -Teachers not feeling comfortable with talking about the vaccine or promoting it or answering questions -Parents unsure of how to approach the topic with children as it is a "sex vaccine" -High workload or lack of resources for nursing -Catch-up days for lack of school attendance -Logistical issues in organizing vaccination days with the schools -Change in provincial HPV program from girls to both genders

"The problem is not a lack of information": a qualitative study of parents and school nurses' perceptions of barriers and potential solutions for HPV vaccination in school	
Author and date of publication	Dionne et al. (2023)
Province, country	Quebec, Canada
Aim of study	Describe barriers and enabling conditions of HPV vaccination as perceived by parents and school nurses and identify potential solutions to improve HPV vaccine uptake rates and acceptance in school-based programs
Study Design	Qualitative Research
Start Date	Fall 2022
End Date	Fall 2022
Funding Source	Canadian Partnership Against Cancer Corporation
Conflicts	None declared
Population description	Parents of grade 2/3s who were unsure or unwilling to vaccine; school nurses
Inclusion criteria	Parents: Individuals with children eligible for the HPV vaccination, specifically those in the target age group for school-based vaccination programs. Parents should be unwilling or unsure to vaccinate. School Nurses: Healthcare professionals actively working within the school system, involved in administering vaccines and educating students and parents about vaccination.
Exclusion criteria	Parents: Those without children in the eligible age group for HPV vaccination or who had already completed the vaccination series for their children. Those wanting to vaccinate. School Nurses: Individuals not currently practicing in a school setting or without direct involvement in vaccination programs.
Method of recruitment	School nurses – emails Parents – a questionnaire by an external agency
Total number of participants	22 parents; 24 nurses
Strengths	-Extremely relevant and timely following the COVID-19 pandemic

	-Perspectives from a group of individuals that are generally hard to recruit (vaccine hesitant)
Limitations	- May not be generalizable findings due to the lack of diversity of parents in terms of area of residence, level of education - This group is known as hard to reach generally (vaccine hesitant) - Nurses were recruited from a limited part of the province
Key Findings	-Parental concerns re: young age -Parental concerns re: possible side effects -Nurses reported parents having lots of concerns re: side effects -Nurses felt parents about doubts about efficacy -Parental concerns re: interactions with COVID-19 vaccine -Parental concerns re: the rationale of boys being added to the program -Nurses saw a distrust in vaccinations following the COVID-19 pandemic -Nurses felt parents fear injections for children -Nurses perception that parents needed more education re: boys are now included -Nurses perception that parents feel kids are too young for an STI vaccine -Nurses perception of general distrust of vaccines and government -Nurses thought parents felt too many injections in the same year -Parents felt vaccines unnecessary due to other screening measures -Vaccine hesitant parents feel that information tools push parents towards vaccination

Stakeholders' perspectives on barriers to and facilitators of school-based HPV vaccination in the context of COVID-19 pandemic-related disruption: a qualitative mixed methods study	
Author and date of publication	Khan et al. (2024)
Province, country	Saskatchewan, Canada
Aim of study	explore stakeholders' perspectives on the barriers and facilitators to implementing school-based HPV vaccination programs in the context of disruptions caused by the COVID-19 pandemic.
Study Design	Qualitative mixed methods
Start Date	Not listed
End Date	Not listed
Funding Source	Canadian Partnership Against Cancer
Conflicts	None declared
Population description	Stakeholders – provider level and system level MHOs or PHNs
Inclusion criteria	Stakeholders in the Saskatchewan Health Authority area who responded to advertising
Exclusion criteria	
Method of recruitment	Voluntary

Total number of participants	31
Strengths	-Comprehensive Stakeholder Perspectives: The study gathered perspectives from a wide range of stakeholders (e.g., parents, healthcare providers, and public health officials), which provided a holistic view of the challenges and opportunities for school-based HPV vaccination during the pandemic. -Qualitative and Mixed-Methods Approach: The use of both qualitative interviews and quantitative data provided a nuanced understanding of the barriers and facilitators, strengthening the validity of the findings. -Timeliness and Relevance: By addressing the impact of the COVID-19 pandemic, the study responded to an urgent and real-world public health issue, making its findings highly relevant to current vaccination strategies.
Limitations	-Potential Bias in Participant Selection: The participants might not fully represent all relevant stakeholders, especially those who were harder to reach or less involved in the vaccination programs during the pandemic. This could limit the diversity of perspectives. -Recall Bias: As the data collection occurred after the pandemic disruption, there is a possibility that recall bias influenced participants' accounts of their experiences. -Context-Specific Findings: The findings are based on a specific context (pandemic-related disruptions in school-based HPV vaccination) and may not be directly applicable to other settings or vaccination programs outside of the study's context. -Limited Generalizability: Because the study used qualitative methods, the results may not be generalizable to all regions or broader populations, as the sample was specific to those involved in school-based HPV vaccination programs during the pandemic.
Key Findings	-Increase anti-vax movement, especially with social media -COVID-19 led to resource scarcities -Children too young to be receiving a STI vaccine -Perceptions formed by religious beliefs -HPV vaccine with encourage sexual behaviour -Ideas about the cost of vaccines and when publicly funded -COVID-19 pandemic lead to vaccine skepticism -Vaccine information sheets do not always include all languages -School space and confidentiality -Understaffing for routine clinic -COVID-19 lead to an increase in parents wanting clinic appointments for vaccines

	-Too many needs in grade 6, suboptimal vaccine spacing -Vaccine sheets poorly designed re: STI, too wordy, etc. -Lack of access to parents -Original marketing towards the cervix, making gender stereotypes worse -Staffing issues, lack of staffing for catch-up clinics

Assessing sociodemographic disparities in HPV vaccine uptake among grade 6 and 9 students in the Vancouver Coastal region	
Author and date of publication	Lawal et al. (2024)
Province, country	British Columbia, Canada
Aim of study	To identify sociodemographic factors associated with HPV vaccine uptake in a universal, in VCH in 2021/2022
Study Design	Cross sectional study
Start Date	2021
End Date	2022
Funding Source	Urban Public Health Network & Canadian Partnership Against Cancer
Conflicts	None declared
Population description	Grade 6 and 9 students enrolled in VCH schools during the 2021/2022 school year
Inclusion criteria	grade 6/9 students, residents of VCG geographical area and enrolled in school
Exclusion criteria	students registered in FN communities , students who don't identify as a gender, and students whose postal codes were not represented in the 2016 census
Method of recruitment	Database
Total number of participants	17939
Strengths	- large population examined - no recall bias -geographical area included both urban and rural students
Limitations	-small geographical area
Key Findings	- Male students had a 15% lower odds of being vaccined - Those in coastal rural had a 37% lower odds of being fully vaccinated - non-faith-base independent schools had 40% lower odds of being fully vaccinated - those in neighbourhoods of visible minority had a 28% odds increase of being vaccinated - those in socially deprived neighbourhoods had a 30% lower odds of being fully vaccinated - materially deprived neighbourhoods had a 25% lower odds of being fully vaccinated compared to other grade 6s

	- The repeat offering of HPV in older grade is a key programmatic strategy to reach under-immunized population and should be complemented by other approaches

Individual and geospatial determinants of health associated with school-based human papillomavirus immunization in Alberta: Population based cohort study	
Author and date of publication	Malkin et al. (2024)
Province, country	Alberta, Canada
Aim of study	to identify factors influencing HPV vaccination rates among school-aged children in Alberta. By analyzing both individual-level characteristics (such as age, gender, and socioeconomic status) and geospatial factors (including geographic location and access to healthcare services), the researchers sought to understand disparities in vaccine uptake
Study Design	Cohort study
Start Date	Not listed
End Date	Not listed
Funding Source	Canadian Institute of Health Research
Conflicts	None declared
Population description	Albertans born in 2004
Inclusion criteria	Those born in 2004, both male and female Those in grade 5 during the 2014-2015 school year,
Exclusion criteria	missing age, sex or postal code, not having alberta health care coverage 3 years before index at index or during follow-up and those residing outside of Alberta
Method of recruitment	Provincial data bases
Total number of participants	45207
Strengths	-Large population based sample sizes have high internal validity - Database was more reliable than self-reporting - The research can be applied to school based programming due to the source -Uptake of this research can be quickly applied due to those involved
Limitations	-May not be able to generalize outside of Alberta -Exclusion criteria removed 5% of the population - Data was only drawn from those who received doses from the Alberta Public Health system (ie. Not at the doctors office, pharmacy, etc.)
Key Findings	-Lack of lack health use may be an important indicator to vaccine uptake as those who had not seen their GP in the last 3 years were less likely to be immunized -Social and material deprivation was associated with decreased immunization rates

	-Those living in rural areas were less likely to be immunized due to - there being are a shortage of family doctors in these areas, less nurses compared to the general population, increased level of vaccine hesitancy

Estimates and determinants of HPV non-vaccination in 14-year-old Canadians: results from the childhood national immunization coverage survey, 2019	
Author and date of publication	Sathiyamoorthy et al. (2024)
Province, country	Nation-wide, Canada
Aim of study	Estimate the prevalence of HPV non-vaccination among 14-year-old Canadians and to identify the demographic, socioeconomic, and geographic factors associated with non-vaccination.
Study Design	Cross sectional study
Start Date	Dec 2 2019
End Date	Apr 30 2020
Funding Source	Public Health Agency of Canada
Conflicts	None declared
Population description	children's parent or guardians (person most knowledgeable)
Inclusion criteria	Children living in Canada, aged 14 Those claiming child tax benefit June 2019 PMK spoke English or French
Exclusion criteria	Residing on reserve, in foster care and institutionalized
Method of recruitment	
Total number of participants	1104 PMK of 14 year olds
Strengths	First study to explore the determinants of HPV non-vaccination in Canada Comprehensive sampling frame that included 96% of Canadians
Limitations	Some 14 year olds may have been mature minors and received vaccination without parent's knowledge 47% of respondents provided information based on recall- subject to human error Inclusion criteria limited to those who spoke English or French which may have lost information about those new to Canada Exclusion criteria excluded those who live on reserve – notably a population who has decreased vaccine uptake for HPV in the past
Key Findings	- Reduced uptake in males (27% compared to 12.9%) - Quebec had the highest uptake of vaccinations - Those living in Nunavut and the NWT were most likely not to be vaccinated. - Higher income households were more likely to vaccinate

The impact of publicly funded immunization programs on human papillomavirus vaccination in boys and girls: an observational study	
Author and date of publication	Shapiro et al. (2022)
Province, country	Nation-wide, Canada
Aim of study	impact of introducing publicly funded school-based HPV vaccination programs for boys directly on the uptake of boys and indirectly on the uptake in girls, while concurrently examining other important sociodemographic and psychosocial factors
Study Design	Cohort
Start Date	
End Date	
Funding Source	Canadian cancer society research institute
Conflicts	None declared
Population description	Parents of children aged 9-16
Inclusion criteria	Internet access, resident of Canada, parent of child 9-16
Exclusion criteria	No internet class, non-Canadian resident, not a parent of a child 9-16
Method of recruitment	voluntary
Total number of participants	716 parent of males, 843 parent of female
Strengths	-unique study as the program funding was a slow roll out between boys and girls
Limitations	-territories were not included - those who participated in the study were more wealthy, educated and white compared to the 2016 census
Key Findings	-No recommendations from healthcare providers for the vaccine -Young age, as older children were more likely to be vaccinated -Non-publicly funded school based vaccinations -Perceived harms re: vaccine and side effects -Thought that there is a cost associated with it

Enhancing HPV Vaccine uptake in girls and boys- A qualitative analysis of Canadian school-based vaccination programs	
Author and date of publication	Dubé et al. (2024)
Province, country	British Columbia, Alberta & Nova Scotia, Canada
Aim of study	To better understand barriers and enabling conditions for HPV vaccination in school-based vaccination programs in Canada
Study Design	Qualitative Research
Start Date	2018
End Date	2020
Funding Source	Canadian Immunization Research Network
Conflicts	None declared

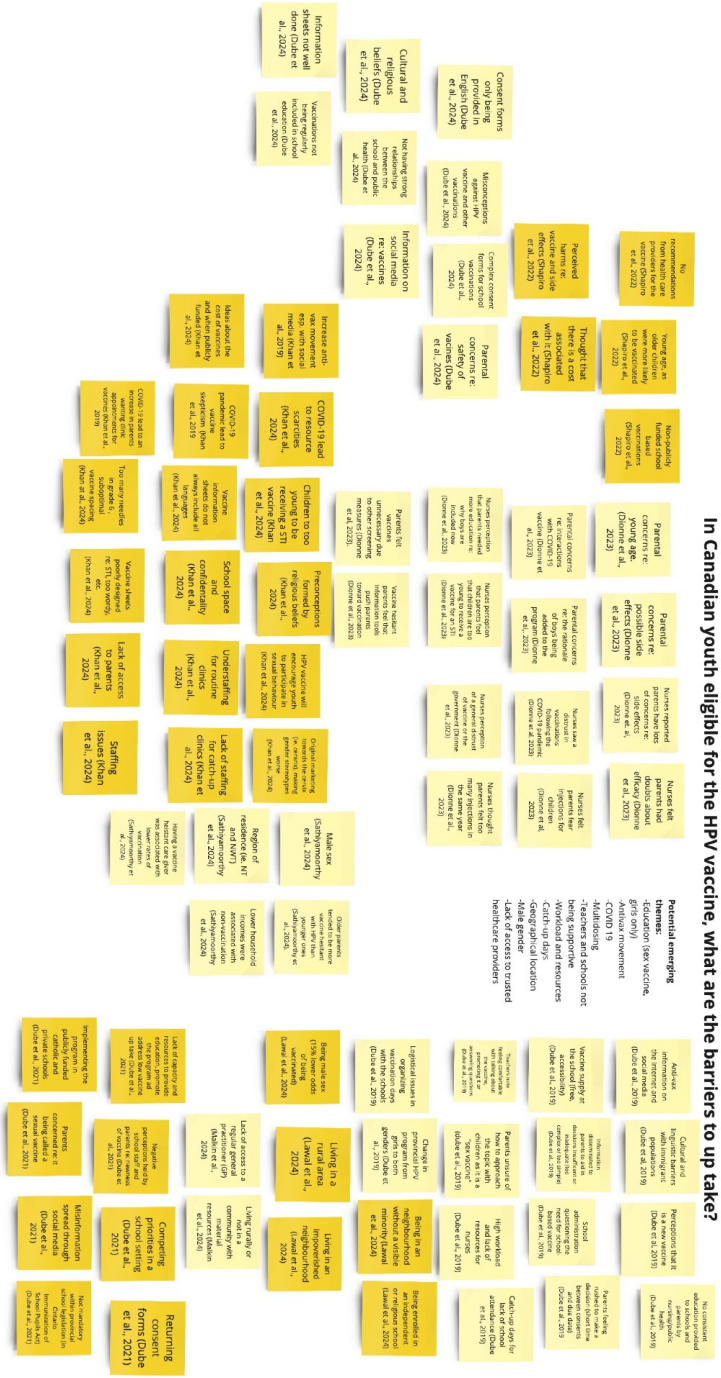
Population description	Parents, nurses and school staff
Inclusion criteria	Alberta, BC and NS schools with high uptake and poor uptake
Exclusion criteria	
Method of recruitment	Mailouts from the school
Total number of participants	50
Strengths	-Selected provinces that had not previously done a lot of research in the area
Limitations	-Limited number of participants with varied profiles were recruited -Nearly all participants had a positive few of vaccines (26/28) -Children were not included in the study -Qualitative research often has desirability bias or selection bias
Key Findings	-Consent forms only being provided in English -Misconceptions against HPV vaccine and other vaccinations -Complex consent forms for school vaccinations -Parent concerns re: safety of vaccinations -Cultural and religious beliefs -Not having strong relationships between the school and public health -Information on social media re: vaccines -Information sheets not well done -Vaccinations not being regularly included in school education

"It takes time to build trust": a survey Ontario's school-based HPV immunization program ten years post-implementation	
Author and date of publication	Dubé et al. (2021)
Province, country	Ontario, Canada
Aim of study	Describe Ontario's school-based HPV vaccination from the perspective of the local public health unit mangers to help elucidate the drivers and barriers of HPV vaccine acceptance and uptake
Study Design	Qualitative Research
Start Date	2018
End Date	
Funding Source	Canadian Immunization Research Network
Conflicts	None declared
Population description	Vaccine preventable disease managers from PHU in Ontario
Inclusion criteria	
Exclusion criteria	
Method of recruitment	Email
Total number of participants	18 respondents out of 35 contacted
Strengths	- stakeholder engagement

	- longitudinal study
Limitations	- Recall bias - Generalizability (only Ontario) - Response bias - Small study - Almost half of those contacted did not respond
Key Findings	-Lack of capacity and resources to provide education, promote the program and address low vaccine uptake -Negative perceptions held by school staff and parents re: newness of vaccine -Competing priorities in a school setting -Returning consent forms -Implementing the program in publicly funded catholic and private schools -Parents concerned re: it being called a sexual vaccine -Misinformation spread through social media -Not mandatory within provincial school legislation (in Ontario)

Appendix D

Thematic Analysis Process



Appendix E
CASP Checklists

Y	Yes/Strong
N	No/Poor
U	Unknown/Unclear

CASP Qualitative Study Checklist Table

Study	Was there a clear statement of the aims of the research?	Is a qualitative methodology appropriate?	Was the research design appropriate to address the aims?	Was the recruitment strategy appropriate?	Were the data collected in a way that addressed the issue?	Has the relationship between researcher and participants been adequately considered?	Have ethical issues been taken into consideration?	Was the data analysis sufficiently rigorous?	Is there a clear statement of findings?	How valuable is the research?
Dubé et al., (2019)	Y	Y	Y	Y	Y	U	U	Y	Y	Y
Dubé et al., (2021)	Y	Y	Y	Y	Y	U	Y	Y	Y	Y
Dionne et al., (2023)	Y	Y	Y	Y	Y	U	Y	Y	Y	Y
Dubé et al., (2024)	Y	Y	Y	Y	Y	U	Y	Y	Y	Y
Khan et al., (2024)	Y	Y	Y	Y	Y	U	Y	Y	Y	Y

CASP Cross-Sectional Study Checklist Table

Study	Did the study address a clearly focused issue?	Did the authors use an appropriate method to answer the question?	Were the subjects recruited in an acceptable way?	Were the measures accurately measured to reduced bias?	Were the data collected in a way that addressed the research issue?	Did the study have enough participants to minimize the play of chance?	Was the data analysis sufficiently rigorous?	Is there clear statement of the findings?	Can the results be applied to the local population?	Is the research valuable?
Lawal et al. (2024)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Sathiyamoorthy el al. (2024)	Y	Y	Y	Y	Y	U	Y	Y	Y	Y

CASP Cohort Study Checklist Table

Study	Did the study address a clearly focused issue?	Was the cohort recruited in an acceptable way?	Was the exposure and outcome accurately measured to minimize bias?	Have the authors identified all important cofounding factors?	Was the follow-up complete and long enough?	How precise are the results?	Do you believe the results?	Can the results be applied to the local population?	Do the results fit with other available evidence?	Are there implications of this study for practice?
Malkin et al. (2024)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Shapiro et al. (2022)	Y	Y	Y	Y	Y	U	Y	Y	Y	Y