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Factors That Determine Utilization of the Canadian School-Based Human Papilloma Virus Vaccine Programs

Diane Gloria Brown
Walden University

Walden University

College of Health Professions

This is to certify that the doctoral dissertation by

Diane G. Brown

has been found to be complete and satisfactory in all respects,
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the review committee have been made.

Review Committee
Dr. Sheryl Richard, Committee Chairperson, Health Services Faculty
Dr. Kristin Wiginton, Committee Member, Health Services Faculty
Dr. Donna Clews, University Reviewer, Health Services Faculty

Chief Academic Officer and Provost
Sue Subocz, Ph.D.

Walden University
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Abstract

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by

Diane G. Brown

MHSA, D'Youville College, 2006

BScN, University of Toronto, 1991

Dissertation Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Philosophy

Health Services

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December 2021

Abstract

Human Papilloma Virus (HPV) is the most common sexually transmitted infection in the world and is the known causative agent of many HPV-associated cancers in both males and females. HPV vaccination rates in Canada are significantly lower than other developed countries and this finding is poorly understood as Canadian adolescents have access to free-of-charge HPV vaccines through school-based vaccination programs. This quantitative descriptive study used an online survey to collect data from 992 eligible respondents. This study identified predisposing, enabling, and need factors characterized by the Andersen behavioral model of health services use which facilitate or impede the use of this HPV vaccine program. The study aimed to understand the relationship between health services utilization factors that were associated with parents' immunizer status (HPV immunizer or HPV nonimmunizer) and what factors were predictive of a parent being an HPV immunizer. Results from descriptive and inferential statistical analysis demonstrated that there was an association between key predisposing, enabling and need factors. Having a primary care health provider was highly predictive of parents being an HPV-immunizer (74; 95% CI 23.6 - 232.4) This is aligned with findings in the literature which indicated that parents are more likely to accept immunizations for their children when directly supported by a primary health care professional. This study identified prioritized opportunities to improve the uptake of the HPV vaccine in the Canadian school-based public vaccine programs. Increasing HPV vaccine uptake may impact social change by improving health outcomes and decreasing the burden of illness of HPV-related infections and cancers.

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Dedication

I dedicate my dissertation work to my family. My deepest gratitude to my children who had to share my time with both my professional work but also this research project. Thank you to my husband Darrin who provided me with constant support, encouragement, and patience to allow me to complete this work. Mom and Dad, I hope this would have made you proud.

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Chapter 1: Introduction to the Study

Human papilloma virus (HPV) is the most common sexually transmitted infection in the world and is the primary cause of cervical and other serious cancers (Okunade, 2019). It has been well-established that persistent infection of the cervix with certain types of HPV is a necessary causative factor for the occurrence of cervical cancer (Spriggs et al., 2019). To decrease the burden of cervical and other cancers in both males and females caused by HPV, population-based HPV vaccination programs are available in all Canadian provinces for school-aged boys and girls (Shapiro et al., 2017). HPV infection was once thought of as a concern only for women; however, this misconception has been discredited due to the rise in HPV-related cancers in men (Government of Canada, 2018).

The cervical cancer, HPV-associated invasive cancers and HPV infection statistics in Canada are unacceptably high for a wealthy and highly developed country with a publicly available preventative care health services program (Government of Canada, 2018). Since 2007, all Canadian provinces and territories have had a publicly funded school-based program for immunization against HPV (Goyette et al., 2021). HPV vaccination rates vary from province-to-province with the initial HPV dose and then consistently demonstrate significantly lower completion rates of the three-dose vaccine series (Bird et al., 2017). This attrition rate for subsequent doses is a disappointing and poorly understood outcome (Gainforth et al., 2012). To minimize attrition and to save costs, supporting real-world evidence has allowed the Canadian HPV programs to evolve from a three-dose to a two-dose vaccines series moving from a quadrivalent to a

nonavalent vaccine (Goyette et al., 2021). In this study, I utilized a comprehensive methodology to examine and analyze the factors that determine parental utilization of the Canadian school-based public HPV vaccine programs.

This study was significant because it provided essential insights and information about the parents of children who were eligible to access no-charge HPV vaccines in the Canadian school-based public programs and their utilization of this preventive health care service. Despite lagging HPV vaccination rates, Canadian HPV programs have nonetheless been shown to be effective and have resulted in a decline of the incidence of pre-cancerous cervical lesions and genital warts (Steben et al, 2018). This study supports social change as increasing HPV vaccination rates through access to preventive health care services may further decline HPV infections and their resulting sequelae. Understanding the individual and collective barriers that impede utilization of these health services is important for the evaluation and optimization of the national HPV vaccine programs.

This chapter contains the following sections: (a) background of the study, (b) problem statement, (c) purpose of the study, (d) research questions and hypotheses, (e) conceptual framework for the study, (f) nature of the study, (g) definitions, (h) assumptions, (i) scope and delimitations, (j) limitations, (k) significance, and (l) summary and transition.

Background of the Study

HPV infection usually results from direct skin-to-skin contact during intimate sexual contact with someone who has HPV (Ranjeva et al., 2017). In the absence of

vaccination, it is estimated that 75% of sexually active Canadians, both females and males, will have a sexually transmitted HPV infection in their lifetime. This results in approximately 550,000 people being infected with HPV each year (Crum et al., 2003). Cervical cancer remains a serious public health concern in Canada. In 2021, it was the 14th most common cancer in Canadian women, and it was estimated that 1,450 women will be diagnosed with cervical cancer and 380 will die from the disease (Canadian Cancer Society, 2021). In 2018, cervical cancer was the fourth most common cancer in Canadian women between the ages of 15 and 44 and ranked third for mortality caused by a cancer (Bruni et al., 2019). HPV is a significant problem in men as well as it is estimated that approximately 63% of HPV-associated invasive cancers in men are attributed to the high-risk strains HPV14 or HPV16, both of which may be prevented by the HPV quadrivalent or nonvalent HPV vaccines (Derstenfeld et al., 2020).

Multiple publications demonstrate the importance of examining factors that may determine health services utilization of the school-based Canadian HPV vaccine programs. Sussman et al. (2015) found numerous factors that influence HPV vaccination uptake and those that provide opportunities for informed decision making by primary care physicians in the United States. Through in-depth qualitative interviews with experts which included primary care physicians, policy makers and experts in immunization, they determined that the greatest barrier to HPV uptake was challenges in health services delivery which contrasts with the majority of the literature describing vaccine hesitancy. The authors concluded that health system changes that focused efforts toward a coordinated delivery of care approach may be necessary to address these challenges.

Lobão et al. (2018) examined parental acceptance of both female and male HPV vaccination in Brazil after its introduction to the National Immunization Program. In seven major Brazilian cities, the investigators conducted a survey of parents from July 2015-October 2016 using a validated knowledge, attitude, and practices questionnaire as a study tool. The authors found that parental acceptance of the vaccine was not a barrier to immunizing their daughters and sons with the HPV vaccination. Instead challenges in adolescent vaccine delivery and barriers at health-care centers affected vaccine uptake, rather than parental acceptance.

Holman et al. (2014) conducted a systematic literature review of barriers to HPV vaccination of adolescents in the United States with a goal to inform future vaccine coverage efforts. The literature revealed that significant informational gaps continue to exist for parents and that direct interaction with a health care professional is essential to supporting parental decision making. It was noted that a key barrier to adolescents in the U.S. not receiving a first HPV dose was parents who did not receive a recommendation from a health care professional. The linkage to not completing the three-dose HPV vaccine series was also linked to a lack of recommendation from a health care professional.

Dempsey and O'Leary (2018) found that primary health care providers play a pivotal role in providing information and an appropriate level of communication and interaction with parents considering the HPV vaccines for their children. The strength of the health care provider's recommendation regarding the vaccine greatly influences the parent's perception of vaccine safety and subsequent uptake. Significant efforts are being

made toward understanding optimal communication strategies and narratives for primary health care providers to adopt into their practice to increase HPV vaccine uptake. In Canada, this sequential flow from health care provider to parent to health services delivery is disrupted. Parents must provide written consent to the school-based programs in the absence of having guaranteed contact with a primary health care provider to provide a recommendation on the vaccine.

Krawcyzyk et al. (2015) found that in the Canadian public school-based vaccination system where parental consent is required, understanding utilization determinants is critical. If children are not immunized in school or through catch-up programs, the vaccine is often not covered by the various provincial health insurance programs. When delivered by a primary health care provider outside the national vaccine programs the cost must be borne by the parents. The approximate cost of the three-dose vaccination series is approximately $1,350 and varies from province to province (City of Toronto, 2018). Krawcyzyk et al. also determined in their qualitative research study that vaccine cost was found to be a highly prohibitive factor in parents immunizing their children.

The literature review could not identify any studies that examined health services utilization barriers to preventive HPV vaccination in Canada which utilized the Andersen behavioral model of health services use framework. Identified barriers have not been incorporated into a unified, comprehensive, and inclusive health services conceptual framework for understanding parental consent for utilization of the HPV vaccine (Gainfort et al., 2012; Perez et al., 2016; Remes et al., 2014; Shapiro et al., 2017).

Understanding the association of individual and collective barriers that challenge parents to accept the HPV vaccine for their children is important for the evaluation and optimization of the various provincial vaccine programs. The outcome of this study may provide insight into the relationships between individual and collective barriers and the subsequent use of preventive health services. This analysis and understanding could contribute to the improved utilization of the provincial HPV vaccine programs not only in Canada, but by extrapolation, to other developed countries facing similar uptake challenges with the HPV vaccine.

Problem Statement

HPV represents a group of more than 200 related viruses (Ranjeva et al., 2017). Certain high-risk HPV strains cause cervical and other cancers, whereas lower-risk HPV strains cause anogenital condylomas (Okunade, 2019). The morbidity and mortality associated with high-risk HPV infections can largely be avoided through vaccination (deSanjosé et al., 2018).

Vaccination programs for adolescents are typically comprised of a triumvirate of the parent, provider, and health care system; however, in the Canadian model for HPV health services delivery, the primary care physician provider and traditional health care delivery setting are often not part of the network. In Canada, regional public health departments typically administer the HPV vaccine, along with other recommended vaccines, as part of the no charge public school-based vaccination programs for students. Depending on the province or territory, students are eligible for their regional program

based on their school grade which is typically between Grades 4 and 8 (Krawcyzk et al., 2015; Salvadori, 2018; Shapiro et al., 2017).

The HPV vaccine is often not directly covered by the provincial health insurance programs outside the scope of this universal school-based program and the approximate cost of the vaccination series is $1350 (City of Toronto, 2018). This emphasizes the need for the initial successful uptake of the vaccine through utilization of the school-based programs as Krawcyzk et al. (2015) found cost to be a highly prohibitive factor in subsequent vaccine uptake. Canadian HPV vaccination coverage targets currently lag Canadian 2025 national adolescent vaccine targets (Government of Canada, 2018; Ontario Agency for Health Protection and Promotion, 2018). The Government of Canada's (2018) target coverage for adolescent HPV immunization with at least two doses in 2025 is 90%. This target comes from a recommendation from the Canadian Partnership Against Cancer (CPAC)'s target requirement to eliminate cervical cancer by 2040, which would require 90% of 17-year-olds to be fully vaccinated by 2025 (Canadian Partnership Against Cancer, 2019). The Ontario Agency for Health Protection and Promotion (2018), Canada's largest province, reports the HPV immunization coverage estimate for the 2016-2017 school year in Ontario as 59.4%. In addition, Canadian HPV vaccine coverage rates are significantly lower in comparison to other developed countries, which have reported uptake rates of more than 70% (Bird et al., 2017).

The National Advisory Committee on Immunization (NACI) provides the Public Health Agency of Canada with ongoing and timely medical, scientific, and public health advice relating to immunization. The NACI conducted a workshop to identify key

knowledge and infrastructure gaps for the optimal utilization of the HPV vaccine in Canada. Understanding the knowledge, attitudes, and beliefs and acceptability of HPV vaccination programs in recipients, providers and parents was identified as one of ten highest ranked open research questions at this workshop (NACI, 2012). This is also a priority research area of the Canadian Immunization Research Network (Canadian Immunization Research Network, n. d.).

Despite national prioritization, there is limited research available to describe determinants of health services utilization of the school-based Canadian HPV vaccine program. (Childhood National Immunization Coverage Survey, 2015). The preponderance of literature is focused on psycho-social determinants, the decision-making behavior and intent of parents and individual determinants rather than on the determinants of health services utilization (Gainforth et al., 2012; Perez et al., 2016; Remes et al., 2014; Shapiro et al., 2017). Knowing the determinants of health services utilization and enhancing the body of knowledge on this topic from a health services delivery perspective is critical as evidence from the United States has demonstrated that the delivery of health services is the greatest barrier to accessing the HPV vaccine (Sussman et al., 2015). Research from Brazil where parental acceptance was thought to be the key barrier, it was found that the key challenge preventing HPV immunization uptake was barriers in health services delivery (Lobão et al., 2018). The HPV vaccine is a safe and effective cancer prevention strategy, and its optimal delivery offers a significant improvement to cancer control and prevention (NACI, 2012). For the purposes of this study, parents who did not utilize this program were considered HPV nonimmunizers.

Purpose of the Study

The purpose of this quantitative study was to determine which health services utilization factors were associated with parents who were HPV immunizers and those who were HPV nonimmunizers, compare the results of the two groups for statistical significance, and determine if any factors were predictive of parents' using this no-charge health service. The independent variables were the health services utilization factors, and the dependent variable was the immunizer status of the parents (i.e., HPV immunizer or HPV nonimmunizer). Identifying these determinants of health services utilization, rather than solely employing a behavioral determinants-based approach as previously studied in the literature, supports strategies for the optimization of the delivery of the HPV vaccine in the Canadian school-based public programs. This research elucidated alternative program delivery mechanisms, novel interventions, informed subsequent research question which all support national public health immunization targets (Bird et al., 2017; Balkin et al, 2007; Remes et al., 2014).

Research Questions and Hypotheses

The research questions that informed this study were as follows:

RQ1: What is the statistically significant relationship between health services utilization factors that are associated with parents who are HPV immunizers and those who are HPV nonimmunizers?

$H_0$1: There is no statistically significant relationship between health services utilization factors associated with parents who are HPV immunizers and those who are HPV nonimmunizers.

H_a1: There is a statistically significant relationship between health services utilization factors associated with parents who are HPV immunizers and those who are HPV nonimmunizers.

RQ2: What is the statistically significant relationship between health services utilization factors and parents who are HPV **i**mmunizers?

$H_0 2$: There is no statistically significant relationship between health services utilization factors and parents who are HPV immunizers.

$H_a 2$: There is a statistically significant relationship between health services utilization factors and parents who are HPV immunizers.

Conceptual Framework for the Study

The conceptual framework used to provide context for interpreting the study findings was the Andersen behavioral model of health services use. The Andersen behavioral model of health services use has been used extensively in studies investigating the use of various health services in multiple different areas of the health care system and in many different diseases (Tesfaye et al., 2018). The purpose of this framework was to discover health services utilization factors that either facilitate or impede health services utilization. The Andersen behavioral model of health services use was initially developed in the late 1960s, and its fourth iteration that was developed in 1995 remains the dominant conceptual framework used to examine health service utilization (Andersen & Newman, 1973; Andersen, 1995).

This model was the first to conceptualize components of health service utilization in a coherent multilevel integrated model. This model proposes that characteristics of a

society influence the health care system, and that both the society and the health care organization influence how persons use health services. The Andersen behavioral model of health services use distinguishes between three types of individual factors that facilitate or impede access to and utilization of health care services; these are predisposing, enabling, and need factors (Andersen, 1995). A pivotal systemic review of the literature between the years 2008-2011 of all studies that used the Andersen behavioral model of health services use, demonstrated great variability in the operationalization of the model as it relates to the selection of a common set of factors and how they were categorized (Babitsch et al., 2012). As there is not a mandated selection of factors or their categorization, this provides study authors flexibility in choosing a panel of factors that is relevant to their specific area of health services research.

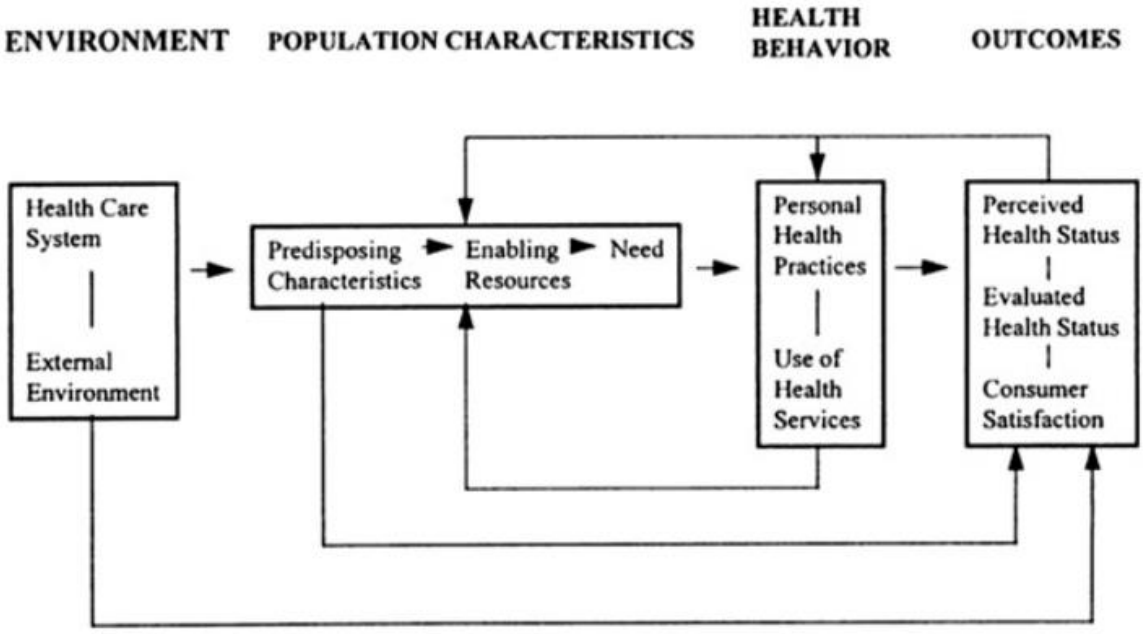
Predisposing factors identified in the setting of vaccine delivery include demographic characteristics and sociostructural characteristics such as education level, race and ethnicity, and family size (Lo & Fulda, 2008). Enabling factors refer to individual or structural resources enabling or increasing the likelihood of service use (Andersen, 1995). In the delivery of immunizations, this includes aspects such as income, private health insurance coverage, availability of health services, access to a regular source of care such as a family doctor, and availability of transportation (Lo & Fulda, 2008; Inkelas et al., 2008). Need factors represent both perceived and actual need for a health care service (Andersen, 1995). As need is a social construct, need is divided into perceived needs and evaluated needs. An evaluated need is an objective measurable need,

whereas a perceived need is partly determined by health beliefs (Andersen, 1995). An example of a perceived need in immunization delivery is whether people think the preventable condition is serious enough to seek health services (Lo & Fulda, 2008).

This framework supported the exploration of factors that are associated with parents who are HPV immunizers and those who are HPV nonimmunizers and allowed the results of the two groups to be analyzed for statistical significance and determined factors that were predictive of parents who used the no-charge HPV vaccine via the national school-based program in Canada.

Figure 1

Andersen Behavioral Model of Health Services Use (1995)



The independent variables are health services utilization factors, and the dependent variable is the immunizer status of the parents (i.e., HPV immunizer or HPV nonimmunizer).

Nature of the Study

This was a quantitative descriptive research study and employed an online survey methodology. The online survey was created using Survey Monkey collected original data for analysis to quantify the research problem. A nonprobability convenience sample was obtained from parents with children who were eligible for no-charge HPV vaccine via the national school-based program in Canada in the 2019/2020 school year. The survey was grounded on the Andersen behavioral model of health services use conceptual framework and review of the literature.

The survey questions were based on the operationalization of the three constructs of the Andersen behavioral model of health services use (predisposing factors, enabling factors, and need factors; Andersen, 1995). The questions from the operationalized constructs were aligned with questions from the 2017 Childhood National Immunization Coverage Survey (CNICS). The CNICS was conducted with care givers and their primary health care providers to determine if children under the age of 18 were immunized in accordance with the recommended vaccination schedules for publicly funded vaccines, including HPV. This additional alignment ensured the appropriateness of a national survey questions for the study population living in all Canadian provinces and territories (Statistics Canada, 2017).

To ensure reliability and validity of the survey, the questionnaire was pretested in a pilot study that involved 12 parents with children who were eligible for the no-charge HPV vaccine via the national school-based program in Canada. The pilot study participants were required to meet all the identical inclusion criteria as the target study

population. The pilot study participants were drawn from my network of family and friends. The online pilot study was administered to participants the same way that it was in the main study, as a SurveyMonkey questionnaire. Pilot study participants were asked for feedback to determine if any questions were confusing, difficult, caused bias, or were uncomfortable to answer. The time taken for parents to complete the survey was measured and recorded by the SurveyMonkey software. The desired time to complete this survey was 10 minutes or less. As described by Norland-Tilburg (1990) all feedback, insights, and time to complete the pilot survey were taken into consideration to ensure that any deficiencies in the survey tool were addressed.

Definitions

Access to care: Access to care is the ability to obtain suitable health care resources in order to preserve or improve the health of an individual. Access to care necessitates the assessment of the accessibility of health care services, the information about access to health care providers, and the barriers to utilization of both primary and preventive services which includes individual and collective barriers (Gulliford et al., 2002).

Health care access barriers: Includes three categories of modifiable health care access barriers: financial, structural, and cognitive. These three barriers reciprocally reinforce and affect health care access individually or collectively and are associated with screening, late presentation to care, and lack of treatment or intervention (Carrillo et al., 2011).

Health services utilization factors: Rational health services utilization factors identified in the literature and framed in the Andersen behavioral model of health aimed to understand health services utilization (Andersen, 1995).

*Immunize*r: A parent who elects to have their child immunized by utilizing their local HPV national school-based program.

*Nonimmunize*r: A parent who elects to not have their child immunized by not utilizing their local HPV national school-based program.

Parent: A mother or father and includes a guardian and a person with whom a child ordinarily resides who has demonstrated a settled intention to treat the child as a child of his or her family (Government of Canada, Department of Justice, 2018).

Parent-rated perceived need: How parents view their child's general health and functional state, as well as how they believe their child is experiencing symptoms of illness, pain, and concern about their child's health and whether they determine their child's problems to be of sufficient importance and magnitude to seek a professional health service (Andersen, 1995).

Vaccine eligible student: A female or male child in either the public or private Canadian school system who was eligible for no-charge HPV vaccine via the national school-based program in Canada in the 2019/2020 school year.

Assumptions

This study was based on the following assumptions:

1. Selection bias may have occurred due to the online delivery of the survey. The online nature of the survey may have limited the survey respondents to

internet users which may potentially exclude parents who do not have access to online resources to due socioeconomic reasons. This situation may have created a nonresponse bias.

2. The anonymity of the survey may have encouraged parents to answer the survey truthfully. The participants were volunteers who could have withdrawn from the study at any time without negative consequences.
3. An underlying assumption of the Andersen behavioral model of health services use was based on the three domains of the model as determinants of the Canadian HPV vaccination health services program. The three domains are entitled predisposing factors, enabling factors, and need factors.
4. The sample is representative of parents with children who were eligible for no-charge HPV vaccine via the national school-based program in Canada in the 2019/2020 school year. I utilized an online convenience sampling method that involved a broad range of provinces and surveyed a large number of parents.

Scope and Delimitations

Delimitations of this study include:

1. The study was limited to Canadian parents with children who were eligible for no-charge HPV vaccine via the national school-based program in Canada in the 2019/2020 school year, who could read and understand English. In the future the results of this study may be generalized to other Canadian parents with children who are eligible for no-charge HPV vaccine via the national

school-based program in Canada who can read and understand English. Generalization to other parents who cannot speak and understand English may or may not be warranted.

2. The objective of this study was to determine which health services utilization factors are associated with parents who are HPV immunizers and those who are HPV nonimmunizers, compare the results of the two groups for statistical significance and determine if any factors are predictive of parents' using this no-charge Canadian health service. Generalization to other health care services, immunizations, or countries may or may not be warranted.
3. The conceptual framework provided a framework for investigating the individual and collective factors of Canadian parents with children who were eligible for no-charge HPV vaccine via the national school-based program in Canada. The use of the framework supported the identification of health care service utilization barriers to the Canadian school-based HPV immunization program. Other factors were not included in the study.

Limitations

The study was limited to parents with children who were eligible for no-charge HPV vaccine via the national school-based program in Canada in the 2019/2020 school year, who could read and understand English and live in Canada. The study was conducted in 2021 during the COVID-19 pandemic; therefore, study subjects had to rely on their actions and experiences from the previous school year. The national school-based HPV program did not run in 2021 due to COVID-19 school closings; parental

participation may have been diminished. As this was a self-reported survey, this study data may have been subject to systematic errors resulting from nonresponsive subjects if they refused to participate in the survey or if they didn't complete certain survey questions.

Measurement due to subjects offering biased estimates of self-assessed behavior potentially may occur due to a misunderstanding of what a proper measurement is of social-desirability bias, even though the survey was anonymous. A convenience sampling online survey was the selected study method which may have resulted in a recruitment bias towards a specific demographic of respondents who have access to the internet and a computer. This online survey study was available only in English and excluded parents who did not read or understand English. The results of this study were interpreted from a Canadian scientific and health belief perspective and parents from other countries of origin may hold other views or health beliefs that act as barriers to health care. Other factors not considered in this study might have caused disparity in the study results.

Significance

To increase adolescent immunization coverage for HPV in Canada, the literature suggested a need for greater utilization of the school-based HPV programs which is the primary mechanism for the delivery of this health service (Rosberger et al., 2014; Shapiro et al., 2017). The underlying factors which impact the utilization of this free of charge health service were examined closely. Elucidating these factors, with the concomitant potential identification of common themes, provided information for health care service providers to modify and enhance program delivery and availability. Such modifications

may eradicate the identified barriers to health services delivery of the HPV vaccine and thereby increase immunization compliance. This study generated data that answer the proposed research questions and identified common factors that may serve as a prerequisite for designing novel health services interventions and also provided new questions for future research.

Summary and Transition

Improving the uptake of the HPV immunization is a priority of the Canadian health care system and a necessary requirement to reduce rates of cervical and other serious cancers. The HPV vaccine is not a mandatory vaccine in Canada; vaccination rates are suboptimal compared to other mandatory childhood vaccines. To increase immunization rates and decrease rates of HPV infection and related cancers, it is imperative that healthcare providers, policy makers and program directors are aware of factors that determine utilization of the school-based Canadian HPV vaccine programs.

Chapter 1 introduced the study, described the problem, the purpose, the significance, and limitations of this study. The Andersen behavioral model of health services use provides the conceptual framework for this study. It demonstrates how specific factors lead to the use of health services through an integrated model that incorporates societal factors which influence the health care system and how individuals utilize health services. Andersen further categorized a person's use of the health care services as a reflection of three domains entitled predisposing factors, enabling, and need. Understanding the factors in these three domains may improve utilization of the Canadian HPV school-based immunization program. The literature review to date demonstrated

that no studies have examined health care utilization of the Canadian HPV school-based immunization program framed by the Andersen behavioral model of health services use.

Chapter 2 covered the literature review, which demonstrated the magnitude of the problem associated with suboptimal HPV immunization. This chapter also addressed the Canadian healthcare system, Canada's school-based HPV vaccine program, time trends in HPV vaccine uptake, health services delivery and vaccine uptake, current HPV vaccine recommendations, the history of immunization, global and national immunization practices, the anti-vaccination movement, safety and side effects of vaccines, and the presently understood causes of vaccine hesitancy.

Chapter 2: Literature Review

Immunization is globally recognized as the single most effective measure to prevent and control infectious diseases, and more recently, chronic diseases, and cancers that are caused by infectious pathogens (Okunade, 2017). In North America, many of the infectious diseases that burdened society from the early 20th century through the 1950s have been reduced to diseases of historical interest (Orenstein & Ahmed, 2017). Vaccine preventable diseases such as measles, mumps, rubella, polio tetanus are rare in developed nations thanks to effective immunization programs (Greenwood, 2014).

The HPV vaccine has the potential to prevent morbidity and mortality from cervical and other HPV-related cancers and diseases, yet has the lowest vaccine concordance of the immunizations provided in the Canadian school-based system (Bird et al., 2017; Daley et al., 2017). The risk perception of acquiring these diseases, and experiencing any of their potential sequalae, such as death or significant morbidity due to complications, is low (Berezin & Eads, 2016). The narrative and concerns of parents are related to vaccine related side effects rather than the diseases they are trying to prevent (Berezin & Eads, 2016). This antivaccine narrative is broadly imposed on parents through exposure to social media (Tustin et al., 2018).

In 1976 zur Hausen, a German virologist, published his hypothesis that HPV had a significant role in the cause of cervical cancer. Later in 1983, he published the results of his research where he isolated the high-grade strains of HPV16 and HPV18 from cervical cancers (Dürst et al., 1983). He later received the Nobel Prize in Physiology or Medicine

for this major contribution to science and fundamental impact to human health (Nobel Prize, 2008).

Cervical cancer remains a concern a global concern for women even with the existence of the Papanicolaou test (PAP test), which is a method of cervical screening used to detect potentially precancerous and cancerous changes in the cervix (Corkum, 2019). It is estimated that it that the number of women developing cervical cancer annually worldwide will increase to more than 700, 000 cases by the year 2030 (Ginsburg et al., 2017). The development of HPV vaccines and their subsequent Health Canada regulatory approvals with widespread implementation in a Canadian national vaccine program have provided an opportunity to prevent cervical and other cancers and reduce other morbidities associated with HPV infection (Bird et al., 2017). Despite the availability of this effective preventative tool, HPV vaccination uptake is uniquely lower than other childhood vaccines that are offered as part of Canadian school-based programs (Government of Canada, 2018). Research that has increased the understanding of behavioral determinants of HPV vaccination, has not successfully been integrated into health services delivery to increase the immunization rates to meet national immunization targets in Canada and other countries (Gainforth et al., 2012; Lobão et al., 2018). Uniquely focusing on the determinants of health services utilization may improve health services delivery of the Canadian school-based programs.

This literature review includes a discussion of health care services constructed from the domains of ethnicity, private health insurance, access to a family doctor and parent-rated perceived need of the child. The literature review entails the Andersen

behavioral model of health services which is used as the conceptual framework for this study.

This chapter contains the following sections: (a) literature search strategy, (b) conceptual foundation, (c) conceptual framework, (d) literature review including sections on the Canadian health care system, Canada's school-based HPV vaccination programs, time trends in provincial HPV vaccine uptake, health services delivery and vaccine uptake, current HPV recommendations in Canada, vaccine hesitancy and herd immunity.

Literature Search Strategy

The literature review demonstrated a broad range of behavioral based data focused on parents and their intent to vaccinate their children with the HPV vaccine. The data identified that barriers to health services potentially posed a more significant barrier to HPV vaccine uptake; however, there is a paucity of data examining health care system gaps and barriers that impacted uptake in the Canadian health care system.

The strategy for the literature review was based on the question: "What factors influence HPV vaccine uptake in Canada?" To answer the literature review research question, articles were identified by searching PubMed-NCBI, Google Scholar, the Walden Health Science Research database, including Medline, ProQuest, and CIHNAHL. The searches were performed from July 2019 through November 2021 and were limited to articles published between the years of 2015 and 2021. References dated earlier than 2014 represent pivotal or seminal work in this field of study and in certain cases highlight gaps in literature which add to the relevance of this study. Except for some references, my emphasis on recent research is consistent with the dissertation

research guidelines established by Walden University (Walden University, 2018a). Government funded and managed websites such as the Government of Canada, the City of Toronto, the National Advisory Committee on Immunization, and the Childhood National Immunization Coverage were queried. These databases were interrogated using keywords that covered the key words *HPV health services utilization, access, barriers to HPV health services, HPV vaccination uptake,* and *Canadian school-based vaccine program*. The articles were selected from article titles and abstracts. The database search also included *parental attitudes, health system vaccine delivery flow, HPV and cervical cancer*.

The selected articles were required to contain relevant information and data regarding HPV services utilization and uptake in the Canadian school-based immunization programs. Full-text peer reviewed journals were included in the literature review. These journals incorporated studies of varying methodologies including qualitative, quantitative, and mixed design. Editorials and publications with only abstract level data were excluded from this literature review.

Conceptual Framework

The Andersen behavioral model of health service use served as the conceptual basis to provide context and understanding of health services utilization factors that determine use of the Canadian school-based HPV vaccine program. The purpose of this framework is to discover determinants that either facilitate or impede health services utilization. It is a well-established framework used for understanding human behavior in the context of health services use (Andersen, 1995). The Andersen behavioral model of

health services use has been widely used and is accepted in researching the use of various health services in diverse areas of the health care system and in many different therapeutic areas (Petrovic & Blank, 2015). This model is appropriate to this research as it is not limited to only human behavior like many other models but also includes health services outcomes which result from this behavior.

Like many conceptual frameworks and models, the Andersen behavioral model of health service use has evolved since its initial publication in 1968. One of the purposes of the original model was used to understand how and why families used health services (Newman, 1995). Through application of the model, constructive criticism and multiple revisions, the model has maintained its relevance to modern day health systems (Andersen & Newman, 2005). The original iteration of the model was highly representative of critical sociological constructs, but over the decades evolved to include novel constructs and concepts that are more characteristic of psychology, health services, and resource utilization (Andersen & Newman, 2005). In its most recent iteration, Andersen (1995) described the four phases of evolution of this model.

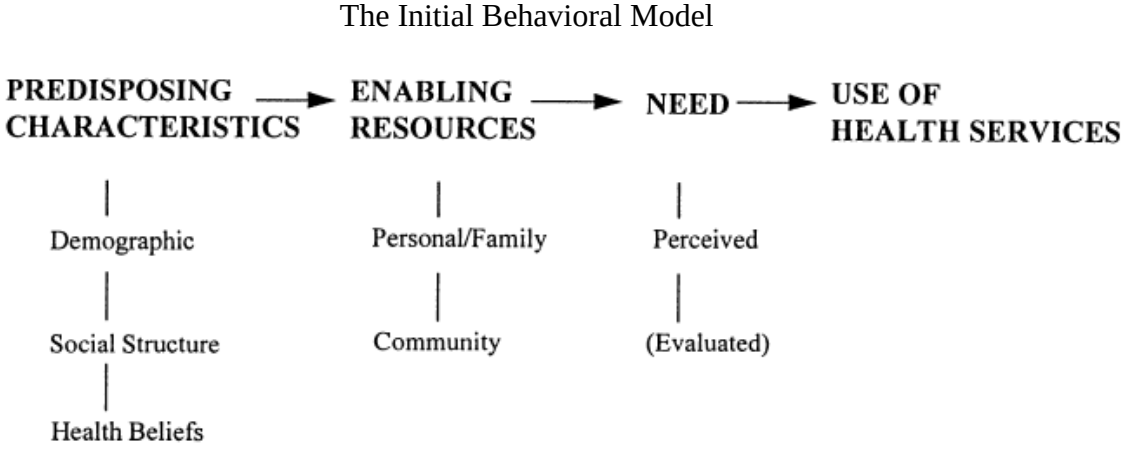
Andersen Health Utilization Model: Phase I

The original behavioral model is considered to be Phase I of the model's evolution. This inaugural model posits that people's use of health services is an outcome of their predisposition to use services, factors which enable or impede use, and their need for care (Andersen & Andersen, 1967; Andersen, 1968). This original model was used to analyze national survey data at the University of Chicago and attempted to explain the

use of personal health services rather than focusing on peri-health care interactions or outcomes (Andersen, 1995).

Figure 2

Initial 1968 Behavioral Model



The model was initially developed to assist the understanding of why families use health services. The family served as the model's original unit of analysis but later shifted to focus on the individual to address the potential heterogeneity and uniqueness of family members (Andersen, 1995). The model was later employed to define and measure equitable access to health care and assisted in developing policies to promote equitable access.

Andersen Health Utilization Model: Phase II

In the following decade, Phase II of the model was developed with his colleague Aday and additional contributors. In this phase, the entirety of health care system was incorporated into the model, largely due to the enhanced role and recognition of importance of national health policy and linkage to health services use (Aday &

Andersen, 1974). The element of consumer satisfaction was also added in this phase as a distinct consequence of health services utilization (Andersen et al., 1970; Andersen & Newman, 1973; Aday & Andersen, 1974; Aday et al., 1975; Andersen, & Fleming, 1980; Aday et al., 1985; Fleming & Andersen, 1986).

Andersen Health Utilization Model: Phase III

As the field of health services continued to the evolve through the 1980s and 1990s, perceived health status and evaluated health status as outcomes of health services became pivotal elements of the Andersen behavioral model of health services use. Perceived and evaluated health status served to define the third phase of development of the model and incorporated both the external environment and personal health practices as important contributions for understanding use of health service (Andersen et al., 1994).

Andersen Health Utilization Model: Phase IV

The fourth and presently final phase of the model has deepened in complexity by increasing its interdependencies and adding feedback loops that integrate the connectedness of the environment, population characteristics, health behavior, and outcomes (Andersen, 1995). The emphasis of this phase is on the individual and the surrounding dynamic of an iterative health services use model (Evans & Stoddart, 1990; Patrick et al., 1988).

Operationalizing the Framework

To gain insight into health services utilization factors that determine the utilization of the Canadian school-based HPV vaccine program, consideration of pertinent theoretical concepts is particularly useful. The fourth iteration of the Andersen

behavioral model of health services use is relevant, particularly in the broader context of how parents elect to utilize these health services. This is due to the consideration of societal characteristics when determining how health services are used and accessed (Andersen, 1995).

The integration of societal and individual factors is relevant in the broader context of parents living in a society where a social narrative is delivered to them regarding the risk associated with infectious disease. This suggests the influence of social media and a person's social narrative that is given context by family, friends and social network can influence their health behaviors and intentions (Andersen, 1995). The risk of infectious disease is muted due to the overall success of immunization and (Orenstein & Ahmed, 2017). Conversely, the risk of adverse effects from immunizations are disproportionately heightened due to a vocal and expanding antivaccination movement (Dubé et al., 2015). Compounding this societal narrative with individual factors provides a deeper context for understanding of health services utilization factors. These elements further validate the appropriateness of the use of the Andersen behavioral model of health services use to provide a framework for this study.

The recognition of the importance of individual factors that either serve to impede or facilitate the utilization of health services is accounted for and categorized in this model. These factors that relate to the individual or person are categorized as predisposing, enabling, and need factors (Andersen, 1995). Despite the several modifications, the basic hypothesis of the behavior model stays unchanged (Figure 2).

This model posits the actual use of health care service as a function of three foundational elements: predisposing characteristics, enabling resources, and need factors.

Predisposing Characteristics

Predisposing characteristics include individuals' demographic factors, social structure factors and health beliefs. Predisposing factors are not directly accountable for health service use. In addition, some predisposing characteristics are closely associated to the enabling factors, such as education and occupation; however, they are categorized under predisposing factors since they temporally precede the enabling factors.

Demographic Factors

Demographic factors include race, gender and age all of which may contribute to the biological foundations of needs for utilization of healthcare services.

Social Structure

There are also pivotal aspects of an individual's social structure such as level of education, social class, race, ethnicity, and employment status which contribute to the necessity for health services. Employment status may influence resource availability in the physical environment can lead an individual to be able to make appropriate health decisions. Measures of social class are necessarily broad and include the status of the individual within the group membership, social hierarchy, or identity in the immediate community (Andersen, 1995).

Health Beliefs

Andersen (1995) believes that health beliefs add to the model's ability to explain health services use in general. These health beliefs include attributes such as attitudes,

values, and knowledge one has about health and health services which impacts need perceptions of healthcare services (Andersen, 1995). The variation seen health service use can be explained by the Andersen model through his concepts of enabling and need factors.

Enabling Factors

The Andersen model suggests that researchers should extend their measurement of health service utilization beyond the usual source of care such as physician numbers and hospital bed count availability (Andersen, 1995). For healthcare service to occur, Andersen suggests that both personal and community enabling resources are readily available in the healthcare consumer's social and geographical context. In other words, the health services must be located where people live and work, and the structure and processes of the health services organization must be accessible in a way that people know how to use them. Enabling factors include personal, familial, and community factors that are essential for individuals to use healthcare services. These enabling factors include availability of healthcare facilities, individual income, health insurance, having a regular source of care, region, waiting times and transportation issues (Andersen, 1995).

Need Factors

Andersen (1995) proposed that one of the strongest determinants of this model of health services use is the need factor. The need factor is described as perceived health status, consumer satisfaction and evaluated health status (Andersen, 1995). The perceived health status of an individual, or in the case of HPV immunization, the parent-rated perceived health status of the child, is considered a social phenomenon that is explained

by both health beliefs and social structure. The parent-rated health status is a biological imperative, or need, represented by the parental judgment and assessment of their child's health status. These social and biological elements are interdependent and are dynamic due to the evolving medical, technology, policy, and geographies in which people access health services (Andersen, 1995). The parent-rated evaluation of need of mortality is the most highly correlated with the type and amount of medical care utilized (Andersen, 1995).

Categorization of Factors

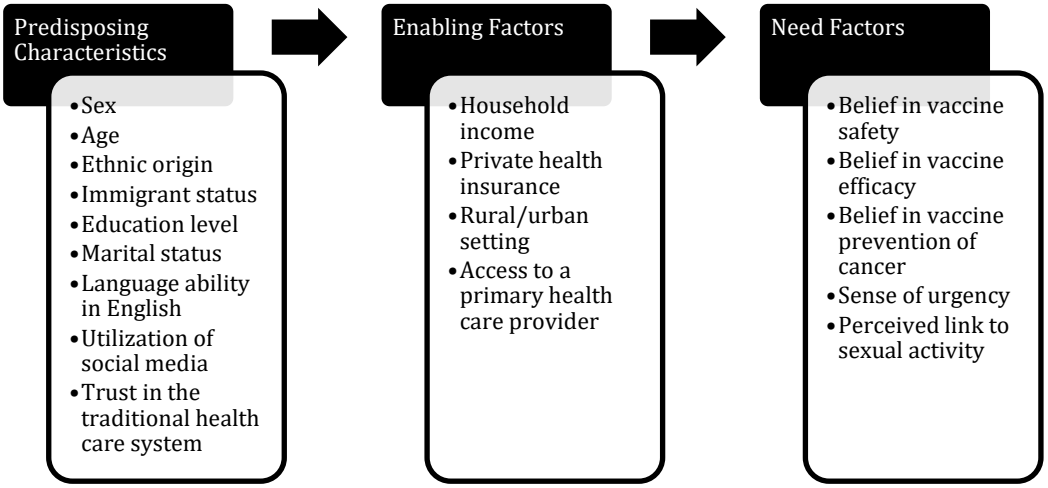
As previously described, when the Andersen behavioral model of health services use has been utilized as a research framework, there were significant freedoms taken by researchers to select and categorize variables (Babitsch et al., 2012; Tesfaye et al., 2018). This flexibility in choosing variables allows the selection of a rational panel of variables that are optimally suited to answer the research question being posed. The flexibility also allows for the most coherent variables to be selected depending on the therapeutic area being investigated (Babitsch et al, 2012). The pivotal systematic literature review of the utilization Andersen behavioral model of health services use by Babitsch et al. (2012), revealed the presence of enormous variability in the variables selected in the literature. This serves to underscore the complexity of the healthcare system and the various health care utilization processes. A prescribed variable set is therefore not established by the conceptual framework or in the literature.

Panel of Variables to be Utilized in this Study

1. Predisposing parent factors selected for this study include age, ethnicity, immigrant status, marital status, employment status, education level, access to social media and trust in the medical system.
2. Enabling parent factors include income, financial situation, private health insurance, rural/urban location, access to a primary care provider and availability of outpatient health services.
3. Parent perceived need factors included: belief in vaccine safety, vaccine efficacy, vaccine prevention of cancer, sense of urgency and perceived link to sexual activity. Assessment questions were devised to determine need factors.

Figure 3

Three Perspectives of the Literature Review



Literature Review

Over the last century, immunization has become recognized as the cornerstone of preventative medicine (Rémy et al., 2015). Immunization has had significant impact on human health globally with the reduction, or complete eradiation, of infectious diseases (Rémy et al., 2015). Population-based immunization has been deemed not only cost-effective, but it has also been noted as a key economic driver that supports the growth and sustainability of the health care system (Toumi & Riccardi, 2015). Immunization is largely a provider-driven medical intervention; however, its durability and stability are embedded in public trust and broad societal acceptance (Dubé et al., 2016). Compliance and adherence to childhood vaccination schedules must always be understood in relation to these social and political contexts (Hendrix et al., 2016).

Canadian Health Care System

The term Medicare refers to Canada's publicly funded health care system which is comprised of 13 provincial and territorial health care insurance plans, there is no single national health care plan (Government of Canada, 2020). These provincial and territorial plans allow for Canadians to have reasonable access to medically necessary hospital and physician services without paying directly out-of-pocket (Government of Canada, 2020). To support this system in Canada, the 2019 national health care expenditure was significant at $263 billion Canadian dollars which represents 11.6% of the gross domestic product (Canadian Institute for Health Information, 2019). Total spending on medications was $40.3 billion which represents 15.3% of the total health care expenditure in Canada (Canadian Institute for Health Information, 2019). Not all medications are funded via the public system which covers 42.7% of medication expenditures, the balance is expected to be paid for from private insurance coverage or directly by the individual (Government of Canada, 2020).

Canada's School-Based HPV Vaccination Programs

Current recommendations state that universal HPV vaccine funding coverage in should exist in Canada and that all physicians who care for children and youth should advocate this position (Salvadori, 2018). Vaccines for the prevention of HPV infection have been approved by Health Canada since 2006 (Health Canada, 2006). Commencing in 2007, and then through to 2010, all provinces and territories implemented routine HPV immunization programs for girls with a publicly funded supply of Gardasil HPV4 quadrivalent vaccine (Salvadori, 2018). Local public health departments are responsible

for administering the HPV vaccination programs through school-based programs to children in specific grades which vary between grades 4 and 8, depending on the province or territory (Salvadori, 2018). As the provincial programs target a specific age-based grade cohort, some provinces have employed time-bound catch-up programs for older girls who require immunization. This provincial practice of catch-up program implementation is in the minority yet has been found effective in decreasing HPV infections (Ahken et al., 2015; Goggin et al., 2018). Only eight of the 13 Canadian jurisdictions instituted a temporary catch-up vaccination program for schoolgirls at either the first or second year of the inception of the program for varying lengths of time which ranged between 1 and 5 years (Goyette et al., 2021).

In February 2010, the Gardasil HPV4 quadrivalent vaccine was approved for use in Canada extending its use to include males 9 to 26 years of age (Salvadori, 2018). In January 2012, HPV-4 was recommended for routine use in boys by the National Advisory Committee on Immunization (National Advisory Committee on Immunization, 2012). By 2017, eight provinces had announced HPV school-based programs that included males. Current provincial and territorial vaccine schedules can be found in Appendix A. A nonavalent HPV vaccine with broader viral subtype coverage named Gardasil® HPV-9 was authorized for use in Canada in 2015, and in 2017, the National Advisory Committee on Immunization published recommendations for its use (National Advisory Committee on Immunization, 2017).

Time Trends in Provincial HPV Vaccine Uptake

Time trends in HPV vaccination coverage rates of the full vaccine course across Canada's provinces and territories have varied over time. In the early years of these programs, coverage rates for girls ranged from 48% in Ontario in the program's inaugural year to 94% in Newfoundland and Labrador in the 2012/2013 school year (Goyette et al., 2021). The only province that maintained coverage rates above 80% in girls was Prince Edward Island from the 2011 and 2012 school year through to 2018 and 2019 (Goyette et al., 2021). Prince Edward Island also maintained the same coverage rate of above 80% in boys from 2014/2015 through 2018/2019 (Goyette et al., 2021). Coverage rates were over 80% in the province of Nova Scotia for boys in the 2015/2016 and 2016/2017 school years (Goyette et al., 2021). The provinces of Alberta and Ontario demonstrated gradual increases in coverage in the first years of the program, whereas Newfoundland and Labrador demonstrated a consistent linear increase (Goyette et. al, 2021). The province of Saskatchewan demonstrated a gradual decline in HPV coverage rates for girls from 75% in 2008/2009 to 69% in 2016/2017. The other Canadian provinces and territories did not demonstrate any obvious time trends in HPV coverage rates (Goyette et al, 2021).

Health Services Delivery and Vaccine Uptake

Vaccination programs for youth are characteristically comprised of a triad of the parent, provider, and health care system; however, in the Canadian school-based model for HPV health services delivery, the primary care physician provider and traditional health care delivery setting are often not part of the coordination of care. The importance of a primary health care provider recommendation in making the decision regarding HPV

vaccination is a well-established finding (Holman et al., 2014; Gilkey et al., 2012). Shapiro et al. (2018) conducted a study to concurrently evaluate the HPV vaccine knowledge, attitudes, and the decision-making stage of Canadian parents for their school-aged children. Shapiro et al. (2018) found in their study that there were two main underlying factors that influenced outcome, these factors were "lack of confidence" and "risks". These subscales were associated with parental HPV vaccine attitudes, and important disparities were found in vaccine hesitancy by parents' stage of the decision-making process (Shapiro et al., 2018). Importantly, hesitancy was also associated with vaccine refusal. This study stresses the importance of a health care professional recommendation as an important differential in the Canadian health care delivery network. This suggests that a health care professional recommendation may increase the probability that a parent allows HPV vaccination, but the recommendation alone may not be sufficient to move parents from deciding to vaccinate their child (Shapiro et al., 2018).

The association between knowledge and vaccine uptake has previously generated mixed results as high and low knowledge have both been associated with vaccination uptake (Radisic et al., 2017). Shapiro et al. (2018) also identified in their study that low HPV vaccine knowledge is an important correlate of early stages of decision-making rather than making the final decision to vaccinate. These results did not hold in their multivariate analysis which showed that parents with higher levels on knowledge about the HPV vaccine were more likely to be immunizers than nonimmunizers (Shapiro et al, 2018). This suggests that educational interventions alone may not be sufficient for HPV vaccination uptake.

Current HPV Recommendations in Canada

There are now three HPV vaccines approved for use in Canada (Gardasil, Gardasil9, and Cervarix) that each differ in formulation and HPV strain protection. In Canada, the Gardasil (HPV4 vaccine) received market authorization for use from Health Canada in 2006 for the prevention of infection caused by HPV Types 6, 11, 16 and 18 - related cancers and genital warts (Gardasil Product Monograph, 2015). Cervarix (HPV2 vaccine) received Health Canada approval in 2010 for the prevention of cervical cancer caused by HPV Types 16 and 18 (Cervarix Product Monograph, 2019). Gardasil or Cervarix are recommended for the prevention of cervical cancer and adenocarcinoma in situ (AIS) in females 9 through 26 years of age, females 15 through 26 years of age who have had previous Pap test abnormalities, including cervical cancer and external genital warts (Cervarix Product Monograph, 2019; Gardasil Product Monograph, 2015).

Gardasil is recommended for the prevention of vulvar, vaginal, anal cancers and their precursors, and AGW in females 9 through 26 years of age, for the prevention of anal intraepithelial neoplasia (AIN), anal cancer, and AGW in males between 9 and 26 years of age, including males who have sex with males (Gardasil Product Monograph, 2015). Cervarix is not recommended for males at this time (Cervarix Product Monograph, 2019). Gardasil or Cervarix may be administered to females over 26 years of age. Gardasil may be administered to males over 26 years of age (Cervarix Product Monograph, 2019; Gardasil Product Monograph, 2015). HPV vaccines are not recommended for females or males less than nine years of age as no immunogenicity or efficacy data are available in these groups

HPV vaccines have been approved by Health Canada to be given as three separate 0.5 mL doses: the Cervarix HPV2 vaccine at months 0, 1, and 6 and Gardasil HPV4 vaccine at months 0, 2, and 6. The Cervarix vaccine expanded its authorization for use in girls from age 9 to 14 years of age at the time of first injection as a three-dose schedule (0, 6 months) (Cervarix Product Monograph, 2019).

Additional data have been collected on a two- versus three-dose HPV immunization schedule and various immunization technical advisory groups have summarized these novel schedules, including the World Health Organization's Strategic Advisory Group of Experts (WHO's SAGE). Consistent with recommendations by these groups, Canada's National Advisory Committee on Immunization recommends that Cervarix HPV2 and Gardasil HPV4 vaccines should be administered to immunocompetent individuals nine to fourteen years of age as two separate 0.5 mL doses at months 0 and 6-12. Three separate does of HPV vaccine are still required for some individuals (Cervarix Product Monograph, 2019). These individuals include persons who have an HIV infection (both immunocompromised and immunocompetent) and anyone who has never received a HPV vaccination by 15 years of age (Cervarix Product Monograph, 2019).

A two-dose HPV immunization schedule among immunocompetent nine- to fourteen-year-old children is expected to provide similar protective efficacy compared to a 3-dose schedule in immunocompetent individuals aged 9 to 26 years and may be considered to allow for potential cost savings and other individual and programmatic

advantages (National Advisory Committee on Immunization, 2012). Immunocompetency refers to individuals who can amount a normal immune response to a foreign antigen.

Gardasil9 (HPV9 vaccine) was given market authorization by Health Canada on February 5, 2015, for the prevention of infection caused by HPV Types 6, 11, 16, 18, 31, 33, 45, 52 and 58. This immunization also protects against 2 types of HPV that cause about 90% of cases of genital warts.

A phase II/III study of the HPV9 vaccine demonstrated that immunogenicity for the HPV Types 6,11, 16 and 18 were non-inferior with respect to their immunogenicity when compared directly to the HPV4 vaccine (Chen, 2015). In addition, the HPV9 vaccine proved to have high efficacy for the five HPV Types (31, 33, 45, 52, and 58) which were also administered in the vaccine (Chen, 2015). The safety profile of the HPV9 vaccine was comparable to the HPV4 vaccine, although adverse events related to injection site (mild-moderate intensity) were more common in the HPV9 vaccine compared to the HPV4 vaccine (National Advisory Committee on Immunization, 2017).

The previously described vaccination schedules are widely available through Canada's HPV provincial vaccination programs. Strict age and temporal limitations and provincial inconsistencies with the applications of the recommended vaccination schedules has left many young Canadians unprotected from HPV (Park & Gratton, 2018). A recent meta-analysis found the median uptake of the HPV vaccine across twelve studies to be 56% (range: 12.40%-88.20%) (Bird et al., 2017). The uptake of the HPV vaccine is comparatively lower to other childhood vaccines and coverage and knowledge

disparities have been broadly reported in specific demographics and subpopulations (Rubens-Augustson et al., 2019).

Vaccine Hesitancy

Despite generally high overall coverage levels for pediatric vaccines, there have been parents, since the inception of immunization programs, who are vaccine hesitant. These parents question the efficacy, safety, and necessity of pediatric immunizations (Weithorn & Reiss, 2018). Recent studies propose that this group of vaccine hesitant parents may be increasing in North America, as evidenced by a steep increase in requests for exemptions from required school-based vaccines (Parasidis & Opel, 2017). Although acceptance of vaccinations is the overall norm, increasing parental refusal and public resistance have been documented in North America (Weithorn & Reiss, 2018). A study by Simpson, Lenton and Randall (1995) indicated that the two most common reasons for declining immunization were religious beliefs and a trend toward homeopathy. Another study from the United Kingdom found that parents who declined the MMR vaccine felt that the risks associated with the vaccine outweighed the benefits (Evans et al., 2001). The direct benefits of immunization are clear; however, the indirect protection provided to the broader community, also known as herd immunity, is often underappreciated by the public (Andersen et al., 2018). Herd immunity occurs when immunized individuals inhibit transmission of an infectious agent (Tsaban & Ben-Shimol, 2017). This inhibition of pathogen transmission protects unvaccinated individuals and susceptible members of the by preventing exposure and limiting the spread of the pathogen (Andersen et al., 2018). Protection of susceptible community members consequently depends on

maintaining high vaccination rates. Susceptible community members are often comprised of society's most vulnerable populations including infants, elderly, cancer patients and other immunocompromised individuals (Tsaban & Ben-Shimol, 2017).

Herd Immunity

Vaccine hesitancy is critical to overcome, as the concept of maintaining herd immunity against HPV infections is highly relevant for preventing the spread of this pathogen and most importantly for the prevention of the unwanted sequalae of secondary diseases including cancer (Andersen et al., 2018). Recent data from the United Kingdom have demonstrated that a vaccination program which immunized only females was associated with significant reductions in oropharyngeal HPV-16 infections in not only in the immunized females, but also in unvaccinated males of the same age group (Mehanna et al., 2019). These are the first scientific data to suggest potential herd immunity conferred from a female-only cohort vaccinated against oropharyngeal HPV infection to contemporaneously aged males (Mehanna et al., 2019). In Canada, it is recommended that all grade 8 children, both males and females, are vaccinated against HPV; however, these recent data from Mehanna et al. (2019) may result in deepening the already considerable social controversy regarding the necessity to vaccinate boys.

A large driver of HPV vaccine hesitancy and vaccine exemption is the antivaccine movement (Whelan, 2016). The antivaccination movement in its broadest sense refers to a group or individuals who are opposed to any immunizations and its existence has been documented as early as the 18th century (Hussain et al, 2018). The main goal of these antivaccine movements is to do away with the compulsory nature of vaccines and this

intention has historically been driven by religious and political origins (Dubé, et al., 2015; Hussain et al., 2018).

The anti-vaccination movement gained a larger following and further traction with the publication in The Lancet by Wakefield. Wakefield was a former British scientist and physician who suggested a causal link between the measles, mumps, and rubella (MMR) vaccine and the development of pervasive developmental delay or autism associated with gastrointestinal tract in children (Wakefield et al., 1998). Wakefield had received compensation from litigants against vaccine manufacturers, which was not disclosed to his co-authors, colleagues, or the Lancet (Godlee et al., 2011). Subsequently, several studies published later disproved any connection between the MMR vaccine and autism (Taylor et al., 1999). Wakefield drew severe criticism for his flawed and unethical research methods and the publication in the Lancet was fully retracted (Wakefield et al., 1998).

Despite the mounting literature documenting the effectiveness and safety of vaccines, an active and vocal antivaccine movement has continued to grow over recent years in Western society (Hussain et al., 2018). The internet has supported the anti-vaccine movement by increasing its presence and ability to disseminate misinformation to a broad audience (Olive et al., 2018). Methods of disseminating information have transformed since the 19th century, but the concerns and activities of antivaccination movements in Europe and their counterparts in the North America have only marginally changed (Hussain et al., 2018). Nineteenth century antivaccination leagues held public demonstrations in the streets, whereas today's antivaccination movement dominates the

internet instead. Websites, online support groups, and electronic bulletin boards are proliferating in this globally accessible media (Olive et al., 2018).

The breadth of access to medical information via the internet has served to change the dynamics of the parent and physician interaction as it relates to immunization decision making (Hussain et al., 2018). Medical knowledge that was previously the unique domain of physicians is now easily accessible to the public which has enabled parents to be more active decision makers in their children's care (Hussain et al., 2018).

The impact of the anti-vaccine movement's activity on the internet has changed how Canadian parents perceive vaccine risk and perceived need of this preventative intervention. Tustin et al. (2018) demonstrated that parents who use the internet for their primary information source for vaccines have a 1.6 times greater negative perception of the safety of vaccines. This has led many parents to seek alternatives to traditional vaccinations that have little or no proven efficacy (Rieder & Robinson, 2015).

Hussain et al. (2018) conducted a survey to better understand vaccine hesitancy in Canadian parents. Approximately 92% of the survey respondents considered vaccines safe and effective, and continued to have confidence in primary health care providers and the health care system to provide appropriate vaccine-related information (Hussain et al., 2018). A concerning finding was that 28% of the parents still believe or are uncertain whether there is a link between vaccines and autism (Hussain et al., 2018). Furthermore, despite the general assumption that social media are becoming the primary source of health updates and information, most parents still rely on traditional media and official government websites for timely and credible information about vaccines and vaccine

preventable diseases, particularly during community-based disease outbreaks (Hussain et al., 2018).

In 2019 the World Health Organization deemed vaccine hesitancy as one the ten gravest threats to global health (Drew, 2019). As a result, many countries and their governments are debating policies that would make immunizations compulsory (Drew, 2019). Although the anti-vaccination movement has been active for over two hundred years, these groups have recently been lent much support and sympathy from the controversy surrounding the oral polio, whole cell pertussis, Hepatitis B and the MMR vaccines (Nour, 2019). The anti-vaccination movement has profoundly affected the uptake of all these vaccines throughout various regions in the world as it has changed parental perceived need of immunizations and increased the risk perception associated with vaccine side effects (Drew, 2019).

Summary and Conclusions

In Chapter 2, I reviewed a breadth and depth of literature and studies related to the Canadian healthcare system, Canada's school-based HPV vaccination programs, national current HPV vaccine recommendations, the Andersen health utilization model and vaccine hesitancy. The literature demonstrates that despite widespread availability of several highly effective vaccines against HPV through a no-charge health service, immunization rates are well below the national targets established by national public health agencies (Government of Canada, 2018). The data revealed that there is a paucity of literature that elucidates the role of health utilization factors in whether parent elect to immunize their children or not. In Chapter 3, I explain the study methodology, data

collection procedures. I describe the research design and rationale, methodology, population, sampling procedures, data collection, instrumentations, threats to validity, and ethical procedures in detail.

Chapter 3: Research Method

The purpose of this quantitative descriptive research study was to determine which health services utilization factors were associated with parents who were HPV immunizers and those who were HPV nonimmunizers, compare the results of the two groups for statistical significance and determine if any factors were predictive of parents' using this health service. The health services utilization factors were framed within the Andersen behavioral model of health services use. This framework provided significant flexibility in the ability to select of appropriate variables for this study.

A survey methodology grounded in this framework was the data collection tool. The aim of the study was to understand the individual and collective barriers that can be optimized in an integrated approach to improve uptake of the HPV vaccine in Canada. Data were collected from parents who were health services users (i.e., HPV immunizers) and parents who did not use these health services (i.e., HPV nonimmunizers).

The objective of this chapter is to describe the methodology that was used to determine the effects of health services utilization factors on the parental utilization of the Canadian school-based HPV vaccine program. Utilization of the Canadian school-based HPV vaccine program categorizes parents as HPV immunizers, those parents who did not utilize the program were categorized as HPV nonimmunizers.

This chapter includes the detailed steps I followed to conduct this study. I provide details on the study design and approach, study scope and population size, sampling method, data collection and analysis procedures, data protection methods, and privacy of the participants. This chapter contains the following sections: (a) research design and

rationale; (b) methodology; (c) data analysis plan; (d) threats to validity, ethical procedures; and (e) summary.

Research Design and Rationale

This quantitative nonexperimental research design incorporated a descriptive design, descriptive statistic, and cross-sectional survey data. The data collection tool was a researcher-developed survey that was based on the Andersen behavioral model of health services conceptual framework and review of the literature. This survey tool was used to collect data from eligible parents was an electronic SurveyMonkey questionnaire which was accessed by study participants online through a website designed specifically for this study. The online questionnaire was open to enrollment from March 1st, 2021, through April 30th, 2021.

This approach provided the method to assess the difference between the (i.e., if parents were HPV immunizers or HPV nonimmunizers) and the independent variables (i.e., health services use factors). The data were gathered during this specific time interval rather than over multiple intervals in order to reduce the effect that information exposure might have on study subjects (Creswell, 2009). Quantitative research employs instruments and "processes of measurement, counting, association, and causality" to identify characteristics of social phenomena (Franfort-Nachmias & Nachmias, 2015, p. 242). Researchers use data collected from research studies and then apply statistical procedures to identify relationships and test the research questions (Creswell, 2009; Franfort-Nachmias & Nachmias, 2015)

Independent Variables

The health services use factors of the Canadian school-based HPV vaccination programs are the independent variables for this study. The independent variables are based on variables identified in the literature that corresponded to the three core population characteristics of the Andersen behavioral model of health services utilization: predisposing factors, enabling factors and need factors (Andersen, 1995).

Table 1

Independent Variables in the Study

Independent Variables	Details
Predisposing Characteristics of Parent	
Sex	Male, female or other
Age	Actual age in years
Ethnic origin	African, Asian, Asian/Indian, Asian Pacific Islander, Caucasian, Hispanic, Multiple Race, Aboriginal, Other
Immigrant Status	Non-immigrant, a Canadian citizen by birth, Immigrant, a person who is or whoever has been a landed immigrant/permanent resident.
Education level	Elementary school, High school, Community college diploma / Associates Degree, Baccalaureate degree, Graduate degree
Marital Status	Single or never married, married or domestic partnership, divorced, widowed, separated.
Language ability in English	Do you have a first language that is NOT English? Yes or no.
Utilization of social media	Do parents utilize social media (e.g. Facebook, Instagram, Twitter etc.) to review health information on HPV and HPV Immunization? (yes, no, unknown).
Trust in the traditional health care system	From which health care provider / provider do you mainly seek advice about immunization? Medical doctor, nurse, pharmacist, naturopath, homeopath, other (describe). .
Enabling Factors of Parents	
Household income	Total household income? Less than $50,000, $50,000 to $74, 999, $75,000 to $99,999, $100,000 to $149,999, $150,000 or more
Private health insurance	

	Family access to private health insurance that covers HPV vaccines. Yes, no, unknown
Rural or urban setting	Does the family reside in an urban (region in or surrounding a city) or rural setting (countryside)?
Access to a primary care provider	Does the parent have access to a primary care provider such as a family physician? Yes or no.
Need factors of Parents	
Immunization with the Human Papilloma Virus (HPV) vaccine is safe for my child and its benefits outweigh the risks.	Does the parent believe in the vaccine's safety profile?
The Human Papilloma Virus (HPV) vaccination provides effective and long-lasting protection again HPV infections.	Does the parent believe the vaccine is effective in preventing HPV infections?
The Human Papilloma Virus (HPV) vaccination provides effective and long-lasting protection against cancers caused HPV infections.	Does the parent believe the prevention of HPV infections will prevent HPV associated invasive cancers?
My friends and family encouraged me to immunize my child with the Human Papilloma Virus (HPV) vaccine.	Does the parent believe the vaccine is effective in preventing HPV infections?
I should immunize my child with the Human Papilloma Virus (HPV)	Does the parent believe the vaccine is effective in preventing HPV infections?

vaccine to help protect others.	
Many people in my community do not immunize their children with the Human Papilloma Virus (HPV) vaccine.	Does the parent believe the vaccine is effective in preventing HPV infections?
I have religious beliefs that influenced my decision regarding immunizing my child with the Human Papilloma Virus (HPV) vaccine.	As HPV is a sexually transmitted infection, do parents have a sense of urgency to immunize their school aged children?
I feel that there is an immediate need to immunize my child with the Human Papilloma Virus (HPV) vaccine.	As HPV is a sexually transmitted infection, do parents have a sense of urgency to immunize their school aged children?
I feel that it is more important to vaccinate girls than boys with the Human Papilloma Virus (HPV) vaccine.	As HPV is a sexually transmitted infection, do parents have a sense of urgency to immunize their school aged children?
My child's family doctor or other primary health care provider discussed the importance of the Human Papilloma Virus (HPV) vaccine with me.	Does the parent believe the vaccine is effective in preventing HPV infections?

I am concerned that Human Papilloma Virus (HPV) immunization will lead my child to engage in earlier or riskier sexual activity.	As HPV is a sexually transmitted infection, do parents have a sense of urgency to immunize their school aged children?
My child is not sexually active, so I don't believe there is a need to vaccinate him/her with the Human Papilloma Virus (HPV) immunization at this time.	As HPV is a sexually transmitted infection, do parents have a sense of urgency to immunize their school aged children?

Dependent Variable

The dependent variable was the immunizer status of the parents (i.e., HPV immunizer or HPV nonimmunizer). This allowed for the categorization of two groups of health services users: HPV immunizers and HPV nonimmunizers. Utilization of the HPV immunization program was defined by the parent's confirmation of their provision of consent to their local public health department to have their child immunized in the school-based program.

Research Questions and Hypotheses

The survey results answered the following quantitative research questions:

RQ1: What is the statistically significant relationship between health services utilization factors that are associated with parents who are HPV immunizers and those who are HPV nonimmunizers?

$H_0$1: There is no statistically significant relationship between health services utilization factors associated with parents who are HPV immunizers and those who are HPV nonimmunizers.

H_a1: There is a statistically significant relationship between health services utilization factors associated with parents who are HPV immunizers and those who are HPV nonimmunizers.

RQ2: What is the statistically significant relationship between health services utilization factors and parents who are HPV immunizers?

$H_0$2: There is no statistically significant relationship between health services utilization factors and parents who are HPV immunizers.

H_a2: There is a statistically significant relationship between health services utilization factors and parents who are HPV immunizers.

The use of the Andersen behavioral model of health services use in this quantitative study provided the framework for a comprehensive analysis of the many variables that affect parents' utilization of the national HPV school-based immunization program. This research design provided novel information in a subject area that has a paucity of data. The breadth of variables used contributed to the delivery of a deeper understanding of the parent's health practices, influencing factors and ultimately their use of health services.

Methodology

Parents of children who were eligible for HPV vaccination through the Canadian national school-based programs were invited to complete a survey with questions to identify barriers to utilizing the program. The three core elements of the Andersen behavior model which have been identified as a function of health services use were the foundation of the online survey and were defined as follows:

1. Predisposing characteristics: identified characteristics as set forth in Table 1.
2. Enabling resources: identified resources as set forth in Table 1.
3. Need factors: identified need factors as set forth in Table 1.

Population

Studies that evaluate population-based interventions frequently rely on large-scale survey data from numerous respondents across many geographic areas to provide evidence of their effectiveness (Cantrell et al., 2018). Statistics Canada (2019) published

that the population of both male and female adolescents between the ages of 10 and 14 years of age of 2,031,762, which should correspond with the availability of at least one parent. Approximately 97% of 15-year-old children attended school in the 2015/2016 school year, which is the most recent data available from Statistics Canada (2018). The study population was calculated using SPSS Statistics Version 26 and G*Power 3.1.9.2. G*Power evaluated a priori the computation to calculate the required sample size for logistic regression given the alpha, power, and effect size. The required sample size was calculated as 783 Canadian parents. This sample may only partially represent the larger population under investigation, replication of this study may be required to fully validate the results (Keppel & Zedeck, 2001).

Each respondent was required to meet the following criteria to participate in this study: must have had (a) a child that was eligible to participate in the national school-based immunization program, (b) 18 years of age or older, (c) English speaking, and (d) willing to voluntarily participate and answer survey questions. Participation was open to include individuals of all genders, ethnicities, socioeconomic status, and level of educational achievement.

Sampling and Sampling Procedures

The sample size was calculated based on an odds ratio of 1.3, power of 0.9 and α of 0.05. A convenience sampling technique was used to extract the sample from the population. Selecting this method of nonprobability sampling was appropriate for this study as the sampling population is difficult to define. The sampling population list is

unavailable, and it is being used for exploratory research and the convenience of the methodology with such a large population (Frankfort-Nachimias & Nachimias, 2014).

The other three main sampling designs that use nonprobability methods were not appropriate for this study. Snowball sampling could not be employed due to the utilization of anonymity of the participants; quota sampling was inappropriate due to the inherent limitations of the requirements of specific inclusion criteria; and purposive sampling would have limited the number of participants required (Frankfort-Nachmias & Nachmias, 2014).

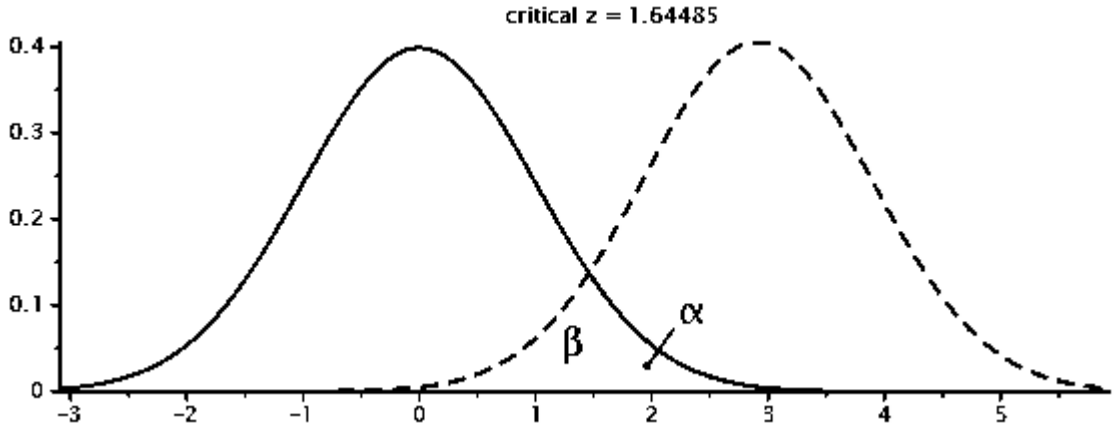
Table 2

Power Analysis Estimated Parameters and Results

Analysis Inputs:		Statistic
Test Family = z-*tests*		
Statistical Test = Logistic regression analysis		
Type of Power Analysis = *A priori*: Compute required sample size – given α, power and effect size		
Tail(s)		= One
Odds ratio		= 1.3
Pr (Y=1|X=1) H0		= 0.2
α err prob		= 0.05
Power (1-β err prob)		= 0.90
R^2 other X		= 0
X distribution		= Normal
X parm μ		= 0
X parm σ		= 1
Analysis Output:	Critical z	1.6448536
	Total sample size	783
	Actual power	0.9000457

Figure 4

*G*Power Plot Power Analysis Graph of Central and Noncentral Distributions*



Procedures for Data Collection, Recruitment, and Participation

The data collection methods used in this study defined the procedures for recruiting, distributing, and collecting the surveys. The public health departments of the ten provinces and three territories were be emailed a cover letter (Appendix B) inviting them to post an advertisement for the study (Appendix C) to the online questionnaire as a link from their webpage. The advertisement provided an overview of the study and directed parents to the website www.Canadian-HPV-Research.ca (Appendix D). A Facebook page was created entitled Canadian HPV Research Study that also directed potential participants to the same website. This website was created solely for the purpose of this study and was hosted by a professional webserver provider DreamHost. The homepage of the www.Canadian-HPV-Research.ca displayed the online cover letter of

informed consent, which explained the purpose of the study and invited parents to participate (Appendix E).

If parents consented to participate, they were invited to click upon a designated link, which redirected them to a secure page that contained an online html questionnaire (Appendix F). The questionnaire was designed to send a Persistent Client-State HTTP Cookie to the respondent's computer so that the respondent could only complete the questionnaire one time. This prevented respondents from completing the survey more than once and potentially submitting multiple surveys. Persistent Client-State HTTP Cookies are files containing information about visitors to a web site (i.e., username and preferences). This information was provided by the user during the first visit to a web server and the server recorded this information as a text file and stored this file on the study participant's hard drive. When the study participant accessed the same website again the server looked for the cookie and configured itself based on the information provided.

Once completed, the questionnaire was returned to my online SurveyMonkey account anonymously. No personal information about the sender appeared in the investigator's account nor was I able to retrieve sender information from DreamHost. The online web form was designed from a template provided by SurveyMonkey, a company that specializes in the creation of online questionnaires and surveys. The anonymous link for the study questionnaire was configured to not record the respondent's email address.

A broad array of internet browsers is supported by SurveyMonkey including Chrome 18 and later, Firefox 24 and later, Safari 7 and later, Microsoft Edge and Internet

Explorer 11. The questionnaire host, SurveyMonkey, does not hold any personal information regarding the respondents. Answers to the questionnaire were downloaded for analysis directly into Microsoft Excel and then to the Statistical Package for Social Sciences (SPSS) software.

To ensure that participants were from the target population, several control measures were implemented in the form of key inclusion and exclusion criteria that were presented as part of the survey. If a potential participant answered *no* to any of the following survey questions they were not be able to participate: Do you have a child that is eligible to participate in the national school-based immunization program, are you 18 years of age or older, can you communicate in English, and are you willing to voluntarily participate and answer survey questions? These measures were implemented as online surveys have the potential to be invalidated by responders who are not part of the target population (Rudestam & Newton, 2015).

Pilot Study

The survey questionnaire was pretested in a pilot study for reliability and validity involving 12 participants, composed of my family and friends who met the same criteria as the target parent population. The data from the pilot study responses were included in the data for analysis for the main research study. The pilot study was administered to participants the same way that it was administered in the main study.

The participants were asked for feedback to identify confusing, difficult, or uncomfortable questions. In addition, the time taken for parents to complete the survey was measured and recorded. SurveyMonkey has the capability of automatically recording

the amount of time it takes to complete the survey which is convenient as it ensures no influence by the study investigator. The desired time to complete the survey was no more than 10 minutes. The feedback and the average time taken for completion of the survey was used to confirm if the survey is reliable and valid and if any changes need to be implemented. The pilot study provided useful insight about what questions might be complicated, inappropriate, or uncomfortable for parents to answer.

Data Analysis Plan

The survey data from the parents was exported into Excel and then collected, collated, and entered into a PC-based computer system. Descriptive statistics were used to analyze the data by item with the SPSS. A report of incomplete, complete, ineligible, and blank surveys was described by frequency and percent. Descriptive statistics were calculated for HPV immunizers and HPV nonimmunizers for the first research question: What is the statistically significant relationship between health services utilization factors that are associated with parents who are HPV immunizers and those who are HPV nonimmunizers? An unpaired *t*-test was used to compare parametric data from the two independent groups of subjects for age and income. The unpaired *t*-test determined if the difference between the group means is of statistical significance. The unpaired *t*-test did not require that the groups be of the same size, which is an element that needed to be satisfied for this study. For the nonparametric data, the Pearson's chi-square was used to assess the independence of the variables and determined whether the paired observations were independent of each other. The Mann-Whitney U-test was used to determine if the summed scores from the nonparametric data obtained with a four-point Likert scale were

significant. An alpha of 0.05 was established for all statistical tests. The Mann-Whitney U-test was selected for data analysis as it is one of the more powerful nonparametric procedures, designed to test the null hypothesis that two independent samples come from the same population (Portney & Watkins, 2000). To answer the research question: What is the statistically significant relationship between health services utilization factors and parents who are HPV nonimmunizers? Logistic regression analysis was used for the statistical analysis in answering the research question. The logistic regression analysis determines the relationship between the independent variables, the health services use factors, and the dependent variable, the dependent variable is the immunizer status of the parents (i.e., HPV immunizer or HPV nonimmunizer).

Threats to Validity

External Validity

This study recognized there was a large and broad spectrum of Canadian parents who were potentially eligible for this study, therefore convenience sampling was used to ensure wide access to a diverse group of respondents. The internet survey option increased access to this large group of parents and reduced the number of dropouts.

Internal Validity

Selection bias may have occurred as only parents who had access to the internet were able to participate. It was also possible that the two groups that represented the dependent variables were unequal, and the test subjects may have had similar subject related variability. In advance of conducting logistic regression analyses, correlations were conducted to determine if any variables were highly correlated. To build an

appropriate logistic regression model any variables that were highly correlated, one or more of them were removed from the model to avoid multicollinearity.

Construct Validity

The tool that was used in this study is a questionnaire that was developed by the study investigator. The reliability and validity of the survey questionnaire has not been determined. The tool was designed to address the eligibility, heath services utilization factors, demographic and economic, questions reflected in the research question. The questionnaire was structured in accordance with Andersen behavioral model of health services use, which suggests that health services is a function of parents' predisposition to use services, factors which enable or impede use, and their need for care (Andersen & Andersen, 1967; Andersen, 1968). The questionnaire consisted of four main categories entitled: eligibility, predisposing characteristics, enabling factors and need factors. Eligibility, predisposing characteristics, enabling factors questions consisted of yes/no and short answer questions, while data regarding the need factors will be obtained by twelve four-point Likert scale questions. A four-point Likert scale was used so that respondents could not provide a neutral response. Face validity of the tool was tested using a group of 12 parents whose responses were not included in the research study. The pilot was conducted in the same manner as the main study and the parents were timed to determine how long it will take to complete the online survey.

Ethical Procedures

Ethical considerations were addressed to ensure the confidentiality and protection of all study participants. It is a requirement of the federal policy for the protection of

human subjects (45 CFR 46 et. seq) that all research involving human subjects be protected, safe, and participants engage willingly and knowingly with appropriate informed consent. This research survey included only eligible adult participants in Canada and did not target a specific group or vulnerable population. All research subjects were provided access to the content of cover letter that invited them to participate in the research study and subjects were required to complete and respond to an informed consent letter before they accessed the survey. The informed consent informed them about what the research entailed and what their rights were as a respondent.

The participants were also advised of their estimated time involvement with this study (Bacon & Olsen, 2003). All research respondents in this study remain anonymous. Study subjects were informed that since the data they submitted to the researcher was completely anonymous, they would be unable to withdraw from the study once their survey was submitted to the investigator. Consent was implied by the subjects' completion and submission of the survey.

The data from the submitted surveys were redirected so that the study subjects' anonymized data was held in a secure database on a remote SurveyMonkey server. All SurveyMonkey data were downloaded into Microsoft Excel format and all data held on the remote SurveyMonkey was permanently deleted. All data and findings collected from this research study will be stored for 7 years on a password protected private computer protected by virus scanning software and secured by a hardware and software firewall. At the end of the 7-year data retention period, all electronic information will be permanently erased using the commercial software package Cyberscrub.

This study was submitted for approval by the Walden University Institutional Review Board (IRB) before any study related activities were undertaken to ensure that ethical procedures and federal policy were followed prior to surveying participants. Approval to conduct the study (IRB Number 03-08-21-0666146) was granted by Walden University on March 8, 2021.

Summary

Chapter 3 provided an overview of the research design and rationale, methodology, threats to validity, and ethical procedures used to examine the relationships between the independent and dependent variables were described. In this study, barriers to utilization of the national school-based HPV immunization program were addressed. It is a non-experimental, quantitative study based on the Andersen's behavioral model of health services use. Adult parents living in Canada answered a survey based on the Andersen's behavioral model of health services use that considered the health services utilization factors (independent variables) and if the parents were HPV immunizers or HPV nonimmunizers (dependent variable). The parents were recruited through a convenience sampling recruitment process and answered an internet-based survey. This methodology supported access to many respondents across the geographical coverage area within Canada, increased the sample size, lowered the cost, increased the representative nature of this study, and increased the confidentiality of the participants in this study. Descriptive and logistic regression analyses using SPSS were used to analyze the resulting data. The next chapter, Chapter 4, will provide a presentation, interpretation, and explanation of the analyzed data.

Chapter 4: Results

The purpose of this study was to determine the relationship between health services utilization factors associated with parents who are HPV immunizers and those who are HPV nonimmunizers. The selected health services utilization factors were framed by the three population characteristics defined by the Andersen behavioral model of health services use. The identified populations characteristics were predisposing factors, enabling factors and need factors. The predisposing factors selected for this study were sex, age, ethnic origin, immigrant status, education level, marital status, language ability in English, utilization of social media to review HPV health information, and trust in the traditional health care system. The enabling factors chosen for analysis were household, private health insurance, rural or urban setting, and access to a primary care provider. The need factors most relevant for this study included belief in vaccine safety, belief in vaccine efficacy, belief in vaccine prevention of cancer, sense of urgency for need of intervention, and perceived link to sexual activity. The research questions and hypotheses were developed to determine whether a relationship existed between the health resource utilization factors and if a parent was an HPV immunizer or an HPV nonimmunizer. The research questions that informed this study and the null and alternative hypotheses were as follows:

RQ1: What is the statistically significant relationship between health services utilization factors that are associated with parents who are HPV immunizers and those who are HPV nonimmunizers?

$H_0$1: There is no statistically significant relationship between health services utilization factors associated with parents who are HPV immunizers and those who are HPV nonimmunizers.

H_a1: There is a statistically significant relationship between health services utilization factors associated with parents who are HPV immunizers and those who are HPV nonimmunizers.

The independent variables for this research question were sex, age, ethnic origin, immigrant status, education level, marital status, language ability in English, utilization of social media to review HPV health information, trust in the traditional health care system, household, private health insurance, rural or urban setting, and access to a primary care provider. The dependent variable was HPV immunizer status of the parents.

RQ2: What is the statistically significant relationship between health services utilization factors and parents who are HPV immunizers?

$H_0$2: There is no statistically significant relationship between health services utilization factors and parents who are HPV immunizers.

H_a2: There is a statistically significant relationship between health services utilization factors and parents who are HPV immunizers.

The independent variables for this research question were parent age, parent sex, other first language, rural or urban setting, access to a primary health care provider, utilization of social media to review HPV information, belief in vaccine safety, belief in vaccine efficacy, belief in vaccine prevention of cancer, sense of urgency for need of intervention, and perceived link to sexual activity. The dependent variable was HPV

immunizer status of the parents. Chapter 4 includes the data collection methodology, a discussion of the statistical results, and a discussion of the results related to each research question and contains the following sections (a) pilot study, (b) data collection, (c) results, and (d) summary.

Pilot Study

A pilot study was conducted in advance of opening the study for enrollment to examine the feasibility of the online survey tool that was later used to collect data for the larger scale study. The online pilot study was administered to twelve pilot study participants via SurveyMonkey in an identical format to the main study. The pilot study was identified in SurveyMonkey as Copy of Canadian HPV Research Study and pilot study participants received a link by email to this duplicate survey.

Pilot study participants were asked if any questions were confusing, difficult, caused bias, or were uncomfortable. The responses from the 12 parents were not included in the results of this research study. The pilot was conducted in the same manner as the main study with the exception that the respondents were known to the investigator. The parents were timed to determine how long it would take to complete the online survey. The longest took 10 minutes to complete, the shortest was 5 minutes and the average was 8 minutes. No age group or sex had difficulty completing the questionnaire. No major changes requested by any of the pilot respondents other than one minor spelling typographical error was corrected. Based on the results of the pilot study, no alternations to the instrumentation or the data collection strategy was made.

Data Collection

The website and survey tool were opened for enrollment on March 8th, 2021, at 23:59 hrs. and closed to enrollment at 23:59 hrs. on May 8th, 2021. A sample of 997 subjects submitted the online study questionnaire. The data were analyzed using descriptive and inferential statistics.

Data Collection Discrepancies

There were no discrepancies in the data collection plan as previously presented in Chapter 3.

Data Cleaning

Data cleaning is an essential exercise required to prepare and validate data before the core analysis of the data set. Data cleaning removed erroneous data and additionally the removal of any incomplete, inaccurate, irrelevant, corrupt, or incorrectly formatted data.

Of the 997 cases submitted from study respondents, some needed to be removed from the data set before conducting further analyses. One case was eliminated because the survey was submitted incomplete. Four cases were removed from the data set as they were not eligible for the study based on age, country of origin and the ability to read and comprehend English. After cleaning the data set, 992 cases were eligible for inclusion. According to the statistical power analyses, to reach the appropriate statistical power for each of the research questions, 783 cases were required. The availability of 992 eligible cases for analysis satisfied the previously calculated power requirements for the study. A breakdown of submitted surveys is presented in Table 3.

Table 3

Breakdown of Submitted Surveys

Analysis Inputs	Frequency	Percent
Submitted incomplete	1	.2
Submitted complete	992	99.5
Ineligible	4	.4
Submitted blank	0	0
Total	997	100

To control for extraneous factors and maintain a relatively homogenous sample, subjects were required to meet certain inclusion criteria. Subjects for this study were restricted only to parents of children who were (a) eligible to receive the Human Papilloma Virus (HPV) vaccine from a Canadian school-based program in the 2019/2020 school year, (b) at least 18 years of age, and (c) could both read and comprehend the English language. This survey was structured based on the Andersen behavioral model of health use and collected the following predisposing characteristics data for each subject: sex, age, ethnic origin, immigrant status, education level, language ability in English, utilization of social media, and trust in the traditional health care system. The following enabling characteristics were collected for each subject: Household income, availability of private health insurance, residing in an urban or rural setting and having access to a primary care provider. A four-point Likert scale was utilized to gather information from the study subjects' answers to twelve questions regarding the need factors that were categorized as belief in vaccine safety, belief in vaccine efficacy, belief in vaccine prevention of cancer, sense of urgency for need of intervention, and a perceived link to sexual activity.

Results

Demographics of the Sample

As seen in Table 4, study respondents were between the ages of 24 and 53 years old with a mean age of 42.6 years (*SD* 5.384, *n*=992) and predominantly female (69.3%, *n* = 688). The majority of survey respondents were Caucasian (64.5%, *n* = 640), married (43.5%, *n* = 432), nonimmigrants (Canadian citizens by birth; 85.4%, *n* = 848) and English was their first language (72.6%, *n* = 720). The sex of the child for which the parent was reporting HPV immunization status was female (58.1%, *n* = 576) and male (41.9%, *n* = 416). Responses were received from across Canada (Ontario 29%, *n* = 288; British Columbia 16.2%, *n* = 161; Québec 9.6%, *n* = 95; Alberta 8.1%, *n* = 80; Saskatchewan and New Brunswick 6.5%, *n* = 64; Nova Scotia 3.2%, *n* = 32 and Nova Scotia 1.6%, *n* = 16). No surveys were received from the province of Prince Edward Island or from the Northwest Territories, Yukon, or Nunavut. Most participants attended some college but did not receive a degree (24.2%, *n* = 240), or received bachelor's degree (41.9%, *n* = 416), or received a graduate degree (24.2%, *n* = 240). The majority of respondents had an annual household income of greater than $150,000 Canadian dollars (72.6%, *n* = 720) and did not have private health insurance coverage for the HPV vaccine (67.7%, *n* = 672). Participants principally lived in urban areas (66.1%, *n* = 656), had access to a primary health care provider (85.5%, *n* = 848) and most sought HPV advice from a medical doctor (59.6%, *n* = 592). Finally, among the survey participants the majority utilized social media to obtain information about HPV immunization (69.4%, *n* = 688).

Table 4

*Demographic and Descriptive Data for Continuous Variables: HPV Immunizers (*N=*608) vs. HPV Nonimmunizers (*N=*384)*

Variable	HPV Immunizer		HPV Nonimmunizers		Total	
	Mean	*SD*	Mean	*SD*	Mean (24-53)	*SD*
Age (yrs.)	42.89	5.071	40.83	5.625	42.6	5.384

Table 5

*Demographic and Descriptive Data for Categorical Data: HPV Immunizers (*N=*608) vs. HPV Nonimmunizers (*N=*384)*

Variable	HPV Immunizers		HPV Nonimmunizers		Total	
	n	%	*n*	%	*n*	%
Parent's Sex						
Male	208	68.4	96	31.6	304	30.6
Female	400	58.1	288	41.9	688	69.3
Child's Sex						
Male	256	42.1	160	41.7	416	41.9
Female	352	57.9	224	58.3	576	58.1
Province						
British Columbia	128	21.1	48	12.5	176	17.7
Alberta	80	13.2	81	21.1	161	16.2
Saskatchewan	64	10.5	16	4.2	80	8.1
Manitoba	32	5.3	32	8.3	64	6.5
Ontario	208	34.2	80	20.8	288	29
Québec	32	5.3	63	16.4	95	9.6
Newfoundland	16	2.6	0	0	16	1.6
Nova Scotia	16	2.6	16	4.2	32	3.2
New Brunswick	32	5.3	32	8.3	64	6.5
Prince Edward Island	0	0	0	0	0	0
Nunavut	0	0	0	0	0	0
Northwest Territories	0	0	0	0	0	0
Yukon	0	0	0	0	0	0
Ethnic origin						
Black	96	66.7	48	33.3	144	14.5
Asian	64	50	64	50	128	12.9
Asian Pacific Islander	0	0	0	0	0	0
Caucasian	384	60	256	40	640	64.5
Hispanic or Latino	0	0	0	0	0	0
Indigenous	0	0	0	0	0	0

Variable	HPV Immunizers		HPV Nonimmunizers		Total	
	n	%	*n*	%	*n*	%
Another race	16	20	64	80	80	8.1
Immigrant Status						
Non-Immigrant	480	56.6	368	43.4	848	85.4
Immigrant	128	88.9	16	11.1	144	14.5
Education Level						
Elementary	0	0	0	0	0	0
High School	64	66.7	32	33.3	96	9.7
Some college but no degree	160	66.7	80	33.3	240	24.2
Community College or Associates Degree	16	100	0	0	16	1.6
Baccalaureate	240	57.7	176	42.3	416	41.9
Graduate degree	128	57.1	96	42.9	240	24.2
Marital Status						
Married	272	63	160	37	432	43.5
Widowed	16	100	0	0	16	1.6
Divorced	112	87.5	16	12.5	128	12.9
Separated	80	62.5	48	37.5	128	12.9
Domestic partnership	128	50	128	50	256	25.8
Single but cohabitating	0	0	32	100	32	3.2
Single never married	0	0	0	0	0	0
English first language						
No	192	70.6	80	29.4	272	27.4
Yes	416	57.8	304	42.2	720	72.6
Utilization of social media for HPV information						
Yes	400	58.1	288	41.9	688	69.4
No	208	68.4	96	31.6	304	30.6

Variable	HPV Immunizers		HPV Nonimmunizers		Total	
	n	%	*n*	%	*n*	%
Health Care Provider for HPV advice						
Medical Doctor	464	78.4	128	21.6	592	59.6
Nurse	16	100	0	0	16	1.6
Pharmacist	80	71.4	32	28.6	112	11.2
Naturopath	16	7.7	192	92.3	208	20.9
Homeopath	0	0	16	100	16	1.6
Other	32	66.7	16	33.3	48	4.8
Household Income (CAD$)						
<15,000	0	0	0	0	0	0
15,000-29,999	0	0	0	0	0	0
30,000-49,999	0	0	0	0	0	0
50,000-74,999	0	0	0	0	0	0
75,000-99,999	64	77.7	32	33.3	96	9.6
100,000-150,000	112	63.6	64	36.4	176	17.7
>150,0000	432	60	288	40	720	72.5
Private Insurance for HPV Vaccine						
Yes	256	80	64	20	320	32.3
No	352	52.4	320	47.6	672	67.7
Residential location						
Urban	432	65.9	224	34.1	656	66.1
Rural	176	52.4	160	47.6	336	33.9
Access to a Primary Care Provider						
Yes	544	64.2	304	35.8	848	85.5
No	64	44.4	80	55.6	144	14.5

Sample Representativeness of the Population

Overall, the study population was generally comparable to national population distributions (Statistics Canada, 2018), with the exceptions noted below which were expected and due to the design of the study and were previously noted as study limitations. The study population of females between the ages of 25-54 years of age was less than the national population of females between the same age range (69.3% versus 49%). It should be noted that the study participant age range was between 24-53 years of age. The study population of males was less than the national population of males between the ages of 25 – 54 years of age (30.6 versus 51%). The study was largely represented by Caucasians (64.5%), Blacks (14.5 %) and Asians (12.9%), versus the national population representation of Caucasians (72.9%), Blacks (3.5%) and Asians (15%). Indigenous and Hispanic or Latino people were not represented in the study population. There were 8.1% of respondents in the study who represented themselves as 'other' when reporting their ethnic background. The majority of study respondents lived in an urban setting 66.1%; however, the national population living in an urban setting is 81.3%. There was a high response from participants living in rural settings in the study at 33.9% versus the national population distribution in a rural setting of 18.7%. There were 72.6% respondents who identified themselves as speaking English as their first language versus the national average of 58.7%. As the study inclusion criteria required participants to be able to read comprehend English, this is an expected outcome of this inclusion criteria and was a previously described study limitation. The largest representation of respondents came from the province of Ontario at 29%, which is less than the provincial

population distribution of 38.26%. Study respondents from Québec represented 9.6% of the total study provincial distribution which was less than the provincial population distribution for Québec at 23.23%. This finding is not unexpected as Québec is a French speaking province and the study survey was only offered in English which would have reduced eligible participants from Québec. The decreased participation from Québec may have affected the over contribution by some of the smaller Canadian provinces versus the national population, as can be seen in Table 6.

Table 6

Sample Representativeness of the Population

	Study Population %	2018 National Population %
Male (25-54 years)	30.6	51
Female (25-54 years)	69.3	49
Caucasian	64.5	72.9
Asian	12.9	15
Indigenous	0	4
Black	14.5	3.5
Hispanic or Latino	0	1.5
Other	8.1	2.6
Urban	66.1	81.3
Rural	33.9	18.7
English as first language	72.6	58.7
Ontario	29	38.26
Québec	9.6	23.23
British Columbia	17.7	13.22
Alberta	16.2	11.57
Manitoba	6.5	3.64
Nova Scotia	3.2	2.63
New Brunswick	6.5	2.13
Newfoundland	1.6	1.48
Prince Edward Island	0	0.41
Northwest Territories	0	0.12
Nunavut	0	.10
Yukon	0	.10

Assumptions

Independent Samples T-*Test (RQ 1)*

An independent samples *t*-test was used to analyze the first research question. In the first research question, the relationship between the independent variable age and the dependent variable immunizer status of the parents (HPV immunizer versus HPV nonimmunizer) was examined. The independent samples *t*-test is used to determine whether the mean of the independent variable is the same in two related groups.

There are four assumptions that must be satisfied to run an independent samples *t*-test. These assumptions include (a) scale of measurement, the scale of measurement applied to the data collected follows a continuous or ordinal; (b) independence, the observations in one sample are independent of observations in the other sample; (c) normality, both samples are approximately normally distributed; and (d) homogeneity of variances, both samples have approximately the same variance (Frankfort-Nachmias & Nachmias, 2014).

The first assumption of scale of measurement is satisfied as the scale of measurement for age is continuous. The dependent variable, immunization status, is comprised of two independent categorical groups and an independence of observations was ensured as each study participant was assigned to either the HPV immunizer or HPV nonimmunizer group. The assumption of independence was met for this research question through the overall design of the research study as each subject could only belong to one group. The third assumption, the normality of the distributions of residuals, was met as assessed by visual evaluation of the Q-Q Plots for age (Laerd Statistics, 2018). The fourth

assumption, a homogeneity of variances, was confirmed based on evaluation of the results of the Levene's test (Laerd Statistics, 2018). Additional analyses of the third and fourth assumptions for the independent samples *t*-test are described in Appendix G.

Pearson's Chi-Square (RQ 1)

The Pearson's chi-square was used to assess the difference in the variables sex, ethnic origin, education level, marital status, household, immigrant status, English as first language, utilization of social media for HPV information, health care provider sought for HPV advice, private insurance for HPV vaccine, residential location, and access to a primary health care provider.to determine whether the paired observations of immunizers vs HPV nonimmunizers were independent of each other. A Pearson's chi-square test has three assumptions that must be satisfied to run this test. The first two assumptions (categorical variables and an independence of observations) were met based on the design of the study. The third assumption of a Pearson's chi-square test is that all cells in the SPSS cross-tabulation output table must have expected counts that are greater than five (Field, 2013). Not all cells in the SPSS cross-tabulations had counts greater than five, so these variables were removed from the Pearson's chi-square analyses. The following variable categories were removed: (Ethnic Background) Asian Pacific Islander, Hispanic or Latino, Indigenous, (Level of Education) elementary, (Marital Status) single but never married and (Household Income) <$15,000, $15,000 - $29,999, $30,000 - $49,999, and $50,000 - 74,999. Additional information on the analysis and satisfaction of these three assumptions for a Pearson's chi-square analysis assumptions are described and shown in Appendix H.

Mann-Whitney U-Test (RQ 1)

The Mann-Whitney U-test was used to determine the relationship of the summed scores from the nonparametric data obtained with a four-point Likert scale and parents who were HPV immunizers and those were HPV nonimmunizer. The Mann-Whitney U-test was selected for data analysis as it is one of the more powerful nonparametric procedures, designed to test the null hypothesis that two independent samples come from the same population. The Mann-Whitney U-test has three assumptions that must be satisfied prior to conducting the statistical test. These three assumptions require the use of a continuous or ordinal dependent variable, a categorical independent variable with two groups, and an independence of observations (Laerd Statistics, 2018). All three of these assumptions were met based on the design of this research study.

Logistic Regression (RQ 2)

A logistic regression was used to examine the relationship between the independent variables, the health services use factors, and the dependent variable, the dependent variable which is the immunizer status of the parents (i.e., HPV immunizer or HPV nonimmunizer). Logistic regression requires six assumptions to be satisfied before fitting this statistical model to a data set. These assumptions are the response variable is binary, independence of samples, little or no multicollinearity, no influential outliers, linearity in the logit, and the sample size is sufficiently large (Laerd Statistics, 2018). The first assumption is that the response variable is binary. This study satisfies this assumption as the response variable can only take on two possible outcomes: HPV immunizer or HPV nonimmunizer. The second assumption requires that the observations

are independent. Observations should not be from repeated measurements of the same individual or be related to each other in any way. To evaluate if observations were independent, the Spearman rank-order correlation coefficient (Spearman's rho) correlation was used to assess the relationship between the ordinal variables from the 4-point Likert scale responses. Three of the 4-point Likert scale responses demonstrated they were highly correlated. These questions were Question 21, immunization with the Human Papilloma Virus (HPV) vaccine is safe for my child and its benefits outweigh the risks (correlation coefficient 1.000), Question 22, the Human Papilloma Virus (HPV) vaccination provides effective and long-lasting protection again HPV infections (correlation coefficient .745), and Question 23, the Human Papilloma Virus (HPV) vaccination provides effective and long-lasting protection again cancers caused HPV infections (correlation coefficient .781). To satisfy the second assumption of a logistic regression, Question 21 was retained but Questions 23 and 24 were removed from the logistic regression model to ensure the independence of observations.

The third assumption of logistic regression is that there is no severe multicollinearity among the explanatory variables (Laerd Statistics, 2018). The Variance Inflation Factor test was used to detect multicollinearity, which measures the correlation and strength between the predictor variables in a regression model (Laerd Statistics, 2018). The existence of multicollinearity is determined by reviewing the collinearity tolerance and Variance Inflation Factor statistics in the coefficients table generated in SPSS. Multicollinearity is present if the tolerance value is less than 0.1 or the Variance Inflation Factor is greater than 10 (Laerd Statistics, 2018). I confirmed there was no

multicollinearity as all collinearity tolerance values were greater than 0.1 (range .244 - .711) and all Variance Inflation Factor values were less than 10 (range 1.407 - 4.097) (Laerd Statistics, 2018).

The fourth assumption assumes that there are no extreme outliers or influence observations in the dataset. The Cook's distance test was used to calculate outliers for each observation in the dataset. It was found that 26 cases exceeded the calculated .004 threshold and were removed from the final regression analysis as they exerted undue influence on the model.

The fifth assumption of logistic regression is that a linear relationship exists between each explanatory variable and the logit of the response variable (Laerd Statistics, 2018). This assumption was met using the Box-Tidwell procedure which revealed that the logit of the outcome variable was a linear combination of the independent variables. The sixth assumption is that the sample size of the dataset was sufficiently large to draw valid conclusions from the fitted logistic regression model. This assumption was satisfied as variables that any outcomes of zero were removed from the model (Laerd Statistics, 2018). The following variable categories included zero counts and were excluded from the regression analysis: ethnic origin, education level, marital status, trust in the traditional health care system and household income. Additional information on the analysis of these assumptions can be found in Appendix I.

Research Question Results

Research Question 1

What is the statistically significant relationship between health services utilization

factors that are associated with parents who are HPV immunizers and those who are HPV nonimmunizers?

The unpaired *t*-test compares the means of the age of parents grouped by the immunizer status of nonimmunizer and immunizer to establish if the means seen in the study sample occurred by chance or if they are representative of the overall population. The group statistics in Table 7 demonstrate that the immunizer status groups are imbalanced (nonimmunizer, $n = 384$ and immunizer, $n = 608$). The spread of the means is similar between the nonimmunizers (mean = 40.83) and immunizers (mean = 42.89) with equally similar standard deviations (5.625 and 5.071, respectively).

Table 7

Group Statistics

	Immunizer Status	*n*	Mean	Std Deviation	Std Error Mean
Parent Age	Nonimmunizer	384	40.83	5.625	.287
	Immunizer	608	42.89	5.071	.206

The Levene's test produced a significance level of .557. As the *p* value of the Levene's test was $p > 0.05$ this indicates that the means of the two immunizer groups are not significantly different. This permits the assumption that the means of the two groups are equal and the statistical output for equal variance assumed is the appropriate data to interpret. The level of significance for the 2-tailed *t*-test is .000, which is $p < 0.05$. This result indicates that the means of age are significant between nonimmunizers and immunizers and can be generalizable to the overall population (Table 7).

Table 8

T-Test for Equality of Means for Age

	Levene's Test		*t*-test for Equality of Means						
								95% CI of the Difference	
	f	*Sig*	*t*	*df*	*Sig*	Mean Difference	Std. Error Difference	Lower	Upper
Equal* variance assumed	.345	.557	-5.976	990	.000**	-2.061	.345	-2.738	-1.384
Equal variances not assumed			-5.838	752.099	.000**	-2.061	.353	-2.755	-1.368

**Note*: Equal variances are assumed based on the $p > 0.05$ value of the Levene's test.

***p* < 0.05, two-tailed.

Results from the Pearson's chi-square test demonstrate that the following variables have an association with the parents' immunization status as the asymptotic *p* values are < 0.05: sex, immigrant status, language ability in English, utilization of social media, trust in the traditional health care system, private health insurance, rural or urban location and access to a primary care provider (Table 8). The variables of annual household income, education level marital status and ethnic origin were removed from the model as they had zero counts in the crosstabulations and did not satisfy the assumptions of the model.

As the Pearson's chi-square only detects if there is any association between variables, a Phi coefficient was calculated to determine the effect size of the association.

A Phi coefficient takes on values between negative one and one where negative one indicates a negative relationship between the two variables, zero indicates no association between the two variables and one indicates a perfectly positive relationship between the two variables. In general, the further away a Phi coefficient is from zero, the stronger the relationship between the two variables (Akoglu, 2018). A Phi coefficient result greater than 0.25 can be interpreted as a very strong association (Akoglu, 2018). Table 8 shows all variables examined demonstrated a very strong association to the parents' immunization status. The strongest association with the parents' immunization status was with the question that measured the parents trust in the traditional healthcare system. The independent variable with the next strongest association to the parents' immunization status was the availability of private health insurance.

Table 9

Pearson-Chi Square Test

Variables[a]	Chi-Square	*df*	Asymptotic Sig.	Phi	Approx. Sig.
Sex	9.394	1	.002*	.097	.000
Immigrant status	54.080	1	.000*	.233	.000
Language ability in English	13.666	1	.000*	.117	.000
Utilization of social media	9.394	1	.002*	.097	.002
Trust in the traditional health care system	365.591	5	.000*	.607	.000
Private health insurance	69.697	1	.006	.265	.000
Access to a primary care provider	20.149	1	.000	.143	.000
Rural or urban location	16.999	1	.000	.125	.000

[a]0 cells (0%) have expected count less than 5.

*$p < 0.05$, two-tailed.

Additional descriptive statistical information was gained from questions assessing the need factors from the Andersen healthcare utilization model. Tables 9 through 20 present the number and percentage of responses to each of the four-point Likert scale survey questions. Each question addressed the need factors that were elucidated by the survey questions 21 through 32.

Table 10

Response to Question 21: Immunization With the Human Papilloma Virus (HPV) Vaccine Is Safe for My Child and Its Benefits Outweigh the Risks. Addresses Parental Belief in the HPV Vaccine Safety Profile (Need Factor)

	HPV Immunizers *(N=608)*		HPV Nonimmunizers *(N=384)*	
	n	%	*n*	%
Strongly Agree	224	36.8	1	.3
Agree	336	55.3	124	32.3
Disagree	48	7.9	259	67.4
Strongly Disagree	0	0	0	0
Total	608	100	384	100

Table 11

Response to Question 22: The Human Papilloma Virus (HPV) Vaccination Provides Effective and Long-Lasting Protection Again HPV Infections. Addresses Parental Belief in the HPV Vaccine Efficacy (Need Factor)

	HPV Immunizers *(N=608)*		HPV Nonimmunizers *(N=384)*	
	n	%	*n*	%
Strongly Agree	224	36.8	1	.3
Agree	336	55.3	124	32.3
Disagree	48	7.9	259	67.4
Strongly Disagree	0	0	0	0
Total	608	100	384	100

Table 12

Response to Question 23: The Human Papilloma Virus (HPV) Vaccination Provides Effective and Long-Lasting Protection Against Cancer Caused by HPV Infections. Addresses Parental Belief in the HPV Vaccine Efficacy Against Cancer Prevention (Need Factor)

	HPV Immunizers *(N=608)*		HPV Nonimmunizers *(N=384)*	
	n	%	*n*	%
Strongly Agree	208	34.2	17	4.4
Agree	272	44.7	125	32.6
Disagree	128	21.1	242	63
Strongly Disagree	0	0	0	0
Total	608	100	384	100

Table 13

Response to Question 24: My Friends and Family Encouraged Me to Immunize My Child With the HPV Vaccines (Need Factor)

	HPV Immunizers *(N=608)*		HPV Nonimmunizers *(N=384)*	
	n	%	*n*	%
Strongly Agree	208	34.2	2	0.5
Agree	256	42.1	124	32.5
Disagree	144	23.7	258	67.2
Strongly Disagree	0	0	0	0
Total	608	100	384	100

Table 14

Response to Question 25: I Should Immunize My Child With the HPV Vaccines to Help Protect Others (Need Factor)

	HPV Immunizers *(N=608)*		HPV Nonimmunizers *(N=384)*	
	n	%	n	%
Strongly Agree	208	34.2	2	0.5
Agree	224	368	173	45.1
Disagree	176	28.9	209	54.4
Strongly Disagree	0	0	0	0
Total	608	100	384	100

Table 15

Response to Question 26: Many People in My Community Do Not Immunize Their Children With the Human Papilloma Virus (HPV) Vaccine (Need Factor)

	HPV Immunizers *(N=608)*		HPV Nonimmunizers *(N=384)*	
	n	%	*n*	%
Strongly Agree	112	18.4	32	8.3
Agree	240	39.5	270	70.3
Disagree	256	42.1	82	21.4
Strongly Disagree	0	0	0	0
Total	608	100	384	100

Table 16

Response to Question 27: I Have Religious Beliefs That Influenced My Decision Regarding Immunizing My Child With the Human Papilloma Virus (HPV) Vaccine (Need Factor)

	HPV Immunizers *(N=608)*		HPV Nonimmunizers *(N=384)*	
	n	%	*n*	%
Strongly Agree	0	0	0	0
Agree	304	50	157	59.1
Disagree	304	50	227	40.9
Strongly Disagree	0	0	0	0
Total	608	100	384	100

Table 17

Response to Question 28: I Feel That There Is an Immediate Need to Immunize My Child With the Human Papilloma Virus (HPV) Vaccine (Need Factor)

	HPV Immunizers *(N=608)*		HPV Nonimmunizers *(N=384)*	
	n	%	*n*	%
Strongly Agree	208	34.2	0	0
Agree	192	31.6	277	72.1
Disagree	208	34.2	107	27.9
Strongly Disagree	0	0	0	0
Total	608	100	384	100

Table 18

Response to Question 29: I Feel That It Is More Important to Vaccinate Girls Than Boys With the Human Papilloma Virus (HPV) Vaccine (Need Factor)

	HPV Immunizers *(N=608)*		HPV Nonimmunizers *(N=384)*	
	n	%	*n*	%
Strongly Agree	0	0	49	12.8
Agree	336	55.3	185	48.2
Disagree	272	44.7	149	38.8
Strongly Disagree	0	0	1	0.3
Total	608	100	384	100

Table 19

Response to Question 30: My Child's Doctor or Other Primary Health Care Provider Discussed the Importance of Immunizing My Child With the Human Papilloma Virus (HPV) Vaccine (Need Factor)

	HPV Immunizers *(N=608)*		HPV Nonimmunizers *(N=384)*	
	n	%	*n*	%
Strongly Agree	304	50	35	9.1
Agree	144	23.7	133	34.6
Disagree	160	26.3	216	56.3
Strongly Disagree	0	0	0	0
Total	608	100	384	100

Table 20

Response to Question 31: I Am Concerned That Human Papilloma Virus (HPV) Immunization Will Lead My Child to Engage in Earlier or Riskier Sexual Behavior (Need Factor)

	HPV Immunizers (N=608)		HPV Nonimmunizers (N=384)	
	n	%	*n*	%
Strongly Agree	0	0	1	0.3
Agree	384	63.2	103	26.8
Disagree	224	36.8	280	72.9
Strongly Disagree	0	0	0	0
Total	608	100	384	100

Table 21

Response to Question 32: My Child Is Not Sexually Active, so I Don't Believe There Is an Urgency to Vaccinate Him/Her With the Human Papilloma Virus (HPV) Vaccine at This Time (Need Factor)

	HPV Immunizers (N=608)		HPV Nonimmunizers (N=384)	
	n	%	*n*	%
Strongly Agree	16	2.6	226	58.9
Agree	336	55.3	119	31
Disagree	256	42.1	38	9.9
Strongly Disagree	0	0	1	0.3
Total	608	100	384	100

Table 22 shows the results of the Mann-Whitney U-test for the survey questions that addressed the need factors from the Andersen behavioral model of health services use (survey questions 21-32). All Likert survey questions were coded in SPSS as Strongly Disagree = -1, Disagree =2, Agree = 3, and Strongly Agree = 4. The test statistics output for the Mann-Whitney U-test showed that for all survey questions 21 through 32 there were significant differences between the Mean Ranks for HPV immunizer and HPV nonimmunizer groups at $p < 0.05$. Study questions 21-25, 27, 28, 30 – 31 with higher mean ranks which indicated higher agreement with the survey question demonstrated an association with the respondent being an HPV immunizer. Questions 26, 29 and 32 had higher mean ranks which indicated lesser agreement with the survey questions and this demonstrated an association with the respondent being an HPV nonimmunizer.

Table 22

Results of Mann-Whitney U-Test for Likert Scale Questions 21 to 32

Variable	Immunizer	*N*	Mean Rank	Sum of Ranks
Immunization with the Human Papilloma Virus (HPV) vaccine is safe for my child and its benefits outweigh the risks.	Nonimmunizer	384	299.58	115040.00
	Immunizer	608	620.87	377488.00
	Total	992		
The Human Papilloma Virus (HPV) vaccination provides effective and long-lasting protection again HPV infections.	Nonimmunizer	384	279.73	107416.00
	Immunizer	608	633.41	385112.00
	Total	992		
The Human Papilloma Virus (HPV) vaccination provides effective and long-lasting protection against cancers caused HPV infections.	Nonimmunizer	384	341.08	130976.00
	Immunizer	608	594.66	361552.00
	Total	992		
My friends and family encouraged me to immunize my child with the Human Papilloma Virus (HPV) vaccine.	Nonimmunizer	384	331.33	127232.00
	Immunizer	608	600.82	365296.00
	Total	992		
I should immunize my child with the Human Papilloma Virus (HPV) vaccine to help protect others.	Nonimmunizer	384	372.77	143144.00
	Immunizer	608	574.64	349384.00
	Total	992		
Many people in my community do not immunize their children with the Human Papilloma Virus (HPV) vaccine.	Nonimmunizer	384	530.21	203600.00
	Immunizer	608	475.21	288928.00
	Total	992		
I have religious beliefs that influenced my decision regarding	Nonimmunizer	384	468.79	180016.00
	Immunizer	608	514.00	312512.00

Variable	Immunizer	*N*	Mean Rank	Sum of Ranks
immunizing my child with the Human Papilloma Virus (HPV) vaccine.	Total	992		
I feel that there is an immediate need to immunize my child with the Human Papilloma Virus (HPV) vaccine.	Nonimmunizer	384	440.77	169256.00
	Immunizer	608	531.70	323272.00
	Total	992		
I feel that it is more important to vaccinate girls than boys with the Human Papilloma Virus (HPV) vaccine.	Nonimmunizer	384	534.83	205376.00
	Immunizer	608	472.29	287152.00
	Total	992		
My child's family doctor or other primary health care provider discussed the importance of the Human Papilloma Virus (HPV) vaccine with me.	Nonimmunizer	384	359.42	138016.00
	Immunizer	608	583.08	354512.00
	Total	992		
I am concerned that Human Papilloma Virus (HPV) immunization will lead my child to engage in earlier or riskier sexual activity.	Nonimmunizer	384	387.33	148736.00
	Immunizer	608	565.45	343792.00
	Total	992		
My child is not sexually active, so I don't believe there is a need to vaccinate him/her with the Human Papilloma Virus (HPV) immunization at this time.	Nonimmunizer	384	689.69	264840.00
	Immunizer	608	374.49	227688.00
	Total	992		

Research Question 2

What is the statistically significant relationship between health services utilization factors and parents who are HPV immunizers?

Table 25 represents the results of the final analysis from the logistic regression model. The table shows the beta weight, the Wald statistical value, and the associated p values. Likert scale questions that were included to preserve the assumptions of the model were questions 22, 24 through to question 32. Likert scale questions 21 and 23 were removed from the model as the Spearman rank-order demonstrated questions 21, 22 and 23 were highly correlated, therefore only question 21 was retained in the model. A crosstabulation of the immigrant status, primary health care provider and immunization status, showed that there were no nonimmunizer immigrants who had a primary health care provider. As there was a zero count in this variable it was removed from the logistic regression model. To test the model fit and appropriateness using these variables, an omnibus test of the model coefficients was conducted. The omnibus test demonstrated that the model with the selected variables was appropriate and fit the data significantly better than the null model without predictors.

Table 23

Omnibus Test of Coefficients

		Chi-square	*df*	Sig.
Step 1	Step	881.027	17	.000
	Block	881.027	17	.000
	Model	881.027	17	.000

To further examine the model fit, the model summary presented in Table 24 showed a Nagelkerke R Square value of .799 which fit between the range of 0 -1 indicating the regression model was a good fit with the data (Laerd Statistics, 2018).

Table 24

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	443.157	.589	.799

A positive beta weight result for a variable indicates that an increasing score on the predictor variable predicts the likelihood that the variable will have membership in the HPV immunizer target group. When this positive beta weight is associated with a *p* value < 0.05 there is a positive predictive relationship between the variable and the HPV immunizer target group. Inversely if there is negative beta weight result for a variable, this indicates that an increasing negative score means the variable is less likely to have membership in the HPV immunizer target group. When this negative beta weight is associated with a *p* value < 0.5 there is a positive predictive relationship that this variable does not belong to the target HPV immunizer group. If the Exp (B), which represents the odds ratios, equals 1 there is no relationship, >1 there is a positive relationship and <1 indicates a negative relationship (Laerd Statistics, 2018). This reflects how much the odds are changing for each unit increase of the predictor variable.

There were five variables that were highly predictive of being an HPV Immunizer. This was determined by the interpretation of the Exp(B) or odds ratio which is a measure of association between exposure and outcome. Parents who have access to a

primary health care provider (Wald - 4.305, Exp(B) - 74.084, *p* = .000) have a 74.084 times higher association with being an immunizer. Parents who believe that HPV vaccination provides effective and long-lasting protection against HPV infections' (Wald - 3.763, Exp(B) - 43.093, *p* = .000) have a 43.093 higher association with being an immunizer. Parents who believe that HPV immunization will lead their child to earlier or riskier sexual activity' (Wald – 2.014, Exp(B) – 7.490, *p* - .000) have a 7.490 higher association with being an immunizer. Parents who had friends and family that encouraged them to immunize their child with the HPV vaccine' (Wald – 1.951, Exp(B) – 7.035, *p* = .000) have a 7.035 times higher association with being an immunizer. Parents who access HPV information from social media (Wald – 2.809, Exp(B) – 16.589, *p* - .000) have a 16.589 times higher association with being an immunizer.

Other variables that were predictive of being an immunizer were 'I should immunize my child with the HPV vaccine to protect others' (Wald – 1.103, Exp(B) – 2.753, *p* - .005), parent sex (Wald – 1.424, Exp(B) – 4.152, *p* - .001), parent age (Wald – .175, Exp(B) – 1.192, *p* - .000), other first language (Wald – 1.558, Exp(B) – 4.751, *p* - .002). Variables that predicted a negative relationship with the HPV immunizer target group were 'Many people in my community do not immunize their children with the HPV vaccine' (Wald – -1.552, Exp(B) – .212, *p* - .000), 'I have religious beliefs that influenced my decision regarding immunizing my child with the HPV vaccine' (Wald – -2.116, Exp(B) – .120, p - .000) and 'My child is not sexually active so I don't believe there is a need to vaccinate him/her with the HPV immunization at this time' (Wald – -1.733, Exp(B) – .177, p - .000). Remaining variables did not have a statistically

significant relationship and results for all variables in the logistic regression can be seen in table 25.

Table 25

Logistic Regression Analysis Analyzing the Relationship Between Health Services Utilization Factors and HPV Immunizers

							95% CI for Exp(B)	
Variables in the Equation	*B*	*SE*	Wald	*df*	*Sig*	*Exp(B)*	*Lower*	*Upper*
The Human Papilloma Virus (HPV) vaccination provides effective and long-lasting protection again HPV infections.	3.763	.491	58.782	1	.000	43.093	16.466	112.778
My friends and family encouraged me to immunize my child with the Human Papilloma Virus (HPV) vaccine.	1.951	.356	30.011	1	.000	7.035	3.501	14.139
I should immunize my child with the Human Papilloma Virus (HPV) vaccine to help protect others.	1.013	.365	7.712	1	.005	2.753	1.347	5.626
Many people in my community do not immunize their children with the Human Papilloma Virus (HPV) vaccine.	-1.552	.362	18.421	1	.000	.212	.104	.430
I have religious beliefs that influenced my decision regarding immunizing my child with the Human Papilloma Virus (HPV) vaccine.	-2.116	.464	20.822	1	.000	.120	.049	.299
I feel that there is an immediate need to immunize my child with the Human Papilloma Virus (HPV) vaccine.	-.492	.352	1.959	1	.162	.611	.307	1.218

Variables in the Equation	*B*	*SE*	Wald	*df*	*Sig*	*Exp(B)*	*95% CI for Exp(B)* *Lower*	*Upper*
I feel that it is more important to vaccinate girls than boys with the Human Papilloma Virus (HPV) vaccine.	-1.715	.361	22.568	1	.000	.180	.089	.365
My child's family doctor or other primary health care provider discussed the importance of the Human Papilloma Virus (HPV) vaccine with me.	.470	.272	2.971	1	.085	1.599	.938	2.728
I am concerned that Human Papilloma Virus (HPV) immunization will lead my child to engage in earlier or riskier sexual activity.	2.014	.337	35.787	1	.000	7.490	3.872	14.488
My child is not sexually active so I don't believe there is a need to vaccinate him/her with the Human Papilloma Virus (HPV) immunization at this time.	-1.733	.320	29.251	1	.000	.177	.094	.331
Parent's sex	1.424	.436	10.677	1	.001	4.152	1.768	9.754
Parent Age	.175	.039	19.911	1	.000	1.192	1.103	1.287
Other first language	1.558	.497	9.849	1	.002	4.751	1.795	12.574
Social media	2.809	.606	21.489	1	.000	16.589	5.059	54.395
Private Health Insurance	-1.880	.633	8.818	1	.003	.153	.044	.528
Urban or rural	-.583	.341	2.913	1	.088	.558	.286	1.090
Primary care health provider	4.305	.583	54.486	1	.000	74.084	23.619	232.371
Constant	-23.698	3.507	45.654	1	.000	.000		

Note. B represents Beta Weight, *SE* represents Standard Error, *Sig* represents significance, *Exp (B)* represents odds ratio.

Summary

This chapter provided the statistical results for the research questions included in this study. An independent samples *t*-test was used to test the hypothesis in the first research question for the variable age and the results of this 2-tailed *t*-test demonstrate that the level of significance is .000, which is $p < .05$ which allows for the rejection of the null hypothesis. These data can be interpreted that age is significant between nonimmunizers and immunizers and can be generalized to the overall population. The Pearson's chi-square test demonstrates that the variables sex, ethnic origin, immigrant status education level, marital status, language ability in English, utilization of social media, trust in the traditional health care system, private health insurance and access to a primary care provider are all associated with the parent's immunization status. The only variable that did not have any association with the parents' immunization status was the parents' annual household income. The Mann-Whitney U-test demonstrated survey questions 21 through 32 were useful to determine associations between the mean ranks for HPV immunizer and HPV nonimmunizer groups at $p < 0.05$. Study questions 21-25, 27, 28, 30 – 31 had higher mean ranks which indicated higher agreement with the survey question demonstrated an association with the respondent being an HPV immunizer and the utility of these survey questions. Questions 26, 29 and 32 had higher mean ranks which indicated lesser agreement with the survey questions and this demonstrated an association with the respondent being an HPV nonimmunizer.

The logistic regression analysis indicated there were five variables that were highly predictive of being an HPV Immunizer: having access to a primary health care provider, ‘HPV vaccination provides effective and long-lasting protection against HPV, ‘HPV immunization will lead my child to earlier or riskier sexual activity’, ‘My friends and family encouraged me to immunize my child with the HPV vaccine’ and accessing HPV information from social media. Having access to a primary health care provider was differentiated from the other highly predictive variables by its high odds ratio which indicates parents were 74.084 times more likely to immunize their children if they had access to a primary health care provider.

In Chapter 5, the final chapter of this study, I will provide an interpretation of the statistical findings in the context of the conceptual framework and a review of the limitations of the study. I will also discuss recommendations for further research as well as the implications of study findings. Finally, I will discuss the impact of the study findings on social change, community health, and public policy.

Chapter 5: Discussion, Conclusions, and Recommendations

Despite free of charge adolescent HPV vaccination programs that are widely available via Canadian school-based programs, the HPV vaccination rates in Canada lag below those of other developed countries. Immunization with the HPV vaccine plays an important role in the prevention of HPV-related cancers caused by persistent HPV infections in both females and males. The purpose of this quantitative descriptive study was to collect and analyze data from parents who were HPV immunizers or HPV nonimmunizers to better understand factors that influence the utilization of Canadian school-based HPV vaccine programs.

A comparison was made of parents who were HPV immunizers or HPV nonimmunizers, and predictive factors were assessed. Data were collected from 997 respondents from an online survey and 992 evaluable survey responses were analyzed. Descriptive and inferential statistics were utilized to analyze the data. The conceptual framework utilized for this study was the Andersen behavioral model of health services use which provided a framework in which to interpret the results. The Andersen behavioral model of health services use characterizes health services utilization factors as predisposing, enabling, and need characteristics. Based on the substantial investment of resources of public funds into the Canadian school-based HPV vaccine programs and the opportunity to prevent significant morbidity and mortality from HPV-related cancers, it is important to understand what health services utilization factors are associated and predictive of parents' decisions to immunize and use these programs. Using primary data obtained from the online survey, two research questions were addressed.

For RQ1, a *t*-test, Pearson's chi square and Mann-Whitney U-test were used to answer the following question: What is the statistically significant relationship between health services utilization factors that are associated with parents who are HPV immunizers and those who are HPV nonimmunizers? These statistical tests were selected to address the specific assumptions that needed to be satisfied for these parametric and nonparametric variables. The *t*-test for age revealed that there was a significant difference in age between the HPV immunizers (42.89 years) and HPV nonimmunizers (40.83 years). These results suggest that the HPV nonimmunizers were younger than HPV immunizers.

The Pearson's chi-square test demonstrated that the parent's sex, immigrant status, language ability in English, utilization of social media, trust in the traditional health care system, private health insurance and access to a primary care provider are associated with their immunization status. Females, Canadian citizens by birth, English as a first language, the use of social medical to obtain HPV information and trust in the traditional health care system as evidenced by seeking information from a physician, pharmacist or nurse we all positively associated with being an HPV immunizer.

The Mann-Whitney U-test which evaluated the mean ranks of the scores from the Likert scale questions revealed that HPV immunizers had higher mean ranks of agreement with questions that assessed parental belief of vaccine efficacy, vaccine safety, vaccine ability to prevent cancer, influence to vaccinate from friends and family, protecting others through herd immunity, urgency to vaccinate, received a positive guidance to vaccines from a health care providers, and concern that HPV will lead to

earlier sexual activity. Parents who were HPV nonimmunizers had higher mean ranks for agreeing with questions that their religion influenced their decision to vaccinate, their community does not support immunization, it is less important to vaccinate boys than girls and that their child was not sexually active therefore they did not feel the need to vaccinate at this time.

For RQ2, a logistic regression analysis was used to answer the question: What is the statistically significant relationship between health services utilization factors and parents who are HPV immunizers? The results of the logistic regression analysis identified five highly predictable variables of a parent being an HPV Immunizer: having access to a primary health care provider, belief in vaccine efficacy, concern about earlier and riskier sexual activity, influence to vaccinate from family and friends and parents who access HPV information from social media. These five variables had very high odds ratios and the interpretation of these results predicted an increased association with parents being immunizers 74.084, 43.093, 7.490, 7.035 and 16.589, respectively.

Interpretation of Findings

Findings in Context of the Literature

The review of the literature for this study showed that a small but growing population of parents exist who completely decline to immunize their children. This study demonstrated that there is a subpopulation of parents (38.7% of respondents) who declined the HPV vaccine for their child. This result is aligned with data from the province of Ontario which indicates that 40.6% of children are not immunized with the HPV vaccine (Ontario Agency for Health Protection and Promotion, 2018). Many of the

results from this study were consistent with findings from other studies of parents declining immunization. The majority of respondents in this study were female at 58.1%. Other studies indicated that the child's mother is commonly primarily responsible for immunization decisions (White & Thomson, 1995). The literature demonstrated that parents who chose not to immunize were often highly educated and with a higher socioeconomic status (Bennett & Smith, 1992). Seventy-one percent of the nonimmunizing parents in this study had bachelor's degrees or higher and 92% of HPV nonimmunizers had an annual household income greater than $100,000 Canadian dollars per year. Another study found that the two main reasons for parents to decline immunizations were religious beliefs and homeopathy (Hamilton et al., 2004; Simpson et al., 1995). In this study, 59.1% of HPV nonimmunizers indicated that they had religious beliefs that affected their decision to not-immunize. Additionally, this study showed that 54.2% of HPV nonimmunizers indicated they sought HPV advice from naturopaths or homeopaths.

Canada is the second largest country in the world by land area and has sparsely populated rural areas which provides a challenging landscape for widespread HPV immunization programs (Goyette et al., 2021). The literature describes how these school-based vaccine programs are independently implemented by the public health agencies of the different provinces and territories. This highlights the lack of a central coordinating authority for overseeing HPV immunization health service delivery.

The literature specifically related to health services use Sussman et al. (2015) determined that the greatest barrier to HPV vaccine uptake was challenges in health

services delivery which contrasts with most of the literature describing general vaccine hesitancy. One of the recommendations of Sussman et al. was to implement a school-based vaccination program in the United States and provide the HPV vaccine along with other childhood vaccines. The Canadian school-based model for HPV health services delivery, the primary care physician provider and traditional health care delivery setting are often not directly part of the network. As HPV vaccines have been available in Canada since 2006 and similar to the findings of Sussman et al., this study demonstrated that access to a primary health care provider was the largest predictor if a parent was an HPV immunizer or not. Parents who had access to a primary health care provider were 74.084 times more likely to have their child immunized with the HPV vaccine. In the Canadian context, this may indicate that focused efforts toward a coordinated delivery of care approach with the early engagement of a family physician or other primary care health care professional may be necessary to address uptake of the school-based vaccine programs.

The importance of the engagement of a primary health care provider as a pivotal element in vaccine health services delivery is well established in the literature was also identified by Holman et al. (2014). Holman et al. confirmed that considerable informational gaps continue to exist for parents regarding the benefits of the HPV vaccines and that direct interaction with a health care professional is essential to supporting parental decision making. This study continues to contribute to the literature by providing additional information that supports the concept that a primary health care

recommendation is a significant and an important differentiating factor between parents who are HPV immunizers and HPV nonimmunizers.

The literature highlights that when Canadian students miss receiving their HPV vaccine in the school-based setting, some provinces have employed and effective time-bound catch-up programs for students and older girls who required immunization. (Ahken et al., 2015; Goggin et al., 2018). While I did not examine catch-up programs, another mechanism to provide students who have missed doses through the public system is through a parent's private health care insurance plan. Parents who had private insurance coverage were highly associated with being in the HPV immunizer target group as determined by the Pearson chi square analysis. This represented the second highest association, second only to the variable of having access to a primary care provider. It should be noted that having access to a private health insurance was not significant on the binary logistic regression analysis, suggestion further understanding of this enabling factor is warranted.

The relationship between parental knowledge and vaccine uptake has previously generated mixed results with respect to being associated with vaccine uptake (Radisic et al., 2017). Some instances have demonstrated that increased knowledge can be correlated with vaccine refusal and also vaccine acceptance (Radisic et al., 2017). Parents who are in the early stages of decision making are correlated with having less HPV vaccine knowledge than parents who have made the decision to immunize (Shapiro et al., 2018). The findings of the logistic regression from this study highlight that parental belief that the HPV vaccine provides effective and long-lasting protection against HPV protection is

significant and highly predictive of being an HPV immunizer. Parents who held the belief in the HPV vaccine's efficacy were 43.093 times more likely to be an HPV immunizer. This finding suggests that the type of knowledge that a parent has may be important to their vaccinating decision. It may also explain why literature parental level of knowledge has had varying outcomes with association with vaccination in the literature as the focus of the knowledge may have been misdirected away from vaccine efficacy. The results of this study in the context of the literature suggest that educational interventions directed toward parental education about vaccine efficacy along with the strong encouragement of a health care provider, may support improved HPV vaccination uptake in the Canadian school-based HPV vaccine programs. These results are consistent with the literature and further enhance the body of knowledge in this area of study.

Relationship of the Results to the Conceptual Framework

The Andersen's behavioral model of health services use was utilized as the conceptual framework to predict individual and contextual characteristics that may facilitate or impede health services utilization (Bradley et al., 2007). In the broadest terms, the model sought to identify the factors that may have prompted the need of using health services. Health care utilization is an important indicator of access to and coverage of health services. The level of utilization varies within a population, and differs amongst individuals and various social groups with different health behaviors

This model suggests that characteristics of a society influence the health care system, and that both the society and the health care organization influence how persons use health services. How a person then subsequently uses health services is impacted by

individual factors. The Andersen behavioral model of health services use defines three types of individual factors that facilitate or impede access to and utilization of health care services: predisposing, enabling, and need factors (Andersen, 1995).

Predisposing Factors

In the Andersen model, predisposing factors refers broadly to anything that might predispose a person to need and use a particular service. These predisposing factors influence decision making of planned or intended behavior and include four domains: attitudes, knowledge, social norms, and perceived control (Bradley et al., 2002). This study selected the following seven parental predisposing factors: sex, age, ethnic origin, immigrant status, language ability in English, utilization of social media for HPV information and trust in the traditional health care system. The results of this study demonstrate that these predisposing factors were associated with positive immunization behavior as suggested by the theoretical framework. Inferential statistics determined that all results were statistically significant meaning these individual factors facilitate utilization of the HPV immunization health service. Notably, the predisposing variable with the highest association for parents being HPV immunizers was their level of trust in the traditional health care system (Chi-square = 365.591, Phi = .607, p = .000). Level of trust was determined in the traditional health care system was determined from which health care provider type the parents sought advice about HPV immunization (physician, nurse, pharmacist, naturopath or homeopath). Parents who received information from the traditional health care system (physicians, pharmacists, and nurses) were more likely to

be HPV immunizers. Parents who received information from non-traditional sources (naturopath or homeopath) were more likely to be HPV nonimmunizers.

Enabling Factors

Enabling factors relate to having appropriate community and individual-level resources necessary for accessing care. Enabling factors selected for this study were annual household income, availability of private health insurance, residing in a rural or urban setting and access to a primary care provider. Due to counts of zero in the crosstabulations for the variable of annual household income it could not be included in the analysis. As the Canadian school-based HPV immunization programs are free of charge and are delivered in the school setting, paying for the vaccine is not a requirement and financial resources are likely not a required enabler. The Pearson chi square test revealed the enabling factors that had the greatest association with a parent being an HPV immunizer, was their access to private health insurance (Chi square - 20.149, Phi - .143, p = .000). This is notable result, as the school-based HPV program does not require the use of private health care insurance This enabling factor may however play a role in the parent's ability to complete the HPV immunization series if their child misses a dose or is unable to access a catch-up program in from the publicly funded programs. These significant findings are in concordance with the conceptual framework; the findings suggest that enabling factors do directly influence health services utilization.

Need Factors

As previously described, the Andersen behavioral model of health services use assumes the presence of predisposing and enabling factors, but in addition the parent

must perceive illness as a need for the utilization of health services. Need factors incorporate both perceived needs and evaluated needs (Andersen, 1995). Parental perceived need for the HPV vaccine may be related to how the parent views the general health of their child, concerns and understanding about the risks associated with HPV infection and efficacy of the HPV vaccine. (Andersen, 1995). The following need factors were evaluated from the survey questions: belief in vaccine safety, belief in vaccine efficacy, belief in vaccine prevention of cancer, sense of urgency for need of intervention, and the perceived link to sexual activity. The results of the study demonstrate that all these need factors directly influence health behavioral intention. Survey questions 21 through 32 there were significant differences between the Mean Ranks for HPV immunizer and HPV nonimmunizer groups at $p < 0.05$. Study questions 21-25, 27, 28, 30 – 31 with higher mean ranks which indicated higher agreement with the survey question demonstrated an association with the respondent being an HPV immunizer. Questions 26, 29 and 32 had higher mean ranks which indicated lesser agreement with the survey questions and this demonstrated an association with the respondent being an HPV nonimmunizer. The need factor that had the highest mean rank for HPV immunizers were parents who believed the vaccine was highly effective and provided long-lasting protection against HPV infection (immunizer mean rank 633.41, nonimmunizer mean rank 279.63). This need factor was also significant and highly predictive in the logistic regression if the parent was an HPV immunizer (Wald – 3.763, OR – 43.093, $p = .000$). These significant findings also are in concordance with the conceptual framework; the findings suggest that need factors do directly influence health services utilization.

Limitations of the Study

This study had several limitations. This study was limited to participants who could read and comprehend English. It is likely this study is missing parents who speak other languages and lack fluency in English. This is evident when comparing the representativeness of the sample to national population distributions in Canada. This study's sample is slightly more homogeneous than the Canadian population. Additional examinations of HPV vaccine uptake in a more diverse population would be beneficial. The inclusion of this missing population could have added more information on barriers and options for recommendations addressing access to HPV vaccination health care services. Results from this study may not apply to other vaccines such as influenza, MMR, DPTP.as this study was limited to the HPV vaccine series for adolescents. This study was open for enrollment during the COVID-19 pandemic in 2021, during a time period when schools were closed to in-person learning and the Canadian public school-based vaccination programs were not operating. Study respondents were therefore asked to respond to the survey questions based on their recollection of their actions and their child's eligibility in the 2019/2020 school year. This may have diminished accuracy of the study and decrease relevance of the results in the context of the COVID-19 pandemic. The survey tool was created by the investigator; therefore, the reliability and validity have not been formally determined. Further research is warranted to modify this tool, assess its predictive validity and test-retest reliability, and conduct evaluations in other populations. A standardized, validated measurement tool of vaccine hesitancy beliefs would benefit in the advancement of research and HPV immunization policy. This study

was conducted as an anonymous online survey which promotes disclosure of sensitive information. It is possible that participants may report less vaccine hesitancy in face-to-face interviews than in an online forum. Due to zero counts detected in the crosstabulations that were conducted for all variables, several variables had to be removed from the various statistical models. This result was due to the sample and the skew towards a more affluent study population which limited analysis of some of the variables. A larger and more heterogenous study sample would likely correct this sampling issue and limitation.

Recommendations

A major finding of this work suggests that efforts to increased HPV vaccination uptake is linked to ensuring informed decision making through an emphasis on teaching vaccine efficacy and safety content with the direct support of a primary health care provider such as a family physician. As preventive vaccines are widely acknowledged as global society's best and most cost-effective protection against infectious disease, research must continue move forward in this area especially during the ongoing COVID-19 epidemic. Due to the lack of comparative results from other studies using the same conceptual framework, it was not possible to determine how representative the study findings were. Future research should address this problem, so that comparisons of data can be carried out on a larger population-based sample and be utilized to validate the baseline measurements of all the variables representing predisposing, enabling and needs factors. Carrying out additional research could also assist in determining how modifiable and predictable the use of the public school-based vaccine programs may be over time

and if any trends can be identified. This may be of critical understanding due to the heightened public awareness of vaccines due to the COVID-19 pandemic and the potential influence on the uptake of other vaccines. Research on understanding how people decide to accept or reject the HPV vaccination based on their perceptions of risk in the COVID-19 era are not yet understood. Prior to COVID-19 vaccine hesitancy was already viewed as complex and multidimensional as individuals may refuse some vaccines, but agree to others, delay vaccination, or accept vaccination despite misgivings (Dubé et al., 2014). The current COVID-19 pandemic has disrupted many HPV immunization activities across Canada as public-school closings were required to control the transmission of COVID-19. Additional disturbances from conflicting priorities on the capacity of the Canadian provincial public health systems have led to a decrease in coverage in the school-based programs (Government of Canada, 2021). There is deep concern for the adolescents in this cohort who have delayed or missed HPV immunization due to the COVID-19 pandemic. It is important to understand how changes in vaccination behaviors may influence short- and long-term consequences related to HPV infection. Provincial surveillance mechanisms are currently assessing the extent of the vaccination delays and losses in coverage (Goyette et al., 2021). The only current published modelling from the U.S. on this missed cohort, indicates that in a worst-case scenario, over the next 100 years there will be an additional 213, 926 cases of cervical cancer in the United States (Daniels et al., 2021).

This survey can be translated into many languages and used for future research to include a more representations sample of Canadians regardless of their ability to read and

comprehend English. Including other non-English speaking parents could reveal more information on barriers to health services use. It would be interesting to find out whether there are differences in results if this study was repeated with non-English speaking parents as Canada has a large French speaking population in Québec and multicultural population that was underrepresented in this study versus national population distributions. It would be useful for future research to evaluate differences in outcomes of this study using online surveys, telephone surveys, and face-to-face assessments.

Implications

Positive Social Change

The results of this study may influence positive social change as it confirms findings in the literature that having a strong and positive engagement and recommendation from a healthcare professional is an important predictor if a parent will choose to vaccinate his or her child. The Canadian school-based public vaccination programs for adolescents do not connect the parent with the health care provider in the delivery of the HPV vaccine. In the Canadian model, the primary care physician provider and traditional health care delivery setting are often not part of the HPV vaccine programs. Improving HPV vaccine uptake targets may decrease HPV infections and decrease the morbidity and mortality associated with HPV-related cancers attributed to the high-risk strains HPV14 or HPV16, both of which may be prevented by the HPV quadrivalent or nonvalent HPV vaccines (Derstenfeld et al., 2020). As an example, Australia's free HPV vaccine program in schools has led to a dramatic decline in future cervical cancer rates. By 2038 cervical cancer in Australia is expected to be eliminated as

a public health concern (Drolet et al., 2019). HPV introduces a major financial burden on the public health care system in Canada and other regions in the world. To illustrate the enormity of the problem, U.S. data from 2010 showed the overall annual direct medical cost burden of preventing and treating HPV-associated disease was approximately $8.0 billion U.S. dollars (Chesson et al., 2012).

Methodological and Theoretical Implications

As the methodology utilized an investigator created survey tool, it is possible that it was due to the survey's construction that significance of the results may not be reliable. For this reason, results of this study should be considered hypothesis generating only. Question selection was based on review of the literature and past health services utilization surveys. These other health services use surveys that were used as a template assessed various variables also aligned with the Andersen behavioral model of health services use. While addressing each predisposing, enabling and need factor of the Andersen model, the questions were also tailored to address safety, efficacy, knowledge, religious barriers, sources of information, anxiety about the HPV vaccine and potential accessibility barriers. These dimensions were focused upon due to their centrality in prior vaccine hesitancy research studies.

The survey was carried out from March 8th, 2021to May 8th, 2021, on a self-selecting sample of subjects which totaled 997, 992 of whom provided evaluative data. As the study was an online questionnaire, it was presupposed that respondents would have access to a computer with an internet connection. As expected, a highly selective sample was obtained and was disproportionately selected from a higher socioeconomic

stratum. A small ethnic sample was obtained, which was resultant of the study design. The study resulted in an adequate sample size due to the online availability. The survey was hosted by Survey Monkey and all survey data was held on their secure server until it was downloaded by the investigator in an excel file. Data was later converted to a SPSS file. All data from respondents was deleted from the server and was kept anonymous and confidential.

Recommendations for Practice

Nearly all theories of behavioral change indicate that knowledge is an essential requirement for adopting new health behaviors. The results of this study support this tenant, as the results suggest a need for increased educational interventions and programs directed at specific parent populations. This survey indicated that 32.3% of HPV nonimmunizers felt that HPV immunization was safe for their child and that the benefits outweigh the risks. This was in contrast to 92.1% of HPV immunizers who felt that the vaccine was safe. The results therefore indicate a need for clinical interventions on both the part of public health officials and individual health professions. The adverse events of immunizations are currently often reported out of context by the media and the risk benefit ratio has to be made very clear to parents to avoid vaccine refusal based on false fears. Health care providers must be informed advocates for vaccines and offer patients an understandable assessment of the risks and benefits of their immunization choices. As health care providers are not directly involved in the Canadian school-based programs, all primary health care providers such as family physicians and pediatricians, should be mandated to commence discussion with parents about the need and benefits of the HPV

vaccines. These educational interventions could commence as early point of contact interventions pediatric visits with primary' health care providers. As the primary health care providers for many nonimmunizers were homeopaths or naturopaths, perhaps introducing immunization education from a physician or midwife as early as prenatal care might provide more accurate information to a broader population of parent. The primary care physician shortage in Canada is well-recognized and this study also reinforces the need for increasing the numbers of primary care physicians (Malko & Huckfeldt, 2017) This results of this study demonstrate that having access to a primary health care provider was the most predictive variable in a parent being an HPV immunizer. By examining the results of this study, clinicians may be better able to predict if parents will be immunizers or nonimmunizers by utilizing a similar predisposing, enabling and need factor assessment tool. Such a tool requires further development, validation, and research support. The ability to predict use of the Canadian school-based vaccine programs may not only guide practice relating to the earlier education of parents but may also provide insight into identifying adolescents who are at risk of contracting vaccine preventable illnesses and so the adolescent themselves is better informed and able to influence parental decision making.

Conclusion

The results of this study confirmed that the Anderson behavioral model of health services use is a useful conceptual framework for determining the association of predisposing, enabling and need factors that are associated with the utilization of the school-based HPV vaccine program in Canada. These results indicate that further study

of broadly-based interventions that consider cultural, demographic, and environmental contexts of individuals and communities may be useful in identifying barriers to this HPV vaccine health service and promoting adherence to the recommended vaccine series in Canada. Most notably, this study confirms the importance of the role that a primary health care provider plays in educating and providing a professional evaluation of need for the vaccine. Parents who had access to a primary care provider were 74.084 times more likely to be an HPV-immunizer. This supports the findings in the literature that parents are more likely to accept immunizations for their children when supported by their primary health care professional. This finding identifies the greatest opportunity to improve the uptake of the HPV vaccine in the Canadian school-based vaccine program and ultimately improve health outcomes and decrease the burden of illness of HPV-related infections and cancers.

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Appendix A: Recommended Immunization Schedule and HPV Vaccine, by Group

Groups	Immunization Schedule	Vaccine(s)
Healthy[1] girls (9 to less than 15 years of age[2])	2 or 3 dose schedule	HPV2 or HPV4 or HPV9
Healthy[1] girls and women (15 years of age and older)	3[2] dose schedule	HPV2 or HPV4 or HPV9
Healthy[1] boys (9 to less than 15 years of age[3])	2 or 3 dose schedule	HPV4 or HPV9
Healthy[1] boys and men (15 years of age and older)	3[3]dose schedule	HPV4 or HPV9
Immunocompromised individuals and immunocompetent HIV-infected individuals	3 dose schedule	Females: HPV2 or HPV4 or HPV9
		Males: HPV4 or HPV9

[1]Immunocompetent, non-HIV infected.
[2]A 2-dose schedule of HPV2 or HPV4 vaccine is sufficient for healthy girls and women 15 years of age and older in whom the first dose was administered between 9 and less than 15 years of age.
[3]A 2-dose schedule of HPV4 vaccine is sufficient for healthy boys and men 15 years of age and older in whom the first dose was administered between 9 and less than 15 years of age.

Abbreviations:
HPV2 = bivalent human papillomavirus vaccine
HPV4 = quadrivalent human papillomavirus vaccine
HPV9 = 9-valent human papillomavirus vaccine

Appendix B: Cover Letter

Dear [Insert Name of Partner Public Health Agency/Department]:

You are invited to participate as a partner organization in a research study that is being conducted as a requirement of a doctoral degree in Health Services at Walden University.

The purpose of this study is to collect and analyze data from parents/guardians who have or have not decided to immunize their child in the Canadian school-based HPV vaccine program to better understand factors that influence the utilization of these Canadian school-based vaccine programs. Despite a free of charge program that is widely available via Canadian school-based programs, the HPV vaccination rates in Canada lag below those of other developed countries. Immunization with the HPV vaccine plays an important role in the prevention of HPV-related cancers caused by persistent HPV infections in both females and males.

This study will require anonymous participation through the completion of an online which will take approximately 10 minutes to complete.
This study will be made available online at **www.Canadian-HPV-Research.ca from March 1st, 2021 through April 30th, 2021**. After April 30th, 2021 participants will not be able to access the online questionnaire.

Once the results of this study are available, they will be posted on this website for a period of one month. The information that is returned to the study investigator will be completely anonymous. No identifying information will be used in any publication or presentations. The results of the research study may be published, but respondents will not be able to be personally identified.

I would be grateful if you create a link on your website to my research homepage www.Canadian-HPV-Research.ca encourage eligible parents/guardians to participate. If you would like more information research study, please visit the website www.Canadian-HPV-Research.ca or contact me at 647-271-6393.
Sincerely,

Diane Brown, R.N., BScN, MHSA
Diane.Brown6@waldenu.edu

Appendix C: Consent Form

Introduction of the consent form.
Thank you for your interest in participating in this research study. This research study will require your **consent** to participate and is entirely **voluntary** on your part.

You are invited to take part in a research study that will examine factors that influence the utilization of Canadian school-based vaccine programs that offer free of charge Human Papilloma Virus (HPV) vaccine to children and adolescents. Participants from all thirteen of Canada's provincial and territorial jurisdictions are invited to participate. This form is part of a process called "informed consent" to allow you to understand this study before deciding whether to take part.
This study is being conducted by a researcher named Diane Brown, who is a doctoral student at Walden University.

Why am I being invited to be in the study?
You are being invited to participate in this study because you are 1) a parent or guardian with a child who was eligible for the Canadian school-based vaccine program in the **2019/2020** school year, 2) you are 18 years of age or older, 3) you can fully read and comprehend either the English or French language to be in the study.

Why is this study being done?

Despite a free of charge program that is widely available via Canadian school-based programs, the HPV vaccination rates in Canada lag below those of other developed countries. Immunization with the HPV vaccine plays an important role in the prevention of HPV-related cancers caused by persistent HPV infections in both females and males. The purpose of this study is to collect and analyze data from parents/guardians who have or have not decided to immunize their child in the Canadian school-based HPV vaccine program to better understand factors that influence the utilization of these Canadian school-based vaccine programs.

How much of my time will this study take?

The survey will take approximately 10 minutes or less to complete.

If I agree to be in this study, what will I be asked to do?

If you decide to be in this study, we will ask you to do several things:

1) Provide consent after reading this form
2) Answer survey questions
3) Submit the completed survey

Here are some sample questions:

From which health care provider / provider do you mainly seek advice about Human Papilloma Virus (HPV) immunization?
Do you have access to a primary care health provider such as a family physician?
Immunization with the Human Papilloma Virus (HPV) vaccine is safe for my child and its benefits outweigh the risks.

□	□	□	□
strongly disagree	somewhat disagree	somewhat agree	strongly agree

Can I refuse to be in the study?

Yes, taking part in this study is your choice. Research should only be done with those who freely volunteer. So, everyone involved will respect your decision to join or not. You will be treated the same by Walden University whether you join the study or not. If you decide to join the study now, you can still change your mind later. Since your participation is anonymous withdrawal after study completion will be impossible.

Who is funding this study?

The researcher is not receiving money, grants, or any other type of compensation to conduct this study.

How many people will be in the study?

783 participants will be sought from across Canada.

How much time will the whole study take?

The whole study is expected to begin in 2021 and end in 2021.

What are the possible risks of participating in this study?

Being in this study could involve some risk of the minor discomforts that can be encountered in daily life, such as **fatigue, stress, or becoming upset**. If you experience these stressors, you may take a break for a while, seek support with a trusted person, and/or support system.

If you need help or need a referral to a hotline that deals with sensitive issues or feeling more upset than normal, you can call:

1) Crisis Service Canada at 1-**833-456-4566** or text **45645**. Crisis Service Canada will connect you with a distress centre or crisis organization in your local area.

With the protections in place, this study would pose minimal risk to your wellbeing.

This study offers no direct benefits to individual volunteers. The aim of this study is to benefit society by gaining understanding of factors that improve the use of the Canadian school-based HPV vaccine programs.

Will I be paid or compensated for my participation?

There is **no payment or compensation** offered for participation in this study.

How will you protect my privacy and confidentiality?

The researcher is required to protect your privacy. Your identity will be kept **anonymous** and the researcher will not be able to identify you. The researcher will not use you the data collected from this study for any purposes outside of this research project. Your name, email address or any other identifying information will not be collected or provided to the researcher. The results of this study may be published, but you will not be able to be personally identified. If the researcher were to share this dataset with another researcher in the future, the researcher is required to ensure all data shared cannot identify you in any way; this would not involve another round of obtaining informed consent. Anonymized survey responses will be kept secure on a password protected computer system and any data transmitted electronically will be encrypted. Data will be kept for a period of at least 5 years, as required by the university.

Who do I call if I have questions about the study?

If you have any questions concerning this study, please do not hesitate to contact the researcher at 647-271-6393. If you want to talk privately about your rights as a participant or any negative parts of the study, you can call Walden University's Research Participant Advocate at 612-312-1210. Walden University's approval number for this study is 03-08-21-0666146 and it expires on March 7, 2022.

You might wish to retain this consent form for your records. You may ask the researcher or Walden University for a copy at any time using the contact info above.

Obtaining Your Consent

If you feel you understand the study and wish to volunteer, please indicate your consent by clicking the box 'Yes' to be in the study and that you understand the consent form process.

Please print or save this consent for your records.

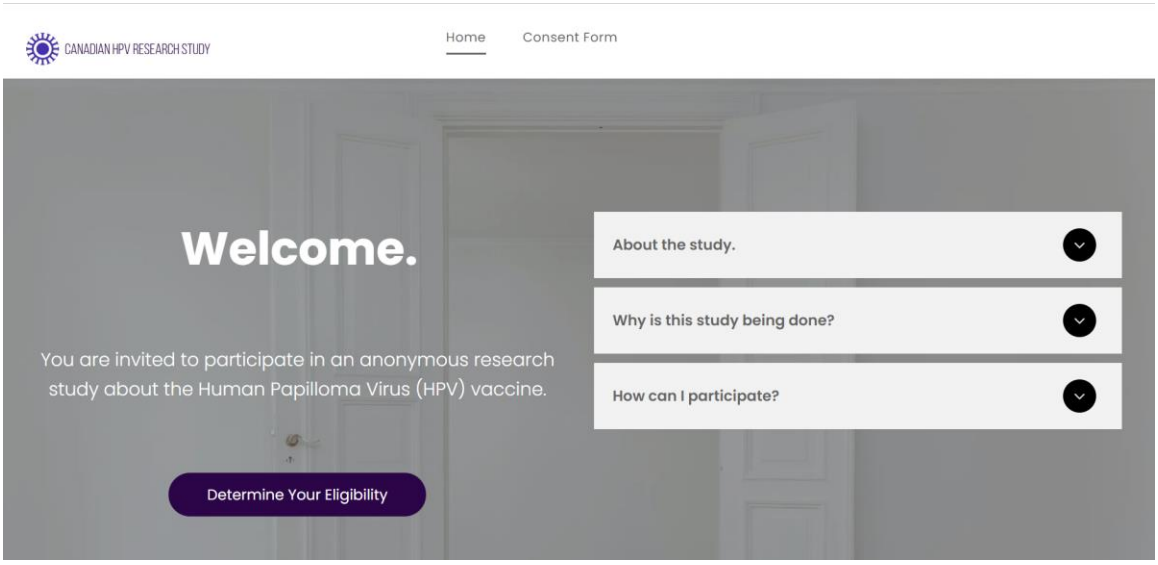
I have read and understood the research study and all my questions have been answered to my satisfaction. I have been offered a copy of this consent. I agree to be in the study; I will keep a copy of this statement for my records.

I consent to participating in this survey by clicking the 'Yes' box below.

Remember to **take breaks, do the survey in chunks of time, and seek support if you are feeling stressed or fatigued while or after taking this survey.**

- ○ Yes
- ○ No

Appendix D: WWW.Canadian-HPV-Research.ca Website



Appendix E: Parent/Guardian Questionnaire

SECTION I – ELIGIBILITY

1. Please indicate your response to the following statement by checking ONE box.

I am the parent or legal guardian of a child eligible for the Human Papilloma Virus (HPV) that is available through the Canadian school-based program?

□ Yes □ No

2. Please indicate if you are 18 years of age or older.

□ Yes □ No

3. Please confirm that you can read and fully comprehend the English language.

□ Yes □ No

4. Please indicate your child's current Human Papilloma Virus (HPV) immunization status by checking ONE box.

My child has:
□ received no Human Papilloma Virus (HPV) immunizations at my request

□ received all the recommended Human Papilloma Virus (HPV) immunizations for his/her age
□ received some of the recommended Human Papilloma Virus (HPV) immunizations for his/her age

5. My child has received all other childhood vaccinations offered from the provincial/territory school-based vaccination program

□ Yes □ No

6.What Canadian province or territory do you live in _____?

7. Please indicate if your child is a male or female.

□ Male □ Female

SECTION II – predisposing characteristics

8. What is your sex?

□ Female □ Male □ Other _____

9. How old are you?

_____ years old.

10. What is your ethnic origin?
□ Black or African American
□ Asian or Asian American
□ Asian Pacific Islander
□ Caucasian
□ Hispanic or Latino
□ Indigenous
□ Another race

11. What is your immigrant status?

□ Non-immigrant (a Canadian citizen by birth)

□ Immigrant (a landed immigrant or a permanent resident of Canada)

12. What is the highest level of education that you have completed?

□ Less than high school degree
□ High school degree or equivalent (e.g. GED)
□ Some college but no degree
□ Associate degree
□ Baccalaureate degree
□ Graduate degree

13. What is your marital status?

□ Married
□ Widowed
□ Divorced
□ Separated
□ In a domestic partnership or civil union
□ Single, but cohabitating with a significant other
□ Single, never married

14. Do you utilize social media (e.g. Facebook, Instagram, Twitter etc.) to review health information on Human Papilloma Virus (HPV) and HPV Immunization?

□ Yes □ No

15. Do you have a first language that is NOT English?

□ Yes □ No

16. From which health care provider / provider do you mainly seek advice about Human Papilloma Virus (HPV) immunization?

□ Medical Doctor
□ Nurse
□ Pharmacist
□ Naturopath
□ Homeopath
□ Other (describe) _____

SECTION III – ENABLING FACTORS

17. Please indicate your total annual household income in Canadian dollars?

□ Under $15,000/year
□ $15,000/year to $29,999/year
□ $30,000/year to $49,999/year
□ $50,000/year to $74,999/year
□ $75,000/year to $99,999/year
□ $100,00/year to $150,000/year
□ Greater than $150,000/year

18. Please indicate if you have Private Health Insurance that covers Human Papilloma Virus (HPV) vaccines?

□ Yes □ No □ Unknown

19. Please indicate if you live in an urban (a region in or surrounding a city) or a rural (countryside) setting?

□ Yes □ No

20. Do you have access to a primary care health provider such as a family physician?

□ Yes □ No

SECTION IV – NEED FACTORS

Please indicate your response to the following statements by checking ONE box.

21. Immunization with the Human Papilloma Virus (HPV) vaccine is safe for my child and its benefits outweigh the risks.

□ strongly disagree □ disagree □ agree □ strongly agree

22. The Human Papilloma Virus (HPV) vaccination provides effective and long-lasting protection again HPV infections.

□ strongly disagree □ disagree □ agree □ strongly agree

23. The Human Papilloma Virus (HPV) vaccination provides effective and long-lasting protection again cancers caused HPV infections.

□ strongly disagree □ disagree □ agree □ strongly agree

24. My friends and family encouraged me to immunize my child with the Human Papilloma Virus (HPV) vaccine.

□ strongly disagree □ disagree □ agree □ strongly agree

25. I should immunize my child with the Human Papilloma Virus (HPV) vaccine to help protect others.

□ strongly disagree □ disagree □ agree □ strongly agree

26. Many people in my community do not immunize their children with the Human Papilloma Virus (HPV) vaccine.

□ strongly disagree □ disagree □ agree □ strongly agree

27. I have religious beliefs that influenced my decision regarding immunizing my child with the Human Papilloma Virus (HPV) vaccine.

□ strongly disagree □ disagree □ agree □ strongly agree

28. I feel that there is an immediate need to immunize my child with the Human Papilloma Virus (HPV) vaccine.

□ strongly disagree □ disagree □ agree □ strongly agree

29. I feel that it is more important to vaccinate girls than boys with the Human Papilloma Virus (HPV) vaccine.

□ strongly disagree □ disagree □ agree □ strongly agree

30. My child's family doctor or other primary health care provider discussed the importance of the Human Papilloma Virus (HPV) vaccine with me.

□ strongly disagree □ disagree □ agree □ strongly agree

31. I am concerned that Human Papilloma Virus (HPV) immunization will lead my child to engage in earlier or riskier sexual activity.

□ strongly disagree □ disagree □ agree □ strongly agree

32. My child is not sexually active so I don't believe there is a need to vaccinate him/her with the Human Papilloma Virus (HPV) immunization at this time.

□ strongly disagree □ disagree □ agree □ strongly agree

Appendix F: List of Partner Organizations Contacted

Alberta
Alberta Health
Public Health and Compliance
Immunization Program
10025 Jasper Avenue NW
PO Box 1360
Edmonton, AB T5J 2N3

British Columbia
BC Centre for Disease Control
Immunization Programs & Vaccine Preventable Diseases
655 West 12th Avenue
Vancouver, BC V5Z 4R4

Manitoba
Manitoba Health, Seniors & Active Living
Active Living, Population & Public Health Branch
4th Floor-300 Carlton Street
Winnipeg, MB R3B 3M9
Phone: 204-788-6737

New Brunswick
Disease Prevention and Control
Office of the Chief Medical Officer of Health
Department of Health
2nd Floor HSBC Place, 520 King Street
P.O. Box 5100
Fredericton, New Brunswick E3B 5G8

Newfoundland and Labrador
Population Health Branch
Disease Control Division
PO Box 8700 St. John's NB A1B 4J6

Nova Scotia
Dept. of Health and Wellness
Barrington Tower, 4th Floor
1894 Barrington Street
P.O. Box 488
Halifax, NS B3J 2A8

Northwest Territories
Office of the Chief Medical Health Officer
Dept. of Health and Social Services
Box 1320
Yellowknife, NT X1A 2L9

Nunavut
Office of the Chief Medical Health Officer
of Health and Social Services
Box 1000, Station 1000
Iqaluit, Nunavut X0A 0H0

Prince Edward Island
Office of Chief Health Officer
Dept. of Health and Wellness
Box 2000
Charlottetown, PEI C1A 7N8

Québec
Institut national de santé publique du Québec
945 Wolfe Avenue
Québec, QC G1V 5B3

Ontario
Public Health Ontario
661 University Avenue, Suite 1701
Toronto, ON M5G 1M1

Saskatchewan
Saskatchewan Ministry of Health
Population Health Branch
3475 Albert Street

Yukon
Vaccine Program Manager
Yukon Government
Dept. Health and Social Services
305 Jarvis Street, Second Floor
Whitehorse, Yukon Y1A 2H3

Appendix G: Research Question 1 Independent Samples *T* Test Assumptions

Table G1

Group Statistics

	Immunizer	*N*	*Mean*	*Std. Deviation*	*Std. Error Mean*
Parent Age	Nonimmunizer	384	40.83	5.625	.287
	Immunizer	608	42.89	5.071	.206

Table G2

Levine's Test for Equality of Variances

		F	*Sig*	*t*	*df*
Parent Age	Equal variances assumed	.345	.557	-5.976	990
	Equal variances not assumed			-5.838	752.099

Table G3

T-*Test for Equality of Means*

						95% CI of the Difference	
		Sig (2-tailed)	*Mean Diff.*	*Std. Error Diff*	*df*	*Lower*	*Upper*
Parent Age	Equal variances assumed	.345	.557	-5.976	990	-2.738	-1.384
	Equal variances not assumed			-5.838	752.099	-2.755	-1.368

Cohen's *d* is a type of effect size between two means. An effect size is a quantitative measure of the magnitude for the difference between two means, in this regard. Cohen's *d* values are also known as the standardised mean difference (SMD). Cohen's *d* values as standard deviations between the two groups. A value of 1 indicates that the means of the two groups differ by 1 standard deviation. The results of the Cohen's *d* in Table G4 yields a value of -.390 which indicates the mean age differences between the HPV immunizer and HPV nonimmunizer groups differ by -.390 standard deviations, which is a very small effect.

Table G4

Independent Samples Effect Sizes

				95% Confidence Interval	
		Standardizer[a]	Point Estimate	Lower	Upper
Parent Age	Cohen's *d*	5.292	-.390	-.518	-.261
	Hedges' correction	5.296	-.389	-.518	-.260
	Glass's delta	5.071	-.407	-.536	-.277

[a]*Note*: the denominator used in estimating the effect sizes

Cohen's *d* uses the pooled standard deviation.

Hedges' correction uses the pooled standard deviation, plus a correction factor.

Glass's delta uses the sample standard deviation of the control group

Table G5

Test of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	*df*	Sig.	Statistic	*df*	Sig.
	.117	992	.00	.962	.260	

a. Lilliefors Significance Correction

Three methodologies were used to determine if the study data was normally distributed. These three approaches included analyzing the results of the Kolmogorov-Smirnov test, the Shapiro-Wilk's test and interpreting the shape of the Normal Q-Q Plots (Laerd Statistics, 2018). As seen in table G5, the Komogorov-Smirnov and Shapiro-Wilk tests both have a significant value less than the alpha value of .05, which infers that the data differs from a normal distribution (Field, 2013). The Komogorov-Smirnov and Shapiro-Wilk tests compare the scores in the sample to a normally distributed set of scores with the same mean and standard deviation. The null hypothesis is that the sample distribution is normal and if the test is significant, the distribution is non-normal (Field, 2013). For small sample sizes, normality tests have little power to reject the null hypothesis and therefore small samples most often pass normality tests (Oztuna, Elhan & Tuccar, 2006). For large sample sizes, significant results would be derived even in the case of a small deviation from normality (Ghasemi & Zahediasl, 2012). In this case, the best way to determine normality is to visually inspect a Q-Q plot for normal distribution. Normally distributed data will appear as round dots located near the diagonal line (Laerd Statistics, 2018). Based on my graphical assessment of the Normal Q-Q Plots presented

in Figure 5, the age of the study participants was normally distributed. In addition, I plotted the age data in a box plot. A boxplot that is symmetric with the median line at approximately the center of the box and with symmetric whiskers that are slightly longer than the subsections of the center box suggests that the data has come from a normal distribution (Ghasemi & Zahediasl, 2012). The output from the boxplot showed four outliers; however, due the large sample size is expected and does not affect the normality of the curve (Field, 2013). Due to the small number of outliers when compared to the overall sample size, the outliers were not removed from the study analysis. Output from the box plot can be seen in Figure 6.

Figure 5

Normal Q-Q Scatter Plot Depicting Parent Age That is Normally Distributed

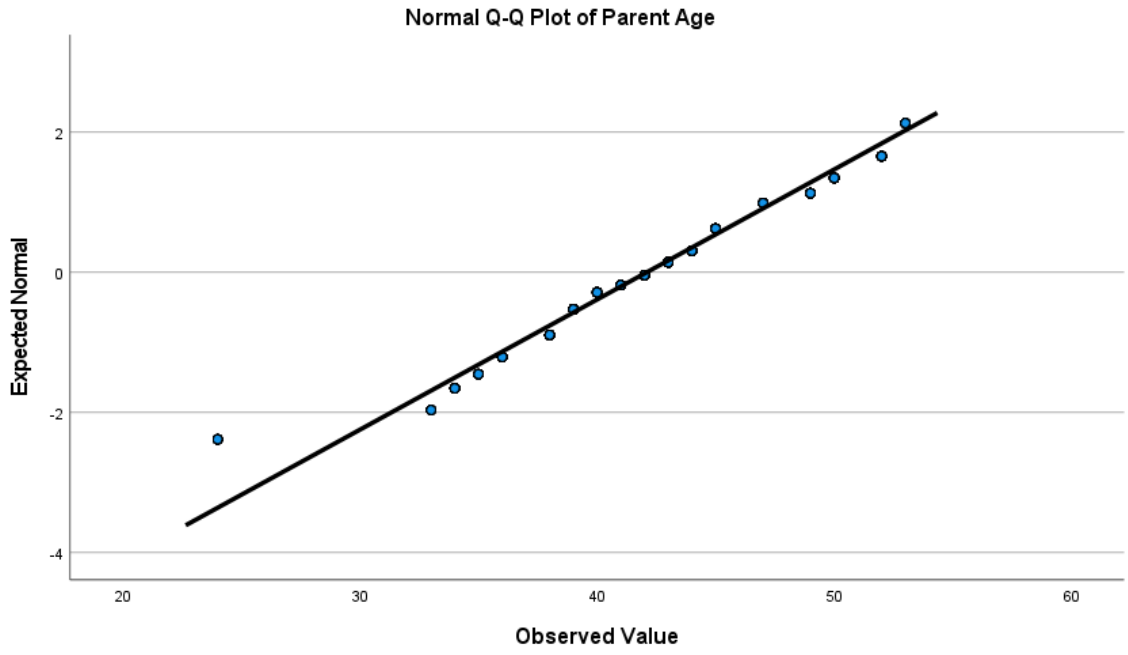
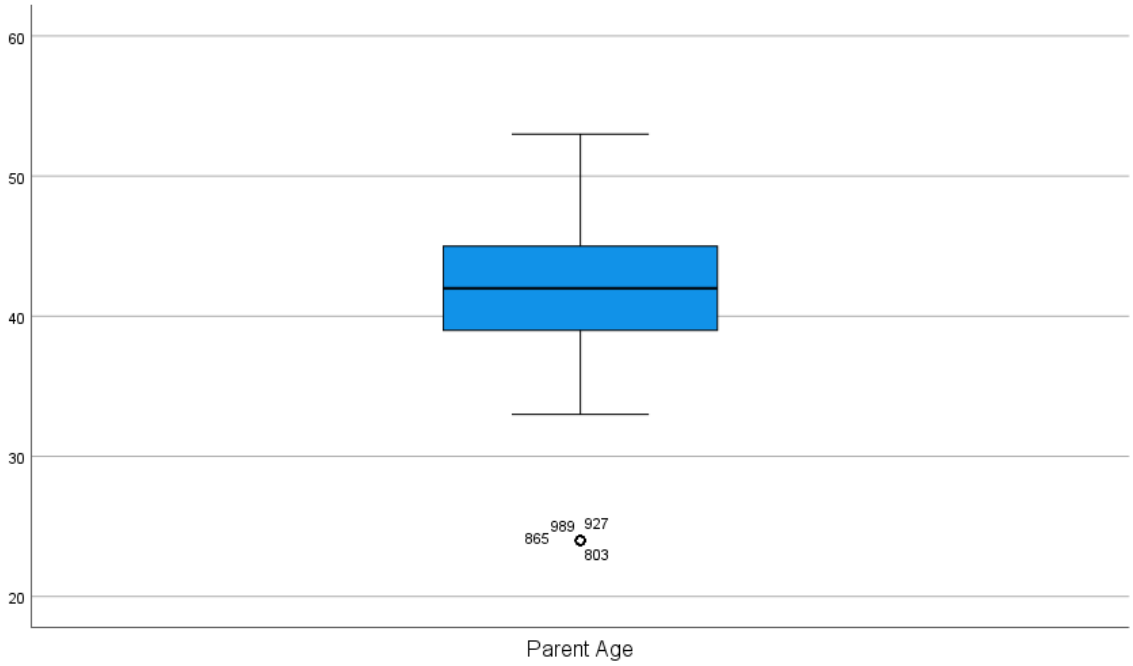


Figure 6

Box Plot Showing the Presence of Four Outliers in Age



Appendix H: Research Question 1 Pearson's Chi-Square Assumptions

In the first research question, I used a Pearson's chi-square to address the difference in paired observations by sex, ethnic origin, education level, marital status, household, immigrant status, English as first language, utilization of social media for HPV information, health care provider sought for HPV advice, private insurance for HPV vaccine, residential location, and access to a primary health care provider. Three assumptions must be satisfied to run this test.

I met the first two assumptions (variables must be categorical and an independence of observations) based on the design of my study. The third assumption of a chi-square test is that all cells in the SPSS cross-tabulation output table must have expected counts that are greater than five (Field, 2013). As can be seen in Tables H1 through H12, I met this assumption as all cell counts from the cross-tabulation for the expected count were greater than five. Any variable with a value with less than five was not included in the calculation as demonstrated in each cross-tabulation tables below.

Table H1

Parents' Sex Cross-Tabulation

			Immunizer		
			Nonimmunizer	Immunizer	Total
Parent's sex	Female	Count	288	400	688
		% within Parent's sex	41.9%	58.1%	100.0%
	Male	Count	96	208	304
		% within Parent's sex	31.6%	68.4%	100.0%
Total		Count	384	608	992
		% within Parent's sex	38.7%	61.3%	100.0%

Table H2

Parents' Ethnic Origin Cross-Tabulation

			Immunizer		
			Nonimmunizer	Immunizer	Total
Ethnic origin	Caucasian	Count	256	384	640
		% within Ethnic origin	40.0%	60.0%	100.0%
	Black	Count	48	96	144
		% within Ethnic origin	33.3%	66.7%	100.0%
	Asian	Count	64	64	128
		% within Ethnic origin	50.0%	50.0%	100.0%
	Another race	Count	16	64	80
		% within Ethnic origin	20.0%	80.0%	100.0%
Total		Count	384	608	992
		% within Ethnic origin	38.7%	61.3%	100.0%

Note. Asian Pacific Islander, Hispanic or Latino, Indigenous all had counts of less than five and were removed from the Pearson's chi-square test to satisfy the assumptions of the test.

Table H3

Parents' Education Level Cross-Tabulation

			Immunizer		
			Nonimmunizer	Immunizer	Total
Highest level of school completed or the highest degree received	High school or equivalent	Count	32	64	96
		% within Highest level of school completed or the highest degree received	33.3%	66.7%	100.0%
	Some college but no degree	Count	80	160	240
		% within Highest level of school completed or the highest degree received	33.3%	66.7%	100.0%
	Associate Degree	Count	0	16	16
		% within Highest level of school completed or the highest degree received	0.0%	100.0%	100.0%
	Bachelor's degree	Count	176	240	416
		% within Highest level of school completed or the highest degree received	42.3%	57.7%	100.0%
	Graduate Degree	Count	96	128	224
		% within Highest level of school completed or the highest degree received	42.9%	57.1%	100.0%
Total		Count	384	608	992

		% within Highest level of school completed or the highest degree received	38.7%	61.3%	100.0%

Note. The elementary category had counts of less than five and was removed from the Pearson's chi-square test to satisfy the assumptions of the test.

Table H4

Parents' Immigrant Status Cross-Tabulation

			Immunizer		
			Nonimmunizer	Immunizer	Total
Immigrant status	Immigrant	Count	384	608	992
		% within Immigrant status	38.7%	61.3%	100.0%
Total		Count	384	608	992
		% within Immigrant status	38.7%	61.3%	100.0%

Table H5

Parents' Social Media Cross-Tabulation

			Immunizer		
			Nonimmunizer	Immunizer	Total
Social media	No, does not obtain HPV info from social media	Count	96	208	304
		% within Social media	31.6%	68.4%	100.0%
	Yes, obtains HPV info from social media	Count	288	400	688
		% within Social media	41.9%	58.1%	100.0%
Total		Count	384	608	992
		% within Social media	38.7%	61.3%	100.0%

Table H6

Parents' Marital Status Cross-Tabulation

			Immunizer		
			Nonimmunizer	Immunizer	Total
Relationship status	Married	Count	160	272	432
		% within Relationship status	37.0%	63.0%	100.0%
	Widowed	Count	0	16	16
		% within Relationship status	0.0%	100.0%	100.0%
	Divorced	Count	16	112	128
		% within Relationship status	12.5%	87.5%	100.0%
	Separated	Count	48	80	128
		% within Relationship status	37.5%	62.5%	100.0%
	In a domestic partnership or civil union	Count	128	128	256
		% within Relationship status	50.0%	50.0%	100.0%
	Single, but cohabitating with significant other	Count	32	0	32
		% within Relationship status	100.0%	0.0%	100.0%
Total		Count	384	608	992
		% within Relationship status	38.7%	61.3%	100.0%

Note. The single but never married category had counts of less than five and was removed from the Pearson's chi-square test to satisfy the assumptions of the test.

Table H7

Parents' First Language Cross-Tabulation

			Immunizer		
			Nonimmunizer	Immunizer	Total
Other first language	No other first language than English	Count	304	416	720
		% within Other first language	42.2%	57.8%	100.0%
	Yes, has another first language than English	Count	80	192	272
		% within Other first language	29.4%	70.6%	100.0%
Total		Count	384	608	992
		% within Other first language	38.7%	61.3%	100.0%

Table H8

Parents' Health Care Provider Cross-Tabulation

			Immunizer		
			Nonimmunizer	Immunizer	Total
From which health care provider	Medical Doctor	Count	128	464	592
		% within From which health care provider	21.6%	78.4%	100.0%
	Nurse	Count	0	16	16
		% within From which health care provider	0.0%	100.0%	100.0%
	Pharmacist	Count	32	80	112
		% within From which health care provider	28.6%	71.4%	100.0%
	Naturopath	Count	192	16	208
		% within From which health care provider	92.3%	7.7%	100.0%
	Homeopath	Count	16	0	16
		% within From which health care provider	100.0%	0.0%	100.0%
	Other	Count	16	32	48
		% within From which health care provider	33.3%	66.7%	100.0%
Total		Count	384	608	992
		% within From which health care provider	38.7%	61.3%	100.0%

Table H9

Parents' Annual Household Income Cross-Tabulation

			Immunizer		
			Nonimmunizer	Immunizer	Total
Annual household income	Between $75,000 and $99,999	Count	32	64	96
		% within Annual household income	33.3%	66.7%	100.0%
	Between $100,000 and $150,000	Count	64	112	176
		% within Annual household income	36.4%	63.6%	100.0%
	Over $150,000	Count	288	432	720
		% within Annual household income	40.0%	60.0%	100.0%
Total		Count	384	608	992
		% within Annual household income	38.7%	61.3%	100.0%

Note. The <$15,000, $15,000 - $29,999, $30,000 - $49,000 and $50,000 – $74,999 categories had counts of less than five and were removed to satisfy the test assumptions.

Table H10

Parents' Private Health Insurance Cross-Tabulation

			Immunizer		
			Nonimmunizer	Immunizer	Total
Private Health Insurance	No Private Health Insurance	Count	320	352	672
		% within Private Health Insurance	47.6%	52.4%	100.0%
	Yes has Private Health Insurance	Count	64	256	320
		% within Private Health Insurance	20.0%	80.0%	100.0%
Total		Count	384	608	992
		% within Private Health Insurance	38.7%	61.3%	100.0%

Table H11

Parents' Residence Location Cross-Tabulation

			Immunizer		
			Nonimmunizer	Immunizer	Total
Urban or rural	Rural	Count	160	176	336
		% within Urban or rural	47.6%	52.4%	100.0%
	Urban	Count	224	432	656
		% within Urban or rural	34.1%	65.9%	100.0%
Total		Count	384	608	992
		% within Urban or rural	38.7%	61.3%	100.0%

Table H12

Parents' Access to a Primary Health Care Provider Cross-Tabulation

			Immunizer		
			Nonimmunizer	Immunizer	Total
Primary care health provider	No	Count	80	64	144
		% within Primary care health provider	55.6%	44.4%	100.0%
	Yes	Count	304	544	848
		% within Primary care health provider	35.8%	64.2%	100.0%
Total		Count	384	608	992
		% within Primary care health provider	38.7%	61.3%	100.0%

Appendix I: Research Question 2 Logistic Regression Assumptions

The Spearman rank-order correlation coefficient (or Spearman's rho) was used to assess the relationship between two ordinal variables. Spearman's rho is an accepted method for correlating unvalidated survey instruments and Likert-type survey responses. The accepted rule of thumb for interpreting the size of a correlation coefficient is that if the size of the correlation is between .90 to 1.00 there is a very high positive correlation (Mukaka, 2012). If the size of the correlation is between .70 and .90 there is a high positive correlation (Mukaka, 2012).

Three of the 4-point Likert scale responses demonstrated they ranged from highly correlated to very highly correlated. These questions were question 21, immunization with the Human Papilloma Virus (HPV) vaccine is safe for my child and its benefits outweigh the risks (correlation coefficient 1.000), question 22, the Human Papilloma Virus (HPV) vaccination provides effective and long-lasting protection again HPV infections (correlation coefficient .745), and question 23, the Human Papilloma Virus (HPV) vaccination provides effective and long-lasting protection again cancers caused HPV infections (correlation coefficient .781).

To satisfy the second assumption of a logistic regression, Question 21 was retained but Questions 23 and 24 were removed from the logistic regression model due to the size of their correlation to ensure the independence of observations. Skewness and kurtosis statistics were conducted on each variable's distribution. If the assumption of normality had met, then a more powerful biserial or Pearson correlations could have been used instead of Spearman's rho.

Figure 7

Spearman Rank-Order Correlation Coefficient Results

Correlations

			Variables2													
Type	Variables1	Statistics	Immunizations with the Human Papilloma Virus (HPV) vaccine is safe for my child and its benefits outweigh the risks.	The Human Papilloma Virus (HPV) vaccination provides effective and long-lasting protection again HPV infections.	The Human Papilloma Virus (HPV) vaccination provides effective and long-lasting protection against cancers caused HPV infections.	My friends and family encouraged me to immunize my child with the Human Papilloma Virus (HPV) vaccine.	I should immunize my child with the Human Papilloma Virus (HPV) vaccine to help protect others.	Many people in my community do not immunize their children with the Human Papilloma Virus (HPV) vaccine.	I have religious beliefs that influenced my decision regarding immunizing my child with the Human Papilloma Virus (HPV) vaccine.	I feel that there is an immediate need to immunize my child with the Human Papilloma Virus (HPV) vaccine.	I feel that it is more important to vaccinate girls than boys with the Human Papilloma Virus (HPV) vaccine.	My child's family doctor or other primary health care provider discussed the importance of the Human Papilloma Virus (HPV) vaccine with me.	I am concerned that Human Papilloma Virus (HPV) immunization will lead my child to engage in earlier or riskier sexual activity.	My child is not sexually active so I don't believe there is a need to vaccinate him/her with the Human Papilloma Virus (HPV) immunization at this time.	Parent Age
Spearman's rho	Immunizations with the Human Papilloma Virus (HPV) vaccine is safe for my child and its benefits outweigh the risks.	Correlation Coefficient	1.000	.745**	.781**	.626**	.637**	.040	.257**	.534**	-.070*	.611**	.246**	-.469**	.286**
		Sig. (2-tailed)	.	.000	.000	.000	.000	.208	.000	.000	.027	.000	.000	.000	.000
		N	992	992	992	992	992	992	992	992	992	992	992	992	992
	The Human Papilloma Virus (HPV) vaccination provides effective and long-lasting protection again HPV infections.	Correlation Coefficient	.745**	1.000	.784**	.549**	.521**	.094**	.320**	.379**	.097**	.515**	.281**	-.496**	.311**
		Sig. (2-tailed)	.000	.	.000	.000	.000	.003	.000	.000	.002	.000	.000	.000	.000
		N	992	992	992	992	992	992	992	992	992	992	992	992	992
	The Human Papilloma Virus (HPV) vaccination provides effective and long-lasting protection against cancers caused HPV infections.	Correlation Coefficient	.781**	.784**	1.000	.645**	.554**	.022	.252**	.502**	.007	.614**	.093**	-.522**	.180**
		Sig. (2-tailed)	.000	.000	.	.000	.000	.482	.000	.000	.832	.000	.003	.000	.000
		N	992	992	992	992	992	992	992	992	992	992	992	992	992
	My friends and family encouraged me to immunize my child with the Human Papilloma Virus (HPV) vaccine.	Correlation Coefficient	.626**	.549**	.645**	1.000	.613**	-.066*	.399**	.533**	-.117**	.596**	.198**	-.374**	.077*
		Sig. (2-tailed)	.000	.000	.000	.	.000	.038	.000	.000	.000	.000	.000	.000	.015
		N	992	992	992	992	992	992	992	992	992	992	992	992	992
	I should immunize my child with the Human Papilloma Virus (HPV) vaccine to help protect others.	Correlation Coefficient	.637**	.521**	.554**	.613**	1.000	.055	.283**	.580**	-.199**	.467**	.130**	-.219**	.080*
		Sig. (2-tailed)	.000	.000	.000	.000	.	.086	.000	.000	.000	.000	.000	.000	.012
		N	992	992	992	992	992	992	992	992	992	992	992	992	992
	Many people in my community do not immunize their children with the Human Papilloma Virus (HPV) vaccine.	Correlation Coefficient	.040	.094**	.022	-.066*	.055	1.000	.126**	.139**	.079*	-.067*	-.040	.260**	.096**
		Sig. (2-tailed)	.208	.003	.482	.038	.086	.	.000	.000	.013	.036	.206	.000	.002
		N	992	992	992	992	992	992	992	992	992	992	992	992	992
	I have religious beliefs that influenced my decision regarding immunizing my child with the Human Papilloma Virus (HPV) vaccine.	Correlation Coefficient	.257**	.320**	.252**	.399**	.283**	.126**	1.000	.460**	.097**	.101**	.210**	-.030	.162**
		Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	.	.000	.002	.001	.000	.347	.000
		N	992	992	992	992	992	992	992	992	992	992	992	992	992
	I feel that there is an immediate need to immunize my child with the Human Papilloma Virus (HPV) vaccine.	Correlation Coefficient	.534**	.379**	.502**	.533**	.580**	.139**	.460**	1.000	.128**	.436**	.116**	-.017	.307**
		Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	.000	.	.000	.000	.000	.599	.000
		N	992	992	992	992	992	992	992	992	992	992	992	992	992
	I feel that it is more important to vaccinate girls than boys with the Human Papilloma Virus (HPV) vaccine.	Correlation Coefficient	-.070*	.097**	.007	-.117**	-.199**	.079*	.097**	.128**	1.000	-.065*	-.072*	.146**	.115**
		Sig. (2-tailed)	.027	.002	.832	.000	.000	.013	.002	.000	.	.040	.024	.000	.000
		N	992	992	992	992	992	992	992	992	992	992	992	992	992
	My child's family doctor or other primary health care provider discussed the importance of the Human Papilloma Virus (HPV) vaccine with me.	Correlation Coefficient	.611**	.515**	.614**	.596**	.467**	-.067*	.101**	.436**	-.065*	1.000	.337**	-.370**	.015
		Sig. (2-tailed)	.000	.000	.000	.000	.000	.036	.001	.000	.040	.	.000	.000	.637
		N	992	992	992	992	992	992	992	992	992	992	992	992	992
	I am concerned that Human Papilloma Virus (HPV) immunization will lead my child to engage in earlier or riskier sexual activity.	Correlation Coefficient	.246**	.281**	.093**	.198**	.130**	-.040	.210**	.116**	-.072*	.337**	1.000	-.197**	-.053
		Sig. (2-tailed)	.000	.000	.003	.000	.000	.206	.000	.000	.024	.000	.	.000	.095
		N	992	992	992	992	992	992	992	992	992	992	992	992	992
	My child is not sexually active so I don't believe there is a need to vaccinate him/her with the Human Papilloma Virus (HPV) immunization at this time.	Correlation Coefficient	-.469**	-.496**	-.522**	-.374**	-.219**	.260**	-.030	-.017	.146**	-.370**	-.197**	1.000	.016
		Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	.347	.599	.000	.000	.000	.	.615
		N	992	992	992	992	992	992	992	992	992	992	992	992	992
	Parent Age	Correlation Coefficient	.286**	.311**	.180**	.077*	.080*	.096**	.162**	.307**	.115**	.015	-.053	.016	1.000
		Sig. (2-tailed)	.000	.000	.000	.015	.012	.002	.000	.000	.000	.637	.095	.615	.
		N	992	992	992	992	992	992	992	992	992	992	992	992	992

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

The third assumption that is required to be satisfied to conduct a regression analysis is that there is little, or no multicollinearity demonstrated between the variables. A Variance Inflation Factor test was conducted to detect multicollinearity in the regression analysis. Multicollinearity occurs when there is a correlation between predictors (i.e., independent variables) in a regression model (Everitt & Skrondal, 2010). The presence of multicollinearity can adversely affect the regression results.

The Variance Inflation Factor estimates how much the variance of a regression coefficient is inflated due to multicollinearity in the model (Everitt & Skrondal, 2010). The Variance Inflation Factor value should be desirably small; however, this value may entirely remove the independent variables from the dataset. The generally accepted Variance Inflation Factor threshold equals ten (Laerd Statistics, 2018d). This indicates that if the value of any independent variable is more than ten, it should be removed. In addition, multicollinearity may be present if the tolerance value is less than 0.1 (Laerd Statistics, 2018).

I confirmed there was no multicollinearity as all collinearity tolerance values were greater than 0.1 (range .244 - .711) and all Variance Inflation Factor values were less than 10 (range 1.407 – 4.097) (Table I1). The Variance Inflation Factor and collinearity tolerance tests were not performed on study questions 22 and 23 as they were removed from the model based on the findings of the Spearman rank-order correlation coefficient.

Table I1

Variance Inflation Factor (VIF)

Variable	Tolerance	*VIF*
Parent's sex	.676	1.480
Parent's age	.533	1.876
Ethnic origin	.440	2.274
Immigrant status	.318	3.140
Highest level of school completed	.361	2.772
Relationship status	.586	1.707
Social media	.573	1.745
Other first language than English	.355	2.820
From which health care provider	.461	2.170
Annual household income	.244	4.097
Private Health Insurance	.359	2.783
Urban or rural	.503	1.989
Primary health care provider	.560	1.784
Immunization with the HPV vaccine is safe for my child and the benefits outweigh the risks.	.267	3.748
My friends and family encouraged me to immunize my child with the HPV vaccine.	.300	3.328
I should immunize my child with the HPV vaccine to help protect others.	.282	3.554
Many people in my community do not immunize their children with the HPV vaccine.	.711	1.407
I have religious beliefs that influenced my decision regarding immunizing my child with the HPV vaccine.	.530	1.888
I feel that there is an immediate need to immunize my child with the HPV vaccine.	.277	3.615
I feel that it is more important to vaccinate girls than boys with the HPV vaccine.	.685	1.459
My child's family doctor or other primary health care provider discussed the importance of the HPV vaccine with me.	.278	3.597
I am concerned that the HPV vaccine with lead my child to engage in earlier or riskier sexual behavior	.675	1.482

My child is not sexually active, so I don't believe there is a need to vaccinate him/her with the HPV vaccine at this time.	.501	1.994

The fourth assumption to be satisfied was that there are no outliers. The Cook's Distance method is an estimate of the size of influence a data point exerts on the model. Utilizing the 4/*n* general rule of thumb for Cook's Distance the threshold for this data set is .004. The maximum Cook's Distance was .015 as demonstrated in Table I2.

Table I2

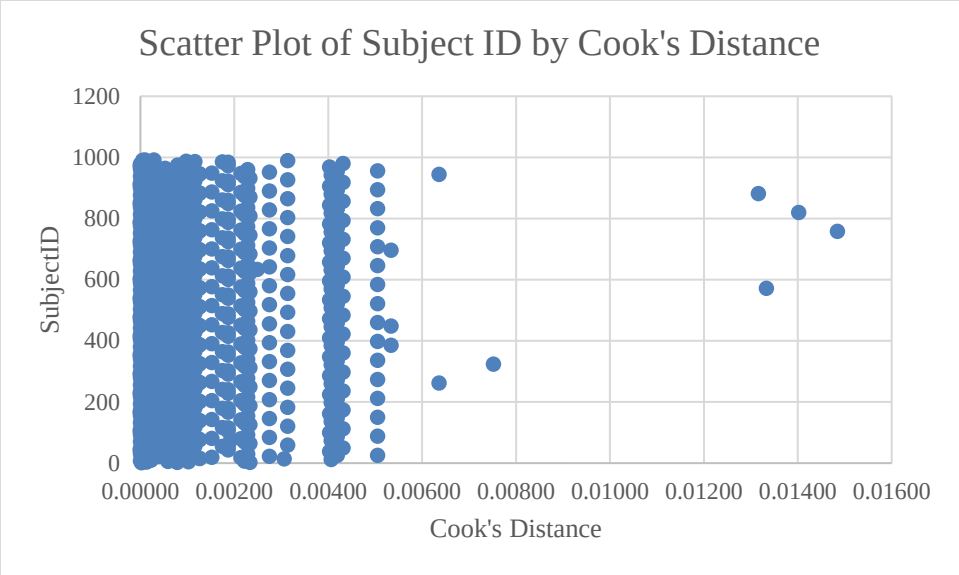
Cook's Distance Method

	Minimum	Maximum	Mean	Standard Deviation	N
Cook's Distance	.000	.015	.001	.002	992

Outliers above the .004 calculated threshold were investigated to ensure that the identified outliers would not exert undue influence on the logistic regression line. This was performed by visual inspection of an SPSS generated scatter plot of the Cook's Distance outputs (x-axis) and individual study subject study IDs (Figure 8).

Figure 8

Cook's Distance by Subject ID



The scatter plot revealed that there were a number of observations that were clear outliers above the .004 threshold and a number of other observations that were close to the threshold. To identify the specific cases, all study subjects were identified and sorted by their calculated Cook's Distance in the data view of SPSS. All study subjects who had a rounded Cook's Distance of .004 were retained and all individual subject IDs that recorded a Cook's Distance output of $\geq$ .00505 were removed from the regression analysis. The following 26 records were removed from the regression analysis (758, 820, 572, 882, 324, 262, 944, 386, 448, 696, 26, 88, 150, 212, 274, 336, 398, 460, 522, 584, 646, 708, 770, 832, 894 and 956) which resulted in 966 cases available for the regression analysis.

The fifth assumption to the satisfied is that there is a linear relationship between the explanatory variable and the logit of the response. This can be determined by

conducting a Box-Tidwell procedure. In SPSS the independent variables were transformed using the natural log of each variable and then multiplied by the value of the variable. A binary regression analysis was performed using only the transformed variables. The output demonstrated that all values were not significant which indicates that the assumption of a linear relationship was met (Table I3).

Table I3

Box-Tidwell Procedure Demonstrating the Transformed Logit Is a Linear Function of the Predictor

	B	*SE*	*Wald*	*df*	*Sig.*	*Exp(B)*
Parent's Sex	21.350	1595.958	.000	1	.989	1872230902.094
Parent's Age	1.051	163.382	.000	1	.995	2.860
Ethnic origin	-2.092	1274.540	.000	1	.999	.123
Immigrant status	41.604	5057.095	.000	1	.993	1.171E+18
Highest level of school completed	-13.306	730.250	.000	1	.985	.000
Relationship status	-3.902	614.978	.000	1	.995	.020
Social media	14.285	3338.671	.000	1	.997	1599704.099
Other first language than English	.625	3976.118	.000	1	1.00	1.869
From which health care provider	1.777	1016.875	.000	1	.999	5.913
Annual household income	14.320	2367.349	.000	1	.995	1656453.231
Private Health Insurance	9.644	7917.916	.000	1	.999	15422.593
Urban or rural	8.477	1473.343	.000	1	.995	4804.104
Primary health care provider	10.060	2533.675	.000	1	.997	23394.941
Immunization with the HPV vaccine is safe for my child and the benefits outweigh the risks.	10.087	1855.989	.000	1	.996	24035.365
My friends and family encouraged me to immunize my child with the HPV vaccine.	-11.524	2271.767	.000	1	.996	.000
I should immunize my child with the HPV vaccine to help protect others.	-5.256	2179.413	.000	1	.998	.005

	B	*SE*	*Wald*	*df*	*Sig.*	*Exp(B)*
Many people in my community do not immunize their children with the HPV vaccine.	-15.092	3006.407	.000	1	.996	.000
I have religious beliefs that influenced my decision regarding immunizing my child with the HPV vaccine.	11.227	2892.293	.000	1	.997	75144.232
I feel that there is an immediate need to immunize my child with the HPV vaccine.	-3.161	1415.432	.000	1	.998	.042
I feel that it is more important to vaccinate girls than boys with the HPV vaccine.	4.117	2341.704	.000	1	.999	61.394
My child's family doctor or other primary health care provider discussed the importance of the HPV vaccine with me.	-12.870	1813.830	.000	1	.994	.000
I am concerned that the HPV vaccine with lead my child to engage in earlier or riskier sexual behavior	-16.365	3777.426	.000	1	.997	.000
My child is not sexually active, so I don't believe there is a need to vaccinate him/her with the HPV vaccine at this time.	1.994	2540.488	.000	1	.999	7.348
Constant	-243.231	29994.047	.000	1	.994	.000