CANCER PREVENTION AND THE HUMAN PAPILLOMAVIRUS VACCINE: PSYCHOSOCIAL AND BEHAVIOURAL FACTORS INVOLVED IN VACCINATION DECISION-MAKING

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February 2012

A thesis submitted to McGill University in partial fulfilment of the requirements of the degree of Doctorate of Philosophy

Dedication

To my parents, Paulina and Eduardo

To my grandfather, Motel

To my beloved husband, Isra

Acknowledgements

This dissertation would not have been possible without numerous people who have played an intrinsic part in its completion in multiple ways, be it scientific, technical, statistical, financial, emotional, as well as spiritual. Being unable to name all of those who have helped me in the last six years, I would like to express my warmest gratitude to the following special people.

First, I would like to express my profound thanks to my supervisor Dr. Zeev Rosberger for his immense support and encouragement. His wisdom combined with his sense of humour helped me, during these challenging years, not only to navigate through challenging waters but also to enjoy the trip. Thank you, Zeev, for believing in me and referring to me as Dr. Krawczyk, already on the first day of graduate school. Thank you for your countless mentorship stories. Thank you for fostering and inspiring my development as a dedicated scientist and a well-trained and compassionate clinical psychologist. I thank you, Zeev, for your patience, strength, empathy, humour and wisdom. Zeev, muchas gracias!

I am truly appreciative and thankful also to Bärbel Knäuper and Richard Koestner, my thesis committee members. Thank you, Bärbel, for your guidance and support, your inspiring ideas and insights and your prompt and caring answers to my questions and concerns. Thank you, Richard, for your warm and encouraging feedback, for being there for me from the beginning, for your generous advice and for supporting and encouraging my autonomy and development as a researcher. I feel extremely privileged to have had both of you as mentors in my career.

I would like to express my deepest gratitude to Carmen Loiselle, Director of the Psychosocial Oncology Research Training Program (PORT) for her support, inspiration and the encouragement to use creativity in my research. Carmen, thank you for believing in my potential as an independent researcher. I also want to thank all the other wonderful mentors from PORT, in particular, Joan Bottorff, Thomas Hack, Lynda Balneaves and Mary Jane Esplen.

A warm thank you to Andrew Ryder, who co-supervised my undergraduate thesis at the University of British Columbia and taught me not to be afraid of factor analysis. Andrew, I thank you for your wise advice, your encouragement to present, for the first time in my life, a poster at an academic conference. For your continuing mentorship and your friendship, I thank you warmly.

I would like to thank Rhonda Amsel, Christina Holcroft, Manale Ouakki and Brett Thombs for their statistical advice, kindness and patience.

Special thanks to the collaborators from the Institut National de Santé Publique du Quebec, in particular Ève Dubé and Vladimir Gilca, for their great help, support and expertise that allowed the development and successful completion of the province-wide study of HPV vaccination decision making.

This dissertation would not have been possible without the help and support of collaborators, senior researchers, students and assistants from the Rosberger lab. Thank you, Eduardo Franco, Phyllis Zelkowitz, Teodora Constantinescu, Ellen Stephenson, Samara Perez, Elsa Lau, Vanessa Delisle, Sara-Lyn Moore, Andrea Feldstain, Elisha Morrison, Reena Tabin, Laurence Girouard, Sophie Label, Roxane Robitaille, Lina Di Dio, Caroline Camateros,

Kevin Junghwan Dong, Zachary Frenkiel, and Norris Miller; in many different ways all of you have helped so much in the development of my career and my research. A particular thank you is due to Johanne Archambault for her constant practical and emotional support, for having the right solution for every problem, and for her heart-warming smile. Thank you, Johanne, for all your help and for translating, into French, the abstract of this dissertation.

I owe sincere and earnest gratitude to all the professors and mentors that have inspired my desire and curiosity in academic research though their classes and mentorship advice including Peter Suedfeld, Steve Heine, Wolfgang Linden, Peter Graff, Eric Eich at the University of British Columbia, and Robert Pihl, Judith Le Gallais, Robin Cohen, Irving Binik, Blaine Ditto, Heungsun Hwang, Debbie Moskowitz, Gillian O'Driscoll, and Laurence Kirmayer at McGill University.

For their supervision, guidance, and teaching clinical practice at the Jewish General Hospital, I would like to thank Judith Gradinger, Caminee Blake, Sharon Bond, Ronald Feldman, Barbara Hayton, Sylvain Néron, Michael Bond, Evan Brahm, Marsha Heyman, and Ashley Wazana. Likewise, I want to thank Jonathan Keeley, Thomas Milroy and Ann Gamsa at the Montreal General hospital. In particular, I want to express my immense gratitude to Liliane Spector, my inspirational internship supervisor at the Jewish General Hospital and Richard Karmel, who was the previous director of the Montreal General Hospital psychology internship program and a very dear friend.

My graduate experience would not have been the same without the warmth and support of many wonderful friends who I met at McGill, in clinical

internships, and at conferences. In particular, my friends Gentiana Sadikaj, Deborah Tang, Geneviève Taylor, Julie Laurin, Julia Di Nardo, Lisa Bradford, Sarah Katz, Clare Macdonald, Magdalena Barrera, Lauren Ban, Elena Pérez Hernández, Sylvie Lambert, Rose Matousek, and Anna Levin.

Also, I thank Giovanna LoCascio, Psychology Graduate Program Coordinator, and Chantale Bousquet, Clinical Program Secretary, for their support, great energy, and kindness.

A warm thank you to other mentors and dear friends who, during these years, have inspired and supported me, including Rhona Bezonsky, Bebe Postner, Meryl Elman, Jorge Palacios-Boix, Toby Ryder, Gabi Rosberger, and Amir Raz.

Thank you for the immense help I have received from Samara Perez, Ellen Stepenson, Rhona Bezonsky, and Bruce Peterson in proof-reading this dissertation.

I am extremely grateful to the founding agencies who supported the present research, The Canadian Institute of Health Research (CIHR), The Psychosocial Oncology Research Program (PORT), and Fonds de la recherche en santé du Québec (FRSQ).

Thank you, Violeta Bava, for your friendship during the past seventeen years. Thank you Luciana, Tamara, Silvana, Marina, Robert, Mariana, Hilda, Julia, Paula, and all my beloved family and friends in Argentina, Vancouver, and around the world.

I am so grateful to have such a wonderful and caring family who, despite the physical distance, are always close to me. Thank you, Tía Eva and Tío Tulio, and thanks also to my cousins Eduardo, Patricia, Javier, Nahuel, Daniel, Diana

and Dylan. A special thank you to Laura for her emotional support and to Alicia for her advice and guidance throughout the final stages of writing this dissertation.

A special thank you also to my sister Marina Krawczyk, whose strength, professionalism, and caring have been a great inspiration in my life. Thank you, Maru, for always being there when I needed you the most.

My eternal gratitude goes to my parents, whose selflessness and generosity have allowed me to explore the world and pursue my dreams. Papá, your passion for arts and sciences as well as your valuing of education have inspired me to be curious and to enjoy the world around me. You have taught me the value of hard work and persistence necessary for achieving my goals and overcoming any obstacle. Mamá, thank you for being such a caring person and for always reminding me to pursue my dreams. For your unconditional love and support, Mamá and Papá, thank you!

Last, but not at all least, I am forever grateful to my beloved husband, Israeli Ran, for his infinite support and encouragement, for being my biggest fan and my best friend, for his enormous amount of help and feedback on my academic writing, for making me laugh just by clapping his hands, and for his patience, unconditional love, and wisdom. I thank him for being there always, during happy moments as well as at difficult times. Also, I thank him for being such a good salsa dancer, samba musician, comedy writer, cook as well as critical and curious neuroscientist, loving partner and future amazing father. His love and support have given me the extra strength needed to start and finish this dissertation. The source of my joy, the love of my life, thank you, Isra.

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Contribution of authors

As the first author on the four manuscripts, I developed the research questions, hypotheses, and designs for the four studies. I took the lead on selecting and creating all questionnaires and developing Study 3's intervention. I coordinated and supervised running of participants through the intervention protocol. I ran statistical analyses and wrote first drafts of all manuscripts incorporating suggestions from co-authors on subsequent drafts. I also selected academic journals and led the submission of all manuscripts to the selected journals. Zeev Rosberger, my supervisor and the senior author on the four manuscripts, offered invaluable guidance throughout all phases of the studies, helping me to hone the procedures and perfect the interventions. He also offered important suggestions for statistical analyses. He read and edited numerous drafts of each article and gave critical feedback and suggestions on all aspects of this dissertation. Bärbel Knäuper, one of my committee members, was a co-author on Manuscripts 1 and 4, offered invaluable suggestions, proposed data interpretation, and edited several drafts of the manuscripts. Rhonda Amsel, statistics consultant and faculty lecturer at McGill University, co-authored Manuscripts 1 and 3. She provided statistical advice and reviewed the manuscript. Christina Holcroft, a statistical consultant at the Jewish General Hospital, was a co-author of Manuscript 1. She provided critical input on the study design and data analysis. Samara Perez and Elsa Lau, research assistants from Dr. Rosberger's Psychosocial Oncology (PSO) laboratory provided help with statistical analysis and assistance with the editing and rewriting Manuscripts 1, 2, and 3. Ellen

Stephenson, also a research assistant at the PSO lab significantly contributed to Manuscript 2 by assisting with data analyses and writing parts of the manuscript. She also provided critical assistance with the publication process for all papers. Vanessa Delisle, first as an undergraduate student at the PSO lab and later as research assistant, was a co-author on Manuscript 3. She participated in the protocol development, data collection, and preliminary data analyses. She also gave her input on the final draft of the manuscript. Éve Dubé and Vladimir Gilca**,** collaborators from the Institut National de Santé Publique du Quebec, were co-authors of Manuscript 4 and helped with the planning of the study design, implementing the study protocol, collecting the data, interpreting the studies' results, and editing the manuscript.

Statement of original contribution

This research constitutes an original contribution in the exploration of factors influencing HPV vaccination decision-making in young adults and in parents deciding to vaccinate their daughters. To date, in the HPV vaccination literature, many studies have explored people's HPV vaccination intentions as an indirect investigation of actual vaccination behaviour. Furthermore, there has been a lack of studies using theoretical frameworks. Using a theoretical framework, the present dissertation's major contribution was to explore not only vaccination intentions but also vaccination behaviours in several populations including young adults and parents of young girls.

Study 1 is the first study in the literature to compare predictors of HPV vaccination intentions and actual behaviours in young women. This study contributes to the field by demonstrating that differences exist between correlates of intentions and behaviours. Study 2 is the first study to evaluate the difference between factual knowledge and perceived knowledge on the HPV vaccine in men. This study contributes to the field by differentiating between objective HPV knowledge, objective HPV vaccine knowledge, and perceived knowledge. The study results indicated that perceived knowledge and objective HPV vaccine knowledge were associated with vaccination intentions. Study 3 is original in that it compares two modalities of psychosocial interventions (written and video) designed to increase vaccine acceptability using a randomized controlled design. The contribution of this study is the final development of two effective HPV educational interventions. Finally, Study 4 is the first to evaluate differences

between parents who accepted or rejected the HPV vaccine for their daughters in the context of a universal program in Quebec. The study contributes to the field by demonstrating that vaccination safety is a critical factor in parental HPV vaccination decision-making. In sum, the present program of research constitutes a unique contribution to knowledge and understanding of cancer prevention behaviour.

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Abstract

The purpose of the present thesis was to examine psychosocial and behavioural factors associated with the decision-making process involved in uptake of the human papillomavirus (HPV) vaccine. In Canada, the HPV vaccine has been approved for women and men aged 9 to 26. Using the health belief model as a primary theoretical framework, the present dissertation examined knowledge, attitudes, and beliefs of young adults making a vaccination decision for themselves and of parents making a vaccination decision for their daughters.

Study 1 consisted of a cross-sectional survey exploring correlates of HPV vaccination among female university students who did not intend to receive, intended to receive, or had received the vaccine. The study results showed that social influences were important and unique factors related to young women's vaccination uptake.

Study 2 examined male university students' knowledge and future vaccination intentions. The study differentiated between objective HPV knowledge, objective HPV vaccine knowledge, and perceived knowledge. The study results indicated that perceived knowledge and objective HPV vaccine knowledge were associated with vaccination intentions. Further, perceived knowledge was associated with young men's vaccination intentions even when accounting for objective HPV and HPV vaccine knowledge.

Study 3 used a randomized controlled design to compare two types of educational interventions (written and video) designed to increase knowledge and acceptability of the HPV vaccine in both male and female university students. The study results showed that both the written and video interventions were effective

in improving knowledge and vaccination intentions. However, no differences were found between the two intervention modalities.

Finally, Study 4 identified key differences between parents who accepted and parents who refused the HPV vaccine for their young daughters. The study results indicate that perception of vaccine safety was the strongest factor associated with parental vaccination acceptance.

Collectively, these four studies showed that HPV vaccination decision-making is a complex process and that perception of vaccine safety as well as social influences may be critical components of HPV vaccination decisions. Future research should build on these results by developing and testing comprehensive theories of vaccination decision making that include behavioural, social, and cognitive factors.

Résumé

Cette thèse a pour but d'examiner les facteurs psychosociaux et de comportement, associés à la décision de recevoir ou non le vaccin contre les virus du papillome humain (VPH). La vaccination VPH est approuvée au Canada pour les femmes et les hommes de 9 à 26 ans. En utilisant le modèle de croyance de la santé comme cadre théorique premier, la thèse étudie la connaissance, les attitudes et les croyances des jeunes femmes et hommes dans leur décision quant à la vaccination VPH, tant pour eux-mêmes que pour les parents qui auront à décider pour leurs filles.

L'étude 1 met en évidence la corrélation de la vaccination VPH chez les étudiantes universitaires qui n'avaient pas l'intention de se faire vacciner, qui auraient eu l'intention de recevoir le vaccin, ou qui avaient été vaccinées. Les résultats démontrent que les influences sociales sont des facteurs importants et uniques influençant les jeunes femmes à recevoir le vaccin.

L'étude 2 examine les connaissances et les intentions des étudiants universitaires de recevoir éventuellement le vaccin. L'étude a démontré une différence entre une connaissance objective du VPH, une connaissance objective du vaccin VPH et une connaissance perçue. Les résultats de l'étude indiquent qu'une connaissance perçue et objective du vaccin était associée aux intentions de recevoir le vaccin. De plus, la connaissance perçue était associée aux intentions de vaccination des jeunes hommes en ayant comme objectif les connaissances du VPH et de son vaccin.

L'étude 3 a utilisé un modèle de contrôle randomisé, afin de comparer deux types d'interventions éducationnelles (à l'écrit et par vidéo) afin d'augmenter la connaissance et l'acceptabilité de la vaccination VPH, tant chez les étudiantes que chez les étudiants à l'université. L'étude démontre que les deux méthodes (l'écrit et le vidéo) ont été efficaces à promouvoir la connaissance et les intentions de vaccination. Toutefois il n'y a aucune différence entre les deux modes d'intervention.

Finalement, l'étude 4 a identifié les facteurs clés entre les parents qui ont accepté, et ceux qui ont refusé le vaccin VPH pour leurs jeunes filles. Les résultats de l'étude démontrent que la perception de la sécurité du vaccin était le facteur le plus important, associé à l'acceptation de la vaccination chez les parents. Collectivement, ces quatre études ont démontré que la prise de décision concernant la vaccination du VPH est un processus complexe, et que la perception de la sécurité du vaccin, ainsi que les influences sociales, sont des composantes critiques en ce qui concerne la prise de décision pour la vaccination VPH. Des études ultérieures devraient se baser sur ces résultats, en développant et en mesurant des théories compréhensives pour la prise de décision dans la vaccination, tout en incluant les facteurs sociaux, cognitifs, et de comportement.

GENERAL INTRODUCTION

History of vaccination: Who's afraid of the shot?

Since the development of the first immunization in the beginning of the nineteenth century, vaccines have taken their place among the most important advances in the history of medicine by preventing many fatal diseases that were previously thought to be unpreventable. Through mass inoculations, vaccines have contributed to the virtual eradication of feared diseases as small-pox, and polio. In the twenty-first century, new developments in vaccine research hold promise for protecting against diseases such as AIDS or cancer. However, since the beginning of vaccine development, public health programs have often generated much fear and controversy. After more than two hundred years of immense success, similar controversies and fears remain regarding new vaccines.

The present dissertation focuses on the psychosocial factors related to acceptance of the recently developed human papillomavirus (HPV) vaccine, a vaccine that, in the long run, could prevent several types of cancers and associated diseases. In particular, two important populations are being explored: young women and men making vaccination decisions for themselves and parents making vaccination decisions for their daughters. Understanding factors that affect decision making regarding the HPV vaccine is critical for overcoming barriers to vaccination uptake and to ensure informed decision making.

"Life is a sexually transmitted disease and the mortality rate is one hundred percent."

Ronald David Laing

The Human Papillomavirus

The human papillomavirus (HPV) is a communicable virus, with over 150 strains of which approximately 40 are known to be sexually-transmitted (National Advisory Committee on Immunization, 2007). Most HPV infections clear spontaneously through natural immune response or remain dormant without causing any health problems (Tota, Chevarie-Davis, Richardson, deVries, & Franco, 2011). However, some persistent strains of sexually transmitted HPV can cause anal and genital warts; abnormal lesions of the cervix (dysplasias); cervical, penile, or anal cancers; and cancers of the head and neck (Chaturvedi, 2010; Moscicki, 2011; Shuman & Wolf, 2010).

Sexual intercourse is the most common way that the virus is transmitted. However, HPV can also be spread through skin-to-skin contact with a person who is infected with the virus during a sexual encounter without penetration. Because HPV infections are frequently asymptomatic, it is possible to spread the virus unknowingly. Furthermore, HPV can be transmitted from a mother to her child during delivery (Castellsague et al., 2009).

HPV is the most common sexually transmitted infection (STI) worldwide with highest infection rates in women under 25 years old (Baseman & Koutsky, 2005). Because in most cases individuals infected do not present any symptoms, the HPV has been referred to as "the silent epidemic" (Krishnan, 2008). It is

estimated that more than 70 percent of sexually active Canadian men and women will have a sexually transmitted HPV infection at some point in their lives (Baseman & Koutsky, 2005). Currently, approximately 10% to 30% of sexually active Canadian adults are infected with HPV (Society of Obstetricians and Gynaecologists of Canada, 2011b).

HPV can be detected using HPV DNA testing prior to the development of pre-cancerous lesions or genital warts. HPV testing is more sensitive (but less specific) than regular cytology screening (Ronco et al., 2010). However, the test is relatively new and not readily available for females in North America. Testing guidelines and accessibility vary in different parts of Canada, and HPV testing is not recommended as part of a women's routine screening or for women aged under 30 (Society of Obstetricians and Gynaecologists of Canada, 2011a). If they wish and can afford it, in some parts of Canada, females can pay privately for the test. Private testing costs approximately $100. Currently, there is no approved HPV test available for men in Canada (Society of Obstetricians and Gynaecologists of Canada, 2011a), however it will likely exist in the near future (Marhefka et al., 2012)

Once a person is infected with HPV there is no cure, but as previously mentioned, in most cases the immune system clears the virus or the virus remains dormant without causing any symptoms. Even in cases when HPV does not cause life-threatening diseases, a patient infected with the virus may face significant emotional, physical, and social consequences. Conditions such as genital or anal warts, as well as cervical pre-cancerous lesions usually involve uncomfortable or painful treatments and negative emotional consequences such as shame, guilt, and

anxiety. Furthermore, receiving a diagnosis of HPV can generate psychological distress (Anhang, Goodman, & Goldie, 2004). Patients are required to make choices about communicating the diagnosis to their sexual partners and potentially having to change their sexual habits. Patients may also experience distress regarding the uncertainty about the long-term consequences of the virus (Anhang et al., 2004).

HPV and cervical cancer

Cervical cancer is the third most common cancer among woman worldwide with an estimated 530,000 cases and 275,000 disease-related deaths in 2008 (Arbyn et al., 2011). In Canada, cervical cancer is the thirteenth most common cancer, about 1300 women are diagnosed annually and approximately 350 women die from the disease (Canadian Cancer Society, 2011). Cervical cancer precursors are currently detected using Papanicolaou (Pap) test. Pap test has been successful in decreasing cervical cancer rates, in particular, in developed countries where resources are available (Arbyn et al., 2011).

In 1976, Harald zur Hausen, a German virologist, hypothesized that HPV played an important role in the cause of cervical cancer. After eight years of research, HPV types 16 and 18 were identified as primary precursors of cervical cancer (Zur Hausen, 1977). This discovery lead to the development of HPV vaccines, that protect against two oncogenic types of HPV.

The HPV vaccine: A breakthrough in cancer prevention

"A good doctor treats disease.

A better doctor detects it.

The best doctor prevents it in the first place."

Anonymous

The development of HPV vaccines has been the biggest breakthrough in primary prevention of cervical cancer. Although these vaccines are not the first to protect against cancer (cf. protective effects of Hepatitis B vaccine against liver cancer), it has received a lot of media attention, in particular for its protection against a virus that is exclusively sexually transmitted. These vaccines were also marketed as a "cancer protection vaccine" which increased media attention.

In Canada, the first prophylactic vaccine against HPV, Gardasil, was approved in 2006 and a second vaccine, Cervarix, was approved in 2010 (Health Canada, 2010b). Both vaccines provide protection against HPV strains 16 and 18, two high-risk types of HPV responsible for approximately 70 percent of cervical cancer. In addition, Gardasil provides protection against HPV strains 6 and 11, two low-risk types responsible for 90 percent of genital and anal warts. Gardasil is approved for females and males aged 9 to 26, and Cervarix, is approved for females aged 10 to 25.

The Canadian National Advisory Committee on Immunization (NACI) and The Canadian Immunization Committee (CIC) recommend the HPV vaccine to be administered to females between 9 and 13 years of age, prior to onset of

sexual activity for most females (Canadian Immunization Committee, 2007; National Advisory Committee on Immunization, 2012). Notably, older women may still benefit from the vaccine as long as they have not been previously infected with the vaccine's targeted HPV strains. Due to a lack of data, the HPV vaccine is not recommended during pregnancy or for females or males under 9 years of age.

The HPV vaccine was declared safe by the Public Health Agency of Canada (National Advisory Committee on Immunization, 2007, 2012). Vaccines are approved in Canada after strict evaluations of clinical trials. Reports from these trials state that the only side effects found to be linked to the HPV vaccine were temporary soreness at the injection site, fever, and headache. The vaccine contains no virus, and it is, thus, non-infectious. Also, both Gardasil and Cervarix are free of any preservatives or antibiotics (e.g. thimerosal or mercury; Dawar, Deeks, & Dobson, 2007). Cervarix contains a special new type of adjuvant that has been demonstrated to be safe (Garson, Chomez, & Van Mechelen, 2007).

In 2006, the Canadian government provided $300 million to the provinces and territories over three years to establish their own HPV immunization programs (Cancer Advocacy Coalition of Canada, 2008). Several universal vaccination programs that target pre-adolescent girls were implemented in Canada. In provinces like Ontario, uptake of the vaccine has been as low as 50% in some areas for the first year (Smith et al., 2011). Notably, the currently available HPV vaccines do not protect against all cancer-causing types of HPV. Thus, all women, including those who have been immunized, should continue to undergo regular cervical cancer screening (i.e., Pap tests; Health Canada, 2010a).

HPV and Sex

Because HPV is sexually transmitted, the only way to guarantee 100 percent prevention of HPV is not to engage in sexual activity or to limit sexual contact to partners who have not previously engaged in sexual activity. But even if a women or a man is sexually abstinent until marriage, it is still possible to contract the infection from an infected spouse. Condoms do not completely protect against HPV because HPV can infect genital areas that a condom does not cover (Manhart & Koutsky, 2002). However, they are still recommended to reduce the chances of transmission and to provide protection against other STIs.

Other HPV primary prevention strategies have focused on reducing the chances of contracting the virus by suggesting delaying the age of sexual activity, reducing the number of sexual partners, and maintaining monogamous relationships. Sexual abstinence is promoted by several religious and political groups. Education is a key component of disease prevention, and the Canadian government and professional institutions support and foster sexual health education programs including education on HPV and the HPV vaccine (Public Health Agency of Canada, 2010).

The HPV Vaccine Controversy: Sex, Money, and Politics

"Sex education may be a good idea in the schools, but I don't believe the kids should be given homework"

Bill Cosby

"Our girls are not guinea pigs" was the provocative title of an article published on August 27th of 2007, in *Maclean's*, a popular English Canadian magazine (Gulli, 2007). Referring to HPV vaccination programs in Canada, the article questioned: "Is an upcoming mass inoculation of a generation unnecessary and potentially dangerous?" (Gulli, 2007). The HPV vaccine aroused a heated controversy among various sectors (e.g. religious, political, anti-vaccination groups, and a small part of the scientific community).

One of the primary concerns for the newly developed HPV vaccine was related to its safety. Although several clinical trials demonstrate that the HPV vaccine is safe and on par with standards of most national and international health organizations, many individuals continue to be afraid of the possible future consequences of the vaccine. Some of these fears were based on people's memories of previously approved drugs (e.g.Vioxx) that were after taken off the market. In addition, unfounded early studies which related the vaccine to a high incidence of autism (The Editors of The Lancet, 2010; Wakefield et al., 1998) later followed by several lawsuits still cause some fear of new childhood vaccines among some parents (Poland & Jacobson, 2001).

Published articles questioned many uncertainties related to the HPV vaccine (Lippman, 2008; Lippman, Boscoe, & Scurfield, 2008; Lippman, Melnychuk, Shimmin, & Boscoe, 2007). Lippman (2007) stated that there is not enough evidence regarding the duration of protection for a given patient, whether a booster shot would be necessary, or how the HPV vaccine would interact with other immunizations. Also, the author pointed out questions regarding the conflict of interests underlying the clinical trials (supported by the manufacturer) and the high cost of the vaccine and impact on health care system. Finally, she discussed "unintended negative consequences," including an increase in cervical cancer rates due to false sense of security (leading young women to stop screening themselves regularly for cervical cancer).

Although it is true that the overall duration of immunity provided by the vaccine is not yet known, it is shown to last for at least 7 years (Villa, 2011). More data will become available with follow up studies. Ongoing studies are continually conducted to determine if further immunization is needed for vaccinated women and men to have continued protection.

In addition, political issues also are related to the vaccine controversy. Some groups are suspicious of the true intention of pharmaceutical companies because of their perceived focus solely on commercial gain. In United States, the governor of Texas in 2007, tried to mandate vaccination against HPV for schoolgirls. However, because the pharmaceutical company who developed the HPV vaccine was a generous donor to the governor's campaigns, some sections of the population in Texas, reacted with mistrust and anger and mandatory vaccination was not approved. Further, in this case, mandatory vaccination

conflicts with people who believe that the government should not interfere with private matters.

Research shows that despite lack of evidence, some parents fear about the sexual consequences of the HPV vaccine for their daughters. These fears have been particularly emphasized in the media. For example, some parents reported being afraid that the vaccine will send the "wrong message" to their daughters (it will endorse sexual activity at an early age) or promote sexual activity and even promiscuity. Other reports suggest that parents think because their daughters are not sexually active, their daughters are simply "too young" to be vaccinated, and thus, prefer to delay vaccination. Finally some religious groups prefer to advocate abstinence instead of vaccination.

Practical issues regarding the HPV vaccine also generated great controversy. Because the vaccine is expensive (about 450$ for 3 shots) people who are not covered by the provincially-funded program or private insurance cannot have access to vaccination. Also, the vaccine requires 3 doses and in cases of limited access to the medical system completion of the vaccination schedule can sometimes be delayed. There has been some controversy regarding priorities on publicly funded programs suggesting that government budget should be allocated in secondary prevention (Pap test) and not in vaccination. Last, next-generation vaccines are coming soon and some parents prefer to wait.

Finally, the HPV vaccine raises some social dilemmas. Vaccines only work to eradicate diseases if most individuals receive the vaccine. Incidence of cervical cancer has fallen dramatically in high resource countries, where routine screening measures (Pap test) are widely available. However, cervical cancer

remains a major public health concern in developing countries – where the HPV vaccine would make its biggest impact.

Despite the controversy mainly presented by anti-vaccination groups or isolated academics, the HPV vaccine has been welcomed by the scientific community and governmental health agencies worldwide. Overall most parents and young adults have a positive view of vaccines in general and the HPV vaccine in particular. However due to the novelty of the vaccine, doubts about the vaccine, knowledge, attitudes, and beliefs were identified as factors related to intentions and uptake of the HPV vaccine.

"To V or not to V": Acceptability of the HPV vaccine

The conceptual model of parental decision-making (Sturm, Mays, & Zimet, 2005) was used to guide the literature review. This model suggests that decision-making regarding vaccination may be influenced by personal factors, social-environmental factors, the family's interface with the health care system, institutional policies and interventions, and the physical environment (Sturm et al., 2005). Personal factors refer to parents' attitudes and beliefs about vaccination and the vaccine-preventable disease; social-environmental factors consist of cultural attitudes and beliefs about vaccination as well as the norms of parents' social groups; the family's interface with the health care system consists of the attitudes and practices of health care providers and the accessibility of quality health care to parents; institutional policies and interventions refer to the actions of societal or professional groups regarding vaccines; and the physical environment refers to the existing rates of the vaccine-preventable disease (Sturm

et al., 2005). Personal and social-environmental factors as well as the family's interface with the health care were found to be explored by many of the studies in the literature.

Personal factors

Attitudes and Beliefs about HPV and the HPV Vaccine:

The relation between perceived susceptibility (the subjective belief of personal/daughter vulnerability to HPV), perceived severity of HPV, and HPV vaccination intentions in parents and young adults appears to be inconsistent, with a few studies finding a positive relationship (Allen et al., 2009; Brabin et al., 2008; Jones & Cook, 2008; Ogilvie et al., 2010; Reiter, Brewer, Gottlieb, McRee, & Smith, 2009) and others studies finding no relation (Allen et al., 2009; Kahn, Rosenthal, Hamann, & Bernstein, 2003; Kahn et al., 2008). The majority of studies find that the perception of greater vaccination benefits (e.g., prevention of cervical cancer and/or HPV infection) and fewer barriers are related to intentions to receive the HPV vaccine (Allen, et al., 2010; Allen et al., 2009; Di Giuseppe, Abbate, Liguori, Albano, & Angelillo, 2008; Giede et al., 2010; Juraskova, Bari, O'Brien, & McCaffery, 2011; Mays, Sturm, & Zimet, 2004; Reiter et al., 2009; Waller, Marlow, & Wardle, 2006). STI stigma (Kahn et al., 2008), cost (Giede et al., 2010; Kahn et al., 2008; Zimet, Weiss, Rosenthal, Good, & Vichnin, 2010), fear of shots (Boehner, Howe, Bernstein, & Rosenthal, 2003), and adverse side effects (Allen, et al., 2010; Allen, Coronado, et al., 2010; Allen et al., 2009; Kahn et al., 2008; Kang & Moneyham, 2010; Sauvageau, Duval, Gilca, Lavoie, & Ouakki, 2007) have been found to be factors related to less likelihood of vaccination intentions. In particular, fear that HPV vaccine will have long term

negative health consequences is usually reported as a critical barrier (Dempsey, Zimet, Davis, & Koutsky, 2006; Humiston et al., 2009; Lenselink et al., 2008; Woodhall et al., 2007). Finally, some studies report parents' fears about vaccination impact on children sexuality (Davis, Dickman, Ferris, & Dias, 2004; Lenselink et al., 2008) (Ogilvie et al., 2007; Waller et al., 2006; Woodhall et al., 2007).

Across studies, positive attitudes toward HPV vaccination are consistently associated with HPV vaccination intentions (Allen et al., 2009; Kahn et al., 2008; Kang & Moneyham, 2010). Further, positive attitudes about vaccines in general have been shown to be related to HPV vaccine acceptability (Allen, et al., 2010; Ogilvie et al., 2010;Ogilvie et al., 2007). Subjective norms, the perception that significant others (e.g. peers, parents) approve vaccination, are consistently associated with HPV vaccination intentions in young adults (Allen et al., 2009; de Visser, Waites, Parikh, & Lawrie, 2011; Kahn et al., 2008; Kang & Moneyham, 2010).

Knowledge:

Knowledge of HPV and the HPV vaccine has been associated with vaccination acceptability in certain studies but not in others (Brewer & Fazekas, 2007). Given the relatively recent approval of the HPV vaccine, it is not surprising that people's knowledge is modest overall. The percentage of parents who had heard about HPV and the HPV vaccine greatly varied across studies but rose over time (Trim, Nagji, Elit, & Roy, 2012). However, it is not clear if greater levels of knowledge relate to greater vaccine acceptability (Brewer & Fazekas, 2007). Several studies have found a positive association between HPV and HPV

vaccine knowledge and vaccination acceptability of the HPV vaccine in parents and young adults (Allen, et al., 2010; Guerry et al., 2011; Hughes et al., 2009; Ogilvie et al., 2007; Woodhall et al., 2007) while others have not (Dempsey et al., 2006; Gerend, Weibley, & Bland, 2009; Lenselink et al., 2008). Overall parents report a desire for more information about HPV and the HPV vaccine (Lenselink et al., 2008; Waller et al., 2006). While it is intuitive that increasing knowledge regarding HPV and the HPV vaccine would be important in educating the public and, thus, increasing health awareness and acceptability of the vaccine, it may be the case that the increase in knowledge exerts its effect in the form of mediating the influence of individuals' perceptions of the severity, benefits, and barriers of the vaccine as opposed to directly influencing acceptability.

A fairly recent factor explored as a correlate of vaccination intentions and uptake is anticipated regret. Previous researchers have hypothesized that when people make decisions, they take into account the emotion that they anticipate they will experience as a result of the decision (Sheeran, Orbell, & Trafimow, 1999). If people anticipate they will experience regret, then they may be less likely to make the particular decision. Perceived regret has been found to be a predictor of vaccination uptake (Brewer et al., 2011). Previous vaccination practices has been also shown to be related to vaccination intentions and uptake (de Visser et al., 2011; Lenselink et al., 2008; Ogilvie et al., 2010; Ogilvie et al., 2007; Reiter, Cates, et al., 2010; Reiter, McRee, Gottlieb, & Brewer, 2011; Smith et al., 2011).

Social-Environmental Factors

Media and Vaccination Beliefs:

Cultural attitudes and beliefs about vaccines in general (Allen, et al., 2010; Ogilvie et al., 2010) as well as media influence (Hughes et al., 2009) have been shown to be related to vaccination acceptance.

The Family's Interface with the Health Care System

Physician Recommendation:

There is consistent evidence showing that a doctor's recommendation is one of the most important factors related to vaccination intentions (Allen et al., 2010; Brewer et al., 2011; Dempsey, Abraham, Dalton, & Ruffin, 2009; Gerend et al., 2009; Gottlieb et al., 2009; Guerry et al., 2011; Jones & Cook, 2008; Kang & Moneyham, 2010; Olshen, Woods, Austin, Luskin, & Bauchner, 2005 Reiter, 2009; Rosenthal & Zimet, 2010; Sauvageau et al., 2007). Other factors related to vaccination uptake are trust in health care providers and pharmaceutical companies (Allen, Othus, et al., 2010), regular visits to the doctor (Reiter, Cates, et al., 2010; Reiter et al., 2011) and past uptake of other vaccines (Reiter et al., 2011, Ogilvie et al., 2010, Smith et al., 2011).

Informed by the literature and using the health belief model (HBM) and theory of planned behaviour (TPB) as theoretical frameworks, the aim of Study 1 was to explore differences between correlates of young women's HPV vaccination intentions and uptake. The objective of Study 2 was to examine the relationship between HPV and HPV vaccine knowledge and young men's HPV

future vaccination intentions. The aim of Study 3 was to build on the previous findings by developing and comparing two modalities of an educational intervention (written and video) designed to increase HPV knowledge and vaccine acceptability. Finally, the aim of Study 4 was to identify key differences between parents who accepted and parents who refused the HPV vaccine for their daughters.

Manuscript 1:

Human Papillomavirus Vaccination Intentions and Uptake in College Women

Krawczyk, A. L., Perez, S., Lau, E., Holcroft, C. A., Amsel, R., Knäuper, B., & Rosberger, Z. (2012, January 23). Human Papillomavirus Vaccination Intentions and Uptake in College Women. *Health Psychology*. Advance online publication. doi: 10.1037/a0027012

Abstract

Objective: Using the health belief model (HBM) and theory of planned behaviour (TPB) as theoretical frameworks, the objectives of this study were: 1) to identify correlates of human papillomavirus (HPV) vaccination intentions and 2) to explore differences between correlates of HPV vaccination intentions and uptake.

Methods: Undergraduate females ($N = 447$) who did not intend to receive (n=223), intended to receive (n=102) or had received (n=122) the HPV vaccine were surveyed. Logistic regressions were conducted to examine the correlates of vaccination intentions and uptake.

Results: Negative health consequences of the vaccine, physician's recommendation, positive attitudes toward the vaccine, and subjective norms were significant correlates of vaccination intentions. When comparing correlates of vaccination intentions to correlates of vaccination uptake, physician's recommendation, subjective norms, and perceived susceptibility to HPV were unique correlates of uptake.

Conclusions: Differences between correlates of vaccination intentions and uptake suggest that social influences of liked and trusted individuals may make an important and unique contribution in motivating young women to receive the HPV vaccine beyond other variables from the HBM and TPB. Future utilization of longitudinal designs is needed to understand which factors may cause individuals to decide to receive the HPV vaccine.

Introduction

Considerable effort is being made worldwide to promote uptake of the human papillomavirus (HPV) vaccine, as evidence of its efficacy in preventing HPV infection is confirmed (Frazer, Leggatt, & Mattarollo, 2011). HPV is a sexually transmitted infection (STI), which can cause genital warts and cervical and other cancers (e.g., oropharyngeal, anal; Barr & Sings, 2008; Heffner & Schust, 2010). The highest prevalence rates for HPV infection have been found among women aged 20 to 24 (Dunne et al., 2007). National health organizations have approved two HPV vaccines (Gardasil™ and Cervarix™) for females aged 9 to 26 (Centers for Disease Control and Prevention, 2010; National Advisory Committee on Immunization, 2007). These vaccines have also been approved in several countries for adult women up to 45 years of age, as HPV is also prevalent among this age group (Bornstein, 2009). Given the approval and availability of the vaccine, women must evaluate multiple factors when engaging in the decision-making process to receive the vaccine.

The factors that are associated with females' intentions to receive the HPV vaccine have been explored in previous literature (Boehner et al., 2003; Gerend & Magloire, 2008; Jones & Cook, 2008). Two theoretical frameworks predominate in this literature: the health belief model (HBM) and theory of planned behavior (TPB; Allen et al., 2009; Kahn et al., 2003). The HBM states that individuals are more likely to engage in a health behavior if: they believe they are susceptible to the condition (*perceived susceptibility*); they believe the condition has serious consequences (*perceived severity*); they perceive greater *benefits* and fewer

barriers for taking the action; and they are exposed to influences that prompt action (*cues to action*; Janz & Becker, 1984). The TPB states that behavioral intention is determined by: more positive *attitudes* toward the behavior, approval of significant others for the behavior (*subjective norms*), and a sense of personal control over the behavior (*perceived behavioral control*; Ajzen, 1991). The majority of studies examining correlates of HPV vaccination intentions have used factors from these models, but very few have used these models in their entirety.

Overall, studies examining the relationship between HBM factors and intentions to receive the HPV vaccine have shown varied findings. There is consistent evidence showing that a doctor's recommendation (cue to action) is positively related to vaccination intentions (Boehner et al., 2003; Jones & Cook, 2008; Sauvageau et al., 2007). The majority of studies also confirm that females who perceive greater benefits (e.g., prevention of cervical cancer and/or HPV infection) and fewer barriers (e.g., cost, side effects) are more likely to intend to receive the HPV vaccine (Di Giuseppe et al., 2008; Giede et al., 2010; Juraskova et al., 2011). However, the relation between perceived susceptibility, severity, and HPV vaccination intentions appears inconsistent, with only a few studies finding a positive relationship (Allen et al., 2009; Jones & Cook, 2008). Studies assessing TPB factors suggest that positive attitudes toward HPV vaccination and the positive influence of significant others (e.g., peers, parents) are consistently associated with HPV vaccination intentions (Allen et al., 2009; Kahn et al., 2008; Kang & Moneyham, 2010). Research on the association between perceived behavioral control and HPV vaccination intentions is limited to one study

exploring parental intentions to vaccinate their daughters, in which perceived behavioral control was related to intentions (Ogilvie et al., 2007).

The relationship between intentions and action in health behaviors has long been of great interest to health psychologists. Intentions are often conceptualized as the precursors to action (Glanz & Rimer, 2005). However, intentions to engage in health behaviors may not directly translate into action (Gollwitzer & Sheeran, 2006; Webb & Sheeran, 2006). For example, it has been shown that lacking a concrete plan may hinder the attainment of desired behaviors (Gollwitzer, 1999). HPV vaccination decision-making research has to date focused mostly on exploring the factors that are related to vaccination intentions. In the past several years, there has been a shift in the HPV literature as researchers have begun investigating which factors are implicated in the prediction of *actual vaccine uptake* among young women (Allen et al., 2009; Bendik, Mayo, & Parker, 2011; Juraskova et al., 2011; Roberts, Gerrard, Reimer, & Gibbons, 2010; Rosenthal et al., 2011).

The evidence in the limited HPV vaccination uptake literature suggests that doctor recommendation and subjective norms are the only consistent predictors of HPV vaccine uptake (Allen et al., 2009; Conroy et al., 2009; Juraskova et al., 2011; Rosenthal et al., 2011). These two factors both affirm the important effect that liked and respected individuals have on young females' decision-making. Social influence is implicated as a critical theoretical factor in a wide range of preventive health behaviors (Cuijpers, 2002; Fisher, 1990; Lau, Quadrel, & Hartman, 1990). For example, the transtheoretical model of health behavior change (Prochaska & DiClemente, 1983), suggests that social influence

(e.g. realizing that society supports the health behavior, or finding people who are supportive of the behavior) is critical in the transition from preparing to perform a health behavior to taking action. The TPB and HBM also suggest that social factors (subjective norms and cues to action) are key contributors to the explanation of health behavior change.

The overall objective of this study was to identify which theoretically based factors differentiate between women who do not intend to receive the HPV vaccine, who intend to receive the HPV vaccine, and who have been vaccinated. Using the HBM and TPB as theoretical frameworks, the first hypothesis was that vaccination intentions would be correlated to: (a) higher perceived susceptibility to HPV, (b) higher perceived severity of HPV, (c) higher perceived benefit of the HPV vaccine, (d) lower perceived barrier to the HPV vaccine, (e) higher physician recommendation, (f) higher positive attitudes toward the vaccine, (g) higher positive subjective norms towards vaccination, and (h) higher belief in one's behavioral control.

While the HBM and TPB suggest that all the aforementioned factors would be associated with vaccination intentions as well as uptake, the second hypothesis was that only physician recommendation (cue to action) and the influence of significant others (subjective norms) would be significant correlates of vaccination uptake beyond the other factors in the model.

Method

Participants & Procedure

Four hundred and forty seven female undergraduates from McGill University participated in the current study. The mean age was 20 years (*SD* = 2.7; range 18-43). Participants were recruited from the McGill University Psychology Department participant pool, McGill University classes, printed posters, and online advertisements. All forms of recruitment and consent material stated that the study investigated factors that affect students' decision-making regarding health and sexuality. There was no mention of HPV or HPV-related information. Data was collected at a computer lab reserved solely for the purpose of this study. Participants provided informed consent and then completed a questionnaire in an online survey, which took approximately 30 to 45 minutes. Participants were debriefed and provided with a fact sheet about HPV and the HPV vaccine based on information from the Society of Obstetricians and Gynecologists of Canada (2009).

Individuals who were recruited from the psychology participant pool received one percent extra class credit as compensation. Those recruited through non-psychology classes and advertisements were compensated by having their name entered in a draw for a chance to win one of three $100 prizes. The McGill University Research Ethics Board-II approved the research protocol.

Measures

Participants were asked to provide basic demographic information and were asked questions regarding their sexual health history (e.g., age at first sexual intercourse). HPV and HPV vaccine awareness was assessed using the following

two questions which had a *yes* or *no* response option: "Have you heard of HPV?" and "Have you heard of the HPV vaccine?" Participants were also asked if they knew whether the vaccine cost was covered by either public or private health insurance, with *yes*, *no*, or *I don't know* as response options.

HPV and HPV vaccine knowledge was assessed with a 22-item scale adapted from previous studies (Dempsey, Gebremariam, Koutsky, & Manhart, 2008; Yacobi, Tennant, Ferrante, Pal, & Roetzheim, 1999). Sample items included: "HPV is sexually transmitted" and "the HPV vaccine helps prevent the development of cervical cancer". Participants answered *true*, *false*, or *I don't know* to each item. Correct responses were summed to create a total HPV and HPV vaccine knowledge score (ranging from 0 – 22).

Factors from the HBM and TPB were assessed using questions adapted from previous studies (Dempsey et al., 2008; Fazekas, Brewer, & Smith, 2008; Holcomb, Bailey, Crawford, & Ruffin, 2004; McRee, Brewer, Reiter, Gottlieb, & Smith, 2010; Rosen et al., 2010). In the present study, constructs that were measured using three or more items were assessed for internal consistency using Cronbach's alpha (which were all above .74). All sample items for each construct and Cronbach's alphas are shown in Table 1. Mean scores were calculated for constructs that were measured using more than one item. Participants answered on a continuous 7-point scale ranging from 1 (*strongly disagree*) to 7 (*strongly agree*) for the following constructs: (a) susceptibility to HPV (3 items), (b) severity of HPV (6 items), (c) benefit of receiving the HPV vaccine (to prevent cervical cancer; 1 item), (d) barrier to receiving the HPV vaccine (concern about long-term vaccine side-effects; 1 item), (e) cue to action (doctor's

recommendation; 1 item), (f) attitudes regarding HPV vaccination (3 items), (g) subjective norms (3 items), and (h) perceived behavioral control (1 item).

Participants answered the question: "Have you received the HPV vaccine?" using a *yes* or *no* response. Those who indicated that they were not vaccinated were then further asked: "Do you intend to receive the HPV vaccine?" also using a *yes* or *no* response. These responses allowed the categorization of participants into three groups: those who had not been vaccinated and who did not intend to receive the HPV vaccine (n = 223), those who had not been vaccinated but intended to receive the HPV vaccine (n =102), and those who had been vaccinated (n = 122).

Statistical Analyses

Default p values and confidence intervals presented were calculated using a two-sided alpha. Pearson product–moment correlations were conducted to evaluate collinearity among the independent variables. The intercorrelations were generally low (*r's* between .001 and .39). Moderate correlations were found among attitudes and the following variables: prevent the development of cervical cancer, the barrier of negative health consequences, and subjective norms. A moderate correlation was also found between doctor recommendation and subjective norms. Additionally, the Variance Inflation Factor (VIF) was calculated for each covariate in the multivariate model. VIFs were less than 2.1 for all of the covariates (in both models), indicating no strong relation between the covariates.

In order to assess model fit, a multinomial regression comparing the three groups (those who did not intend to receive the HPV vaccine, those who intended

to receive the HPV vaccine, and those who had been vaccinated) on the HBM and TPB factors was conducted. To test the first hypothesis two analyses were conducted. First, to explore the individual relationship between each factor and vaccination intentions, binomial logistic univariate regressions comparing the group that did not intend to receive the HPV vaccine to the group that intended to receive the HPV vaccine were conducted. Second, to identify which correlates of intentions remained significant when simultaneously controlling for the other factors in the model, a binomial multivariate logistic regression was conducted.

To test the second hypothesis, two analogous sets of analyses were conducted. First, to explore the individual relationship between each factor and vaccination uptake, binomial logistic univariate regressions comparing the group that intended to receive the HPV vaccine to the group that had been vaccinated were conducted. Second, to identify which correlates of uptake remained significant while controlling simultaneously for the other factors in the model, a binomial logistic multivariate regression was conducted.

Theoretical frameworks guided all analyses, and thus all HBM and TPB factors were entered in the multivariate models. Using logistic regression with eight variables and an $\alpha = .05$, $\beta = .20$, a sample size of 447 is sufficient to detect a small to moderate effect size (Multiple R of .15; Cohen, 1988). All analyses were conducted using the PASW Statistics, v.18.0.

Results

Detailed demographics and sexual health characteristics for the entire sample as well as by group are displayed in Table 2 and Table 3, respectively. The SES of this sample was relatively high, with over 49% reporting a family income

of over 100,000 Canadian dollars annually. More than half of the sample (54%) reported currently being in a relationship. Eighty-three percent had previously engaged in sexual intercourse, with a mean age of first sexual intercourse at 17 years (SD = 1.8). The average number of lifetime sexual partners was 3.2 (SD = 4.2).

The majority of the sample had previously heard of HPV as well as the HPV vaccine (94% and 91%, respectively). Despite high levels of HPV awareness, HPV and HPV vaccine knowledge varied by item and was poor overall (M = 12.7/22 correct items, SD = 4.4). Most women knew that HPV is an STI (87%), that it is the primary cause of cervical cancer (61%), and that an HPV vaccine is available for females (93%). However, fewer than half of the participants knew that the majority of sexually active people will contract HPV at some point in their lifetime (48%), that HPV causes genital warts (39%), and that condoms do not prevent the spread of HPV (17%). The majority of the sample (63%) was unaware that the HPV vaccine was covered by health insurance.

The multinomial logistic regression analysis comparing the three groups on HBM and TPB variables was significant ($p < .001$, Nagelkerke $R^2 = .70$), indicating good model fit. A summary of the univariate and multivariate results for the comparison between the group that did not intend to receive the HPV vaccine and the group that intended to receive the HPV vaccine (first hypothesis) is shown in Tables 4. The final multivariate model indicated that the significant correlates of vaccination intentions were lower perceived barrier (that HPV vaccination has negative health consequences), higher doctor recommendation, higher positive attitudes, and higher positive subjective norms.

A summary of the univariate and multivariate results for the comparison between the group that intended to receive the HPV vaccine and the group that had been vaccinated (second hypothesis) is shown in Tables 5. The final multivariate model found that the significant correlates of vaccination uptake were lower susceptibility, higher doctor recommendation, and higher positive subjective norms. Severity was a significant correlate in the multivariate model; however, it was not a significant correlate in the univariate analysis (Table 5). The lack of univariate significance of this correlate indicates a lack of true difference between the two groups on severity and suggests that the multivariate finding is due to a suppressor effect.

Discussion

The first goal of the present study was to examine the correlates of young women's intentions to receive the HPV vaccine. Consistent with the first hypothesis, a number of factors from the HBM and TPB were related to vaccination intentions including: doctor recommendation, subjective norms, positive attitudes, and the perceived barrier that the HPV vaccine has negative health consequences. These findings suggest that these theories are partially successful in determining factors related to vaccination intentions. Both individual beliefs about the vaccine, as well as social influences, appear to be important factors related to vaccination intentions.

Contrary to the first hypothesis, perceived susceptibility, perceived severity, benefits, and behavioral control were not related to vaccination intentions. Most participants had low HPV knowledge and incorrectly identified themselves as being at low risk for HPV infection, despite the fact that 75% of

participants had already engaged in sexual intercourse. This finding suggests that participants were largely unaware of the severity of HPV and their personal risk of contracting HPV. Therefore, they may not have perceived the benefit of vaccination as important enough to intend to receive the vaccine. In addition, overall participants reported high levels of perceived behavioral control. The lack of variability between groups may account for the lack of relationship found between perceived behavioral control and vaccination intentions.

The second goal of the study was to compare the correlates of vaccination intentions and uptake. Consistent with the second hypothesis, physician recommendation and the influence of significant others were related to vaccination uptake. Thus, social influence appears to be a critical factor influencing the transition from vaccination intentions to actual uptake. Physicians could make the most of their influence if they wish to affect vaccination uptake by providing timely and accurate information and recommendations to patients. Physicians can also facilitate young women's vaccination decisions by enabling open discussion and actively sharing with them in the decision-making process (Anhang et al., 2004). Additionally, public health campaigns aiming to increase HPV vaccine uptake (e.g., websites, pamphlets) could provide direct recommendations from physicians and could be endorsed by recognized professional health organizations.

The influence of peers and parents is also critical in affecting young women's vaccination decisions. It is important to educate not only young women, but also their parents and peers regarding the safety, efficacy, and importance of the HPV vaccine in order to increase HPV knowledge and facilitate conversations

regarding the vaccine. Guided group discussions among peers would foster mutual support and confidence in their decisions. As HPV is an STI, it would also be important to provide parents with communication tools to facilitate sexual health discussions which can sometimes be difficult. Educational interventions and multimedia campaigns using popular role models recommending the vaccine may also influence young women's decision-making (Campbell et al., 2008).

Although not hypothesized, susceptibility was also found to be a significant correlate of vaccine uptake. Contrary to the prediction of the HBM, women who perceived themselves as more susceptible were less likely to have been vaccinated. Because of the cross-sectional design of this study, the vaccinated participants answered the questionnaires after receiving the vaccine. Participants who had been vaccinated may have felt less susceptible to HPV because of the protection provided by the vaccine. This is a critical finding in that vaccinated females may experience a false sense of security post vaccination. Current vaccines are protective for only 70% of the oncogenic types of HPV. Therefore vaccinated individuals are still at risk for contracting other oncogenic HPV types and regular cervical screening (e.g. Pap tests) remains essential in order to further decrease the risk of cervical cancer and other HPV related diseases (Saslow et al., 2007).

This study had several important strengths: a sample of young women who are at high risk of HPV and eligible to obtain the HPV vaccine; the comparison of women who received, intended to receive, and did not intend to receive the HPV vaccine; and the use of two widely validated theoretical frameworks. Furthermore, the sample was recruited in Canada, where public health insurance

covers vaccination for females aged 9-18 and private insurance may cover the cost for older females, minimizing cost as a barrier to vaccine uptake.

The current study had several limitations that may affect interpretation of the findings. First, generalizability is limited by a largely homogenous sample of Canadian, high SES university students. In addition, due to national and international variation in HPV vaccine coverage and accessibility, and in the availability of sexual health education, generalizability is further compromised. Second, the measure of HPV vaccine uptake was defined as receiving at least one vaccination dose and did not differentiate between participants who received one, two, or the recommended three doses. Third, due to the study's cross-sectional and retrospective design, a weakness of this study is that direction of causality cannot be inferred between participants' health beliefs (HBM and TPB correlates) and their reported vaccination behavior. Future use of longitudinal designs is imperative to shed light on which factors may cause individuals to receive the HPV vaccine. Finally, the construct of subjective norms in this study was inclusive of all individuals important to the participant and did not differentiate between peers and parents. Future studies should assess peer and parental influences separately, as they may play different roles in the decision-making process of young adults.

As HPV vaccine research continues to evolve, several improvements in research methodology can be considered including the construction of standardized HPV vaccine questionnaires and development of improved theoretical models of vaccine decision-making. The HBM and TPB are interpersonal decision-making models and have constructs that reflect subjective

beliefs. However, decision-making is often a complex socio-ecological process that may not be explained completely by these models. There exist numerous contextual factors (e.g., cultural, SES, institutional mandates, interface with the health care system) that may influence the vaccination decision-making process and require further investigation in larger epidemiological studies (see Sturm et al., 2005).

In addition, potential factors that may influence the relationship between vaccination intentions and uptake should be considered. For example, having a plan that details when, where, and how an individual will engage in a specific behavior, may be a key factor that mediates the transition between behavioral intention and goal achievement (Gollwitzer & Sheeran, 2006). Finally, while the HBM and TPB predict behavior using a linear prediction rule, alternate stage models such as the transtheoretical model and the precaution adoption process (Prochaska & Velicer, 1997; Weinstein, 1988) in the context of longitudinal designs will help researchers to further understand the factors that translate HPV vaccination intentions to actual uptake in the course of the decision-making trajectory.

The current study adds to a growing body of literature on factors that are associated with HPV vaccination decision-making, while using theory driven frameworks. From a theoretical perspective, understanding the relationship between intentions and actual behavior is of utmost importance. From a practical perspective, it is critical to understand the factors that influence young women's vaccination behavior, given the rapidly emerging evidence of HPV-related

diseases combined with the relatively low rates of vaccination uptake in many jurisdictions.

In summary, the findings of this study suggest that trusted individuals (doctors, friends, family, etc.) are of particular importance in motivating young women to receive the vaccine beyond other factors of the HBM and TPB. Therefore, it is important to consider social influences when exploring the adoption of preventive health behaviors. Since health behavior intentions do not necessarily translate into actions, continued research on how specific social influences and other possible psychological mechanisms may turn vaccination intentions into uptake is needed. Understanding these factors in greater depth will aid the development of effective interventions designed to increase HPV vaccine uptake and will shed further light on the complexity of health behavior decision-making.

Table 1
Questionnaire Items for HBM and TPB Constructs

Constructs	Sample items	Cronbach's alpha
Susceptibility	1. It is likely that I would contract HPV in the future 2. It is likely that I would get cervical cancer in the future 3. It is likely that I would get a sexually transmitted infection in the next 5 years.	.74
Severity	1. I think HPV is serious 2. If I got HPV, it would be serious 3. If I got HPV, it would affect my life significantly 4. I think cervical cancer is a serious illness 5. If I got cervical cancer, it would be serious 6. If I got cervical cancer, it would affect my life significantly	.87
Benefit	1. Receiving the HPV vaccine will help prevent the development of cervical cancer	
Barrier	1. I believe that receiving the HPV vaccine will lead to negative health consequences in the future	
Cue to action	1. My doctor recommended the HPV vaccine to me.	
Attitudes	1. I believe that receiving the HPV vaccine is a good idea. 2. I would recommend that women receive the HPV vaccine 3. If an HPV vaccine became available for men, I would recommend that	.95
Subjective norms	1. Most people who are important to me think that I should receive the HPV vaccine 2. It is expected of me to receive the HPV vaccine 3. I feel under social pressure to receive the HPV vaccine	.76
Perceived behavioural control	1.The decision to receive the HPV vaccine is/was beyond my control	

Table 2

Demographic Characteristics

Characteristics *n* (%)	Did not intend to receive the HPV vaccine *(n* = 223)	Intended to receive the HPV vaccine *(n* = 102)	Vaccinated *(n* = 122)	Total sample *(N*=447)
Language				
English	141 (63.2)	66 (64.7)	100 (82)	307 (68.7)
French	23 (10.3)	7 (6.9)	12 (9.8)	42 (9.4)
Other	58 (26.0)	29 (28.4)	10 (8.2)	97 (21.7)
Ethnicity				
White (Caucasian)	146 (65.5)	60 (58.8)	102 (83.6)	308 (68.9)
Arab/West Indian	9 (4.0)	8 (7.8)	6 (4.9)	23 (5.2)
Black	4 (1.8)	3 (2.9)	1 (0.8)	8 (1.8)
Asian	49 (22)	24 (23.5)	7 (5.7)	80 (17.9)
Other	14 (6.3)	7 (6.9)	6 (4.9)	27 (6.0)
Religion				
Christian	101 (45.3)	44 (43.1)	43 (35.2)	188 (42.1)
Jewish	32 (14.3)	9 (8.8)	33 (27.0)	74 (16.6)
Muslim	9 (4.0)	3 (2.9)	1 (0.8)	13 (2.9)
Other	14 (6.3)	9 (8.8)	4 (3.3)	27 (6.0)
Not affiliated	66 (29.6)	37 (36.3)	40 (32.8)	143 (32.0)
Family income				
Less than $40,000	38 (17)	9 (8.8)	5 (4.1)	52 (11.6)
$40,000-$59,999	26 (11.7)	9 (8.8)	3 (2.5)	38 (8.5)
$60,000-$79,999	29 (13)	23 (22.5)	14 (11.5)	66 (14.8)
$80,000-$99,999	24 (10.8)	15 (14.7)	14 (11.5)	53 (11.9)
$100,000-$150,000	61 (27.4)	20 (19.6)	27 (22.1)	108 (24.2)
More than $150,000	35 (15.7)	21 (20.6)	57 (46.7)	113 (25.3)
Marital status				
Single	209 (93.7)	101 (99)	120 (98.4)	430 (96.0)
Common law	6 (2.7)	0 (0)	1 (0.8)	7 (1.6)
Married	6 (2.7)	1 (1.0)	0 (0)	7 (1.6)
Divorced	2 (0.9)	0 (0)	0 (0)	2 (0.4)
Sexual orientation				
Heterosexual	206 (92.4)	92 (90.2)	114 (93.4)	412 (92.2)
Homosexual	3 (1.3)	0 (0)	3 (2.5)	6 (1.3)
Bisexual	12 (5.4)	7 (6.9)	5 (4.1)	24 (5.4)
Other	2 (0.9)	3 (2.9)	0 (0)	5 (1.1)

Table 3

Sexual Health Characteristics

Characteristics *n* (%)	Did not intend to receive the HPV vaccine (*n* = 223)	Intended to receive the HPV vaccine (*n* = 102)	Vaccinated (*n* = 122)	Total sample (*N*=447)
Currently in a relationship				
No	99 (44.4)	55 (53.9)	50 (41.0)	204 (45.6)
Yes	123 (55.2)	47 (46.1)	72 (59.0)	242 (54.1)
Currently have a sexual partner				
No	100 (44.8)	53 (52.0)	49 (40.2)	202 (45.2)
Yes	122 (54.7)	48 (47.1)	72 (59.0)	242 (54.1)
Frequency of condom use				
Never	30 (13.5)	7 (6.9)	14 (11.5)	48 (14.3)
Occasionally	32 (14.3)	16 (15.7)	25 (20.5)	72 (21.5)
Mostly	38 (17)	14 (13.7)	23 (18.9)	73 (21.8)
Always	57 (25.6)	32 (31.4)	41 (33.6)	128 (38.2)
Ever had an STI test				
No	118 (52.9)	61 (59.8)	64 (52.5)	243 (54.4)
Yes	104 (46.6)	40 (39.2)	58 (47.5)	202 (45.2)
Ever had an STI				
No	211 (94.6)	95 (93.1)	117 (95.9)	423 (94.6)
Yes	10 (4.5)	6 (5.9)	5 (4.1)	21 (4.7)
Know anyone who has had cervical cancer				
No	195 (87.4)	91 (89.2)	106 (86.9)	392 (87.7)
Yes	26 (11.7)	11 (10.8)	16 (13.1)	53 (11.9)

Table 4

Binomial Logistic Regressions Comparing the Group that Did not Intend to the Group that Intended to Receive the HPV Vaccine

Correlates	Intended (n = 102)	Did not intend (n = 223)			
		Univariate Analysis		Multivariate Analysis [a]	
		OR	*95% CI*	*OR*	*95% CI*
Health Belief Model					
Susceptibility	Ref	0.96	[0.78, 1.18]	1.02	[0.77, 1.37]
Severity	Ref	0.65*	[0.45, 0.92]	0.82	[0.52, 1.29]
Benefit					
Prevent Cervical Cancer	Ref	0.63***	[0.52, 0.78]	0.92	[0.72 ,1.19]
Barrier					
Negative health consequences	Ref	1.78***	[1.48. 2.13]	1.35*	[1.05, 1.72]
Doctor recommendation	Ref	0.80***	[0.72, 0.89]	0.81**	[0.70, 0.94]
Theory of Planned Behavior					
Attitudes	Ref	0.33***	[0.26, 0.44]	0.41***	[0.29, 0.58]
Subjective norms	Ref	0.45***	[0.36, 0.56]	0.45***	[0.34, 0.60]
Perceived behavioral control	Ref	0.99	[0.85, 1.16]	0.85	[0.68, 1.06]

Note. Those who intended to receive were used as the reference category.

Potential demographic covariates that were significant at $p<.05$ (language, ethnicity, religion and SES) were included in the multivariate model and all proved to have non-significant odds ratios and did not change the reported results.

[a] Model fit: Nagelkerke $R^2= 0.54$

* $p< .05$; ** $p < .01$; *** $p < .001$

Table 5

Binomial Logistic Regression Comparing the Group that Intended to Receive the HPV vaccine to the Group that Had Been Vaccinated

Correlates	Intended (n = 102)	Vaccinated (n = 122)			
		Univariate Analysis		Multivariate Analysis [a]	
		OR	*95% CI*	*OR*	*95% CI*
Health Belief Model					
Susceptibility	Ref	0.73*	[0.58, 0.93]	0.61**	[0.44, 0.85]
Severity	Ref	0.91	[0.59, 1.39]	0.52*	[0.27, 0.98]
Benefit					
Prevent Cervical Cancer	Ref	1.27*	[1.02, 1.59]	1.11	[0.83, 1.48]
Barrier					
Negative health consequences	Ref	.063***	[0.50, 0.80]	0.79	[0.59, 1.07]
Doctor recommendation	Ref	1.92***	[1.58, 2.32]	1.95***	[1.57, 2.42]
Theory of Planned Behavior					
Attitudes	Ref	1.50*	[1.09, 2.06]	1.19	[0.77, 1.84]
Subjective norms	Ref	1.58***	[1.27, 1.97]	1.58**	[1.17, 2.15]
Perceived behavioral control	Ref	0.96	[0.81, 1.13]	0.99	[0.79, 1.24]

Note. Those who intended to receive were used as the reference category.

Potential demographic covariates that were significant at $p<.05$ (language, ethnicity, religion and SES) were included in the multivariate model and all proved to have non-significant odds ratios and did not change the reported results.

[a] Model fit: Nagelkerke $R^2= 0.48$

* $p< .05$; ** $p < .01$; *** $p < .001$

TRANSITION TO MANUSCRIPT 2

Because it is the primary cause of cervical cancer, HPV has been typically referred to as a female burden (Kjaer et al., 2002; Muñoz et al., 2003). However, HPV's consequences are not uniquely restricted to women. HPV causes genital warts in women and men (Baseman & Koutsky, 2005) and is related to an estimated 90% of anal cancers, 40% of penile cancers, and 12% of oropharyngeal cancers (Greer et al., 1995; Kreimer, Clifford, Boyle, & Franceschi, 2005; Parkin & Bray, 2006). Further, men who have sex with men (MSM) are at a higher risk for anal cancer than the general population (Parkin & Bray, 2006). Men can not only suffer the consequences of HPV but also transfer the virus to their sexual partners which contributes to the spread of infection. The rates of male genital HPV infection are comparable to those in females (Giuliano, Lee, et al., 2011; Giuliano et al., 2008), indicating that HPV infection is a potentially serious health issue for men.

Initially, in Canada, the HPV vaccine was approved and recommended for women aged 9 to 26. As of January 2012, the vaccine has been approved and recommended for men of the same age group. It is possible that vaccination programs for men will be implemented in the near future. These programs will contribute to not only the reduction of HPV anogenital infections among men but also the prevention of the spread of HPV and cervical cancer among females (Gillison, Chaturvedi, & Lowy, 2008). As evidence of the vaccine's benefits for men continues to accumulate (Giuliano, Palefsky, et al., 2011), it is imperative to

understand the factors that may be associated with vaccination decision making in men.

According to different studies, men's acceptability of the HPV vaccine varies from 33% to 88% (Ferris et al., 2008; Sauvageau et al., 2007). In addition, males' HPV knowledge is consistently low (Zimet & Rosenthal, 2010). With the intent of increasing knowledge and health behaviours, a primary strategy used in public health policy is to provide information (Copenhaver, Johnson, Lee, Harman, & Carey, 2006; Johnson, Scott-Sheldon, & Carey, 2010; Johnson, Scott-Sheldon, Huedo-Medina, & Carey, 2011). However, as the literature is mixed, it remains unclear as to whether increasing knowledge affects HPV vaccination intentions in men (Oh, Lim, Yun, Lee, & Shin, 2010; Sundström et al., 2010; Woodhall et al., 2007). Study 2 aimed to clarify the relationship between men's HPV vaccination intentions and HPV and HPV vaccine knowledge.

Manuscript 2:

Deconstructing Human Papillomavirus (HPV) Knowledge: Objective and Perceived Knowledge in Males' Intentions to Receive the HPV Vaccine

Andrea Krawczyk, Ellen Stephenson, Samara Perez, Elsa Lau, & Zeev Rosberger
(submitted)

Abstract

Background*:* The human papillomavirus (HPV) vaccine was recently approved for men. To effectively tailor HPV education efforts to men, it is important to understand what men know about HPV and how this knowledge relates to their decision to receive the vaccine. This study examines how objective HPV knowledge, objective HPV vaccine knowledge, and perceived knowledge (level of confidence in one's HPV knowledge) relate to men's HPV vaccination intentions.

Methods*:* One hundred and twenty eight college men completed a survey assessing their demographics, sexual health, objective and perceived knowledge of HPV and the HPV vaccine, and HPV vaccination intentions.

Results: Logistic regression analyses revealed that higher levels of perceived knowledge and objective HPV vaccine knowledge were associated with vaccination intentions. Perceived knowledge was significantly associated with vaccination intentions even when accounting for objective HPV and HPV vaccine knowledge.

Discussion: Perceived knowledge may play an especially important role in motivating men to receive the HPV vaccine. Educational programs that aim to increase HPV vaccine acceptability should foster individual's confidence in their HPV knowledge, beyond providing factual HPV-related information.

Introduction

The human papillomavirus is the most common sexually transmitted infection, affecting over 75% of sexually active individuals at some point in their lives (Tota et al., 2011). Although many infections are asymptomatic, persistent HPV infection causes cervical cancer and genital warts and is associated with the development of various other cancers (vaginal, vulvar, penile, anal and oral; Palefsky, 2010; Tota et al., 2011). HPV vaccines have been approved for females since 2006 (Federal Drug Administration, 2006) and males since 2009 (Federal Drug Administration, 2009). Given the recent availability of the HPV vaccine for men, it is important to understand what men know about HPV and how this knowledge relates to their decision to receive the vaccine.

In order to ensure vaccine acceptability, HPV educational programs are being developed (Brandt, McCree, Lindley, Sharpe, & Hutto, 2005; Sherris et al., 2006). These types of programs often provide factual information designed to increase knowledge (Society of Obstetricians and Gynaecologists of Canada, 2007), which in turn is intended to improve vaccine acceptability. While efforts should be made to improve health literacy and decrease knowledge gaps, this approach may not be sufficient to change vaccination behavior. There is mixed evidence for an association between HPV knowledge and vaccination intentions. Some cross-sectional studies find that higher HPV knowledge in men is associated with greater vaccination intentions (Gerend & Barley, 2009; Petrovic, Burney, & Fletcher, 2011), while others do not (Daley et al., 2010; Reiter, Brewer, McRee, Gilbert, & Smith, 2010). Although men sometimes report needing more

information before deciding to receive the vaccine (Crosby, DiClemente, Salazar, Nash, & Younge, 2011; Petrovic et al., 2011), it is not clear if educating men about HPV increases their intentions to receive the vaccine. In fact, one HPV education program that successfully increased overall HPV knowledge did not generate a corresponding change in HPV vaccination intentions (Gottvall, Tydé, Hoglund, & Larsson, 2010).

One possible reason for the mixed findings concerning the relation between HPV knowledge and vaccination intentions may be that objective HPV knowledge has been assessed as a global construct, encompassing many different knowledge domains. In this study, objective knowledge is defined as the factual information that an individual knows about a certain topic that it can be measured with questions that have objective right or wrong answers. For example, objective HPV knowledge can be virus-related (knowing that some types of HPV causes genital warts) or vaccination-related (knowing that the vaccine helps prevent cervical cancer). Perhaps specifically assessing HPV knowledge and HPV vaccine knowledge will more accurately reflect the relationship between an individual's objective knowledge level and his or her vaccination intentions. It is possible that virus-related knowledge and vaccine-related knowledge do not show the same relationship to HPV vaccination intentions.

In addition to objective HPV and HPV vaccine knowledge, perceived knowledge may also relate to vaccination intentions. In this study, perceived knowledge is defined as the subjective belief that the amount of information that one has is sufficient to make an appropriate decision. Objective and perceived knowledge have been found to operate differently in the decision-making process,

with perceived, but not objective, knowledge showing an association to consumer purchase behavior (Flynn & Goldsmith, 1999) and HIV testing behavior (Hou, 2004; Phillips, 1993). While objective and perceived knowledge are moderately correlated (Carlson, Vincent, Hardesty, & Bearden, 2009), they are distinct constructs that affect different aspects of the decision-making process (Selnes & Gr°nhaug, 1986). Some theoretical models, such as the Precaution Adoption Process Model (PAPM; Weinstein, 1988), view decision making as a process composed of several stages. The PAPM suggests that objective knowledge may be important for generating awareness in the early stages, but less important when it comes to deciding to take action (Weinstein & Sandman, 1992). Other factors which have been associated with HPV vaccinations intentions (e.g. perceived susceptibility, perceived benefits and barriers, vaccination attitudes, social norms, and physician recommendation; Nandwani, 2010) are thought to be more important than knowledge in the later stages of the decision making process (Weinstein, Sandman, & Blalock, 2008).

The present study examines how objective HPV knowledge (facts pertaining to HPV), objective HPV vaccine knowledge (facts pertaining to the HPV vaccine), and perceived knowledge (confidence in one's knowledge about HPV) relate to men's HPV vaccination intentions. It is hypothesized that all types of knowledge will be related to vaccination intentions, but only perceived knowledge will remain associated to vaccination intentions after controlling for objective HPV knowledge and objective HPV vaccine knowledge.

Method

Participants & Procedure

This study was conducted in 2008-2009, after the Canadian approval of the HPV vaccine for females but prior to approval for males. One hundred and twenty-eight male undergraduates were recruited through advertisement at a Montreal university. After providing informed consent, participants completed an online questionnaire at a university computer lab. Following completion of the questionnaire, participants were debriefed and provided with an informational pamphlet about HPV and the HPV vaccine (Society of Obstetricians and Gynaecologists of Canada, 2009). Participants received either 1% course credit for their participation or were entered into a draw for one of three cash prizes valued at $100. The study protocol was approved by the McGill University Research Ethics Board-II.

Measures

Participants provided basic demographic information and answered questions about their vaccination history and sexual health. To assess HPV awareness, participants were asked whether they had heard of HPV and the HPV vaccine, respectively. Objective HPV and HPV vaccine knowledge was assessed using items adapted from previous research (Dempsey et al., 2008; Yacobi et al., 1999; shown in Table 1). Participants answered, "true," "false," or "I don't know" and received one point for every correct response. Objective HPV knowledge was assessed using 11 items (Cronbach's alpha=.72) and objective HPV vaccine knowledge was assessed using 6 items (Cronbach's alpha=.67). Perceived HPV knowledge was assessed using 3 items: "I have enough information about the

HPV vaccine to make my decision," "I feel knowledgeable about HPV," and "I need more information before making my decision about receiving the HPV vaccine." Participants ranked the extent to which they agreed with each statement on a 7-point Likert scale (1="strongly disagree" to 7="strongly agree"). Scores on the 3 items were summed to create a total perceived knowledge score (Cronbach's alpha=.82). Intention to receive the HPV vaccine was assessed using the question, "Do you intend to receive the HPV vaccine?" with a yes-no response.

Statistical Analysis

Participants who did not complete one or more of the knowledge questions were excluded from analysis (n = 5), leaving a final sample of 123 participants. Chi-square tests and t-tests were conducted to assess the relationship between demographic and sexual health characteristics and vaccination intentions. Pearson's correlations assessed the relationship between knowledge and perceived knowledge. Univariate and multivariate logistic regression analyses were used to assess the relationship between objective HPV knowledge, objective HPV vaccine knowledge, and perceived HPV knowledge, and vaccination intentions. All analyses were conducted using PASW Statistics, version 18.0; alpha levels were set at .05.

Results

The mean age of the sample was 20.8 years (SD = 2.0; range 18-30). Eighty-three percent reported having previously engaged in sexual intercourse, with a mean age of first sexual intercourse at 17.0 years (SD = 2.2), and a mean number of lifetime sexual partners of 4.0 (SD = 5.1). Nearly half (48%) had been tested for an STI, but only 5.7% had ever tested positive. The participants were

predominantly heterosexual (85%), Caucasian (71%), and from high SES (over 50% indicating an annual family income over $100,000). Almost all participants (98%) had received most childhood vaccines. Forty-one percent of participants intended to receive the HPV vaccine. Chi-square tests and t-tests revealed that sexual orientation ($\chi^2_{(1)}$=5.52, p <.05) and condom use frequency ($\chi^2_{(3)}$=10.20, p<.05) were the only demographic and sexual health characteristics that differed between those who intended to receive the HPV vaccine and those who did not. Heterosexual men were less likely to intend to receive the vaccine compared to men reporting any other sexual orientation. Those who intended to receive the HPV vaccine were more likely to report using condoms every time they had sex.

Most participants had at least some awareness of HPV, with 89% having heard of HPV, and 73% having heard of the vaccine. Nevertheless, both HPV and HPV vaccine knowledge were low overall (HPV knowledge: *M*=4.03/11, *SD*=2.39; HPV vaccine knowledge: *M*=2.74/6, *SD*=1.66). The percentage of correct, incorrect, and "I don't know" responses to each objective knowledge items are shown in Table 1. Most men knew that HPV is an STI (83%) and that men can carry HPV (58%), but many did not know that the majority of sexually active people will acquire HPV at some point in their lifetime (71%). Many men falsely believed that condoms prevent the spread of HPV (63%) and only a minority (18.5%) knew that the vaccine protects against the contraction of genital warts. Overall perceived HPV knowledge was low (*M*=8.63 out of 21, *SD*=4.28), with approximately one sixth of the men (16.3%) reporting extremely low perceived knowledge, scoring 3 out of 21.

Pearson product-moment correlations found a moderate correlation between perceived knowledge and objective HPV knowledge (r =.41, p<.001), and objective HPV vaccine knowledge (r =.42, p<.001). Univariate logistic regression analyses found that HPV vaccine knowledge (OR=1.28, [95% CI]=[1.07, 1.64]) and perceived knowledge (OR=1.23, [95% CI]=[1.11, 1.36]) were significant correlates of vaccination intentions, while HPV knowledge was not. When all three factors were entered into a multivariate logistic regression, only perceived knowledge was significantly associated with vaccination intentions (OR=1.23, [95% CI] = [1.10, 1.39]). The Hosmer and Lemeshow test (p=.149) and Nagelkerke's R-squared (R^2=.205) indicated an acceptable model fit.

Discussion

By exploring the relationships between objective HPV and HPV vaccine knowledge, perceived knowledge, and vaccination intentions, this study is the first to examine the role of various types of knowledge in HPV vaccination decision-making. Although most men had heard of HPV and the HPV vaccine, they knew relatively little about them, indicating that there are still significant knowledge gaps that need to be addressed. Furthermore a large portion of participants answered "I don't know" to many of the objective knowledge items indicating they were not misinformed but truly lacked knowledge. This is also consistent with the low levels of perceived knowledge found in this study. There is clearly a need to provide men with accurate factual information about this STI and the vaccine available to prevent it.

As expected, both objective HPV and HPV vaccine knowledge were moderately correlated with perceived knowledge, suggesting that participants' perceptions of their knowledge were at least somewhat accurate. Nevertheless, this was not a high correlation, which supports the idea the objective and perceived knowledge are distinct constructs that should be examined independently (Selnes & Gr°nhaug, 1986). Objective HPV vaccine knowledge, but not objective HPV knowledge, was associated with vaccination intentions. When faced with a health threat such as risk of HPV infection, individuals have different options for how to address this issue (e.g. vaccination, screening, abstinence). Specific information that pertains to a particular option (e.g. HPV vaccine availability, vaccine benefits) may be especially important for opting to adopt that particular strategy (e.g. receiving the vaccine).

This study found that perceived knowledge was significantly associated with vaccination intentions even when accounting for objective HPV and HPV vaccine knowledge. Perceived knowledge may be part of an individual's belief system, which serves to motivate individuals to intend and take action. While objective HPV knowledge may be important for generating awareness in the early stages of the decision-making process, it may not directly influence vaccination intentions. Thus, beyond providing objective HPV knowledge to promote informed decision-making, educational programs may increase individuals' intentions to receive the HPV vaccine by fostering individuals' confidence in their own knowledge. Such educational interventions should be developed and tested in well-controlled future studies.

An important limitation of this study is that the sample consisted of a small group of culturally homogeneous, high SES, male college students; therefore, findings cannot be generalized to the general population. Future studies should include culturally diverse men, men from lower socioeconomic status as well as rural residents. Given the small number of non-heterosexual men in our sample is it difficult to interpret the effect of sexual orientation on vaccination intention found in this study. There is evidence to suggest that gay and bisexual men report higher levels of objective and perceived HPV knowledge (Brewer, Ng, McRee, & Reiter, 2010) and greater willingness to receive the HPV vaccine (Gilbert, Brewer, Reiter, Ng, & Smith, 2010). Studies with larger portions of gay and bisexual men may wish to explore differences in HPV knowledge and vaccination intentions among these populations. Furthermore, considering that health behavioural intentions not always lead to actual completion of a behaviour, (Gollwitzer & Sheeran, 2006; Webb & Sheeran, 2006) future studies should also explore male's objective and perceived knowledge as factors related to actual vaccination behaviour. Finally, the present findings are based on correlational data from a cross-sectional design, future experimental and longitudinal studies are needed in order to understand the causal relationship between knowledge and vaccination intentions and behaviour.

Lack of knowledge can be a significant barrier in the decision-making process. While it is important to educate men about HPV so that they can make an informed vaccination decision, educational efforts should focus on providing information that pertains specifically to the vaccine, not just to the disease in general. Further, it seems that a perceived lack of knowledge can pose an even

greater barrier to intending to be vaccinated. It is important that men feel confident in their knowledge about HPV and the HPV vaccine, because it is not only what they *know*, but also what they *think* they know that is related to vaccination intentions.

Table 1

Questionnaire Items for Objective Knowledge

HPV knowledge (α=.72)			
Item	*Correct (%)*	*Incorrect (%)*	*Don't Know (%)*
HPV infection makes you unable to have children.	32.3	12.1	55.6
HPV is sexually transmitted.	83.1	3.2	13.7
Men cannot carry HPV.	58.7	18.5	21.8
HPV can lead to the sexual transmission of Hepatitis B.	5.6	17.7	76.6
The majority of sexually active people will get HPV at some point in their lifetime.	29.0	29.4	47.6
People who have been infected with HPV might not have symptoms.	67.7	1.6	30.6
HPV is the main cause of cervical cancer.	34.7	8.1	57.3
Genital warts are caused by HPV.	23.4	17.7	58.9
Condoms prevent the spread of HPV from person to person.	7.3	62.9	29.8
Smoking increases the risk of developing cervical cancer.	30.6	12.1	57.3
Most women who test positive for HPV will not get cervical cancer.	27.4	12.9	59.7

HPV vaccine knowledge (α=.67)			
Item	*Correct (%)*	*Incorrect (%)*	*Don't Know (%)*
A vaccine for HPV has been approved and is now available for females.	74.2	0	25.8
The HPV vaccine involves the administration of three separate doses.	25.0	0	75.0
The HPV vaccine helps prevent the development of cervical cancer.	54.0	3.2	42.7
The HPV vaccine helps prevent the contraction of genital warts.	18.5	16.1	65.3
Those who have received the HPV vaccine no longer need to be screened for cervical cancer.	68.5	0.8	30.6
The HPV vaccine doesn't protect against transmission of Hepatitis B.	31.5	4.8	63.7

TRANSITION TO MANUSCRIPT 3

Considering that the HPV vaccine could have significant effects on population health, and using the previous findings, the purpose of Study 3 was to design and test an educational intervention to assist young adults with their HPV vaccination decisions. Given the relatively low levels of HPV and HPV vaccine knowledge in young adults, and to ensure their capacity to make informed decisions, it was critical to improve their levels of knowledge. In addition, considering that higher levels of HPV and HPV vaccination knowledge may influence young adults' attitudes and believes about the virus and the vaccine, the intervention aimed at increasing young adults' vaccination intentions. Study 1 and Study 2 demonstrated that the influence of doctor recommendation, social norms, and levels of knowledge and perceived knowledge were related to vaccination intentions in young adults. Inspired by these results, and based on the HBM, Study 3 aimed to examine the effects of educational interventions on young adults HPV and HPV vaccine knowledge and vaccination acceptability.

Manuscript 3:

How to inform: Comparing written and video education interventions to increase human papillomavirus knowledge and vaccination intentions in young adults

Andrea Krawczyk, Elsa Lau, Samara Perez, Vanessa Delisle, Rhonda Amsel & Zeev Rosberger, *Journal of American College Health* (In Press)

Abstract

Objective: To compare the efficacy of two Human Papillomavirus (HPV) educational interventions on increasing HPV knowledge and vaccination intentions in college students.

Participants: Male (n = 60) and female (n = 140) undergraduates (M_{age} = 20.4, SD = 2.3) recruited from a university in Montreal Canada, from October 2009-March 2010.

Methods: Using theory based interventions, participants were randomly assigned to either a written HPV pamphlet, an HPV video, or a control. HPV knowledge and vaccination intentions were assessed pre- and post-intervention.

Results: Low baseline knowledge and intentions were found across groups. Post-intervention, participants in the written and video interventions had significantly higher knowledge and intentions than the control. No differences were found between written and video interventions on knowledge or intentions.

Conclusion: This study, a first in comparing HPV educational formats, suggests that both written and video interventions are equally effective in educating about HPV and increasing young adults' vaccination intentions.

Introduction

The human papillomavirus (HPV) is the most common sexually transmitted infection (STI), with prevalence highest among sexually active young adults between 15 to 24 years of age (Burchell et al., 2006; Weinstock, Berman, & Cates, 2004). HPV is the primary cause of cervical cancer (Kjaer et al., 2002), genital warts (Baseman & Koutsky, 2005), and is associated with vulvar, vaginal, penile, anal, and oropharyngeal cancers (Muñoz, Castellsague, de Gonzalez, & Gissmann, 2006). Cervical cancer is a serious and life threatening disease affecting women (Franco & Harper, 2005). While implementation of cervical cancer screening in North America has significantly decreased the rates of cervical cancer, the number of new cases and associated deaths for a largely preventable disease remains quite high (Ferlay et al., 2010).

Currently, there is no known cure for HPV, but prophylactic vaccines are available which are effective in protecting against approximately 70% of cervical cancers and 90% of anogenital warts (National Advisory Committee on Immunization, 2007). In several countries including the United States and Canada, Gardasil™ and Cervarix™ were approved for females aged 9 to 26 and 10 to 25 respectively. Although the HPV vaccine has maximum benefit when given prior to initiation of sexual activity (Centers for Disease Control and Prevention, 2011), there is strong evidence that sexually active females between the ages of 16 to 25 also will benefit from immunization (Barr et al., 2008). Increasing vaccination uptake in young adults is essential because they are at high risk of contracting HPV, yet it appears that only a minority of young women in

North America have received the HPV vaccine (Allen et al., 2009; Kiely, De Wals, Sauvageau, Dube, & Deceuninck, 2010; Lavoie et al., 2010).

In addition to current low uptake, it is of concern that 18 to 48% of young adults have low vaccination intentions (Jain et al., 2009; Zimet et al., 2010). Intentions are defined as the precursor to health behavior change (Fishbein, 2000; Fishbein & Ajzen, 1975), acting as a mediator through which antecedent predictors influence behaviors (Baron & Kenny, 1986). Some commonly reported barriers of HPV vaccination intentions include: being in a monogamous relationship, fear of side effects, and lack of knowledge (Zimet et al., 2010). HPV knowledge among this age group is relatively low (Brewer & Fazekas, 2007; Holcomb et al., 2004), with males having even lower levels of knowledge than females (Baer, Allen, & Braun, 2000; Holcomb et al., 2004). Across studies, most young adults report having never heard of HPV and further, being unaware of its consequences (Brewer & Fazekas, 2007). Additionally, some studies find that higher levels of knowledge are positively correlated with higher intentions to vaccinate (Doherty & Low, 2008; Lambert, 2001), while others find no relation (Allen et al., 2009).

Educational interventions have been shown to enhance HPV knowledge and vaccination intentions among college students (Doherty & Low, 2008; Lambert, 2001). Additional questions remain as to whether different educational intervention formats may lead to differential outcomes. Most studies examining the impact of educational interventions on HPV knowledge and vaccination intentions have used written formats (Davis et al., 2004; Doherty & Low, 2008; Lambert, 2001), with only a few recent studies evaluating video HPV

interventions (Chapman et al., 2010; Vallely, Roberts, Kitchener, & Brabin, 2008). In other health related fields, video interventions have been shown to be equally or more effective than written materials in increasing health-related knowledge and behaviour (Armstrong, Idriss, & Kim, 2011; Dunn, Shenouda, Martin, & Schultz, 1998; Idriss, Alikhan, Khalil, & Armstrong, 2009).

Research has shown that a health-care professional's (HCP) recommendation is one of the strongest predictors of vaccine uptake (Jones & Cook, 2008; Rosenthal, Kottenhahn, Biro, & Succop, 1995; Zimet, Blythe, & Fortenberry, 2000), with a strong physician recommendation resulting in a 4-fold greater likelihood to receive the HPV vaccine compared to a weaker recommendation (Rosenthal et al., 2011). Despite the advent of the internet and other communication channels, many individuals still cite HCPs as their most trusted source of medical information (Caskey, Lindau, & Alexander, 2009; Hesse et al., 2005), suggesting that HCPs may strongly influence HPV vaccination intentions among young adults. Therefore the presentation of a video in which an HCP recommends the HPV vaccine may be more efficacious than providing written information.

To the best of our knowledge, there are no published studies comparing the efficacy of written and video interventions specific to HPV. The present study evaluates the relative efficacy of two HPV educational interventions (written and video) to increase HPV and vaccine knowledge and vaccination intentions among college students. Furthermore, the present study explored the efficacy of a HCP delivering the information in an audio-video format compared to the same information delivered in a written pamphlet. It was hypothesized that: 1) both

intervention groups (written and video) would improve knowledge of HPV and the vaccine compared to the control group 2) both intervention groups would increase in vaccination intentions compared to the control group, and 3) the video intervention would be more effective in increasing both knowledge and vaccination intentions compared to the written intervention. The possible influence of gender on the results was also explored.

Method

Participants

Two hundred undergraduates were recruited from classes at a university in Montreal, Canada through advertisement. All forms of recruitment and consent material indicated that the study investigated factors that affect students' decision making regarding health and sexuality. There was no mention of HPV or the HPV vaccine.

Individuals recruited from psychology classes received one course credit in return for their participation. Those recruited from other undergraduate classes were compensated by having their names entered in a draw for a chance to win one of three $100 prizes. Individuals who had received the HPV vaccine were excluded from the study. The study protocol was reviewed and approved by the McGill University Research Ethics Board-II.

Procedure

The interventions were completed at a university computer lab reserved solely for this study. Supervised by two research assistants, a maximum of six individuals were in the lab at a time. Participants were randomly assigned to one of three conditions: written, video, or control condition. The written intervention

group read an educational HPV and vaccine pamphlet, and the video intervention group watched an educational HPV and vaccine video. The control group read an educational pamphlet about general cancer prevention strategies. Participants completed an online questionnaire pre-intervention and post-intervention. Each participant sat at an enclosed private cubicle where they read the pamphlet or watched the video on a computer monitor (with audio head phones). All three groups took approximately five minutes to read their pamphlet or watch their video. Following completion of the questionnaire, participants were debriefed. Data was collected from October 2009 – March 2010.

Intervention Development

The development of both the written and the video interventions was guided by the Health Belief Model (HBM), a theoretical framework commonly applied to health-behavior research (Harrison, Mullen, & Green, 1992; Janz & Becker, 1984). Key factors of the HBM as they apply to intentions to receive the HPV vaccine are: perceived susceptibility to and severity of HPV, perceived benefits (e.g., the prevention of HPV), perceived barriers (e.g., side-effects of the HPV vaccine), and cues to action (e.g., a HCP recommending the HPV vaccine).

The written and video interventions contained information about the incidence, transmission, and consequences of HPV and the efficacy and safety of the vaccine, which was obtained from the Society of Obstetricians and Gynaecologists of Canada website (2009). The control intervention contained information about healthy lifestyle choices to prevent cancer, which was obtained from the Canadian Cancer Society website (2010). Both of these websites contain up to date, evidence-based medical health information.

The interventions were developed by the authors for the purpose of this study in consultation with HPV experts in the field of psychosocial oncology. In order to control for the effect of content, the video and written intervention contained identical information but differed in the format (written pamphlet vs. video on computer screen) in which the information was delivered. The video portrayed a senior male HCP delivering the information in a 'talking head' shot frame, talking directly to the camera with only his upper body visible. To ensure the credibility of the interventions**,** participants were asked "How credible did you find the informational pamphlet/video that you read/saw?" Participants answered on a 7-point scale (1 = *"Not at all credible*" to 7 = *"Very credible"*). All three conditions received similar high mean credibility ratings (written intervention: *M* = 5.30, *SD* = 1.13; video intervention; *M* = 5.32, *SD* = 1.33; control pamphlet: *M* = 5.51, *SD* = 1.29).

Measures

Participants completed socio-demographic data and questions regarding their general health (e.g., history of childhood vaccination) and their sexual health history (e.g., age at first sexual intercourse).

Intention to receive the HPV vaccine was the primary outcome measured using the question, "Do you intend to receive the HPV vaccine?" Participants answered *Yes* or *No* to this item and then indicated the degree to which they did or did not intend to receive the vaccine on a 7-point scale (1 = *"Not at all"* to 7 = *"Definitely"*).

HPV and vaccine awareness was assessed using the following two questions: "Have you heard of HPV?" and "Have you heard of the HPV vaccine?"

with a yes/no response category. Knowledge about cervical cancer (e.g., "HPV is the main cause of cervical cancer"), HPV (e.g., "HPV is sexually transmitted"), and the HPV vaccine (e.g., "The HPV vaccine helps prevent the contraction of genital warts") was assessed using a 22-item scale. Six items were adapted from Dempsey and colleagues (2006); eight items were adapted from Yacobi and colleagues (1999), and 8 items were created for the purpose of this study, with particular emphasis on the HPV vaccine. Participants answered either "True", "False," or "Don't know" to each item. Correct responses were summed to create a total knowledge score. Internal consistency of the knowledge scale was high (Cronbach's alpha = .86).

Statistical analysis

Data analysis was conducted using the Statistical Package for the Social Sciences (SPSS) 16.0. Descriptive statistics were conducted on demographic, health, and sexual health variables. The relative efficacy of the interventions in increasing HPV and vaccine knowledge was assessed with a 2 (pre-post) x 3 (control, written, video) x 2 (gender) mixed between-within subjects ANOVA. Using the same design, a 2 x 3 x 2 ANOVA assessed vaccination intentions. Post-hoc Tukey's HSD tests for HPV knowledge and vaccination intentions were conducted to examine specific subgroup differences across time, group, and gender.

Results

Detailed demographic data, as well as health and sexual health characteristics for all participants are shown in Table 1. The mean age of our sample was 20.4 (*SD* = 2.3). The SES of this sample was high (46% indicated an

annual family income of over 100,000). More than half of the sample (54.5%) reported being in a relationship. The mean age of first sexual intercourse among those who reported being sexually active (n = 150) was 17.1 (SD = 2.1), and the mean number of lifetime sexual partners was 2.8 (SD = 3.6). One third of participants have undergone an STI test (35.5%), but only 3.5% reported having had a positive diagnosis.

For the entire sample, pre-intervention knowledge scores were modest (M = 10.58 out of 22, SD = 4.55) and intentions to receive the HPV vaccine were low (M = 3.37. SD = 1.89 out of 7). Only 36.5% of participants indicated high intentions to be vaccinated (score of 5 or above on a 7-point scale). Most individuals had previously heard of HPV as well as the HPV vaccine (89% and 80%, respectively). Across the control, written, and video intervention groups, participants did not differ on any demographic, sexual, and health characteristics (e.g., having had sexual activity, sexual intercourse, a positive STI test result, knowing someone who had cervical cancer).

Results of the ANOVA for knowledge showed a significant main effect for group ($p < .001$, $\eta^2 = .12$), time ($p < .001$, $\eta^2 = .66$) and gender ($p < .001$ $\eta^2 = .10$). There was also a significant time by group interaction effect ($p < .001$), with post hoc Tukey's tests finding that both the written intervention (M_{pre} = 10.48, SD = 4.86; M_{post} = 17.46, SD = 2.09) and video intervention (M_{pre} = 11.49, SD = 4.25; M_{post} = 16.70, SD = 2.19) significantly increased knowledge, whereas no significant change was observed for the control group (M_{pre} = 10.89, SD = 4.15; M_{post} = 12.06, SD = 4.15) (Figure 1.). Post hoc Tukey's tests also indicated that the written and video groups had higher HPV knowledge scores compared to the

control group post intervention. Post hoc Tukey's comparisons found no significant difference in knowledge scores between the written and video groups (Figure 1.). There was a significant time by gender interaction effect ($p < .01$), with a post-hoc Tukey's test indicating that females ($M = 11.49$, $SD = 4.25$) had higher knowledge scores pre-intervention than males ($M = 8.45$, $SD = 4.54$). Post-intervention, females ($M = 15.82$, $SD = 3.32$) had significantly higher knowledge than males ($M = 14.50$, $SD = 4.55$).

Results of the ANOVA for vaccination intentions found a significant main effect for time ($p < .001$, $\eta^2 = .12$). There was a significant interaction effect between time and group ($p < .01$), with post hoc Tukey's tests indicating that both the written intervention ($M_{pre} = 3.52$, $SD = 1.94$; $M_{post} = 4.57$, $SD = 1.90$) and video intervention ($M_{pre} = 3.14$, $SD = 1.85$; $M_{post} = 4.39$, $SD = 1.86$) groups significantly increased reported intentions, whereas no significant difference was observed for the control group ($M_{pre} = 3.51$, $SD = 1.90$; $M_{post} = 3.88$, $SD = 1.77$) across time (Figure 2). Post-hoc Tukey's tests indicated that both the written and video intervention groups had significantly higher post-intervention vaccination intentions compared to the control (Figure 2). Post hoc Tukey's comparisons found no significant difference in vaccination intentions between the written and video groups. Neither pre nor post-intervention intentions differed between males and females.

Comment

The present study evaluated the effects of educational interventions on HPV knowledge and vaccination intentions in college students. The first objective was to investigate whether educational interventions are effective in improving

HPV knowledge. The written and video interventions significantly increased knowledge compared to the control group. While most participants reported having heard of HPV and the vaccine, pre-intervention HPV knowledge was modest, which is consistent with the literature (D'Urso, Thompson-Robinson, & Chandler, 2007; Klug, Hukelmann, & Blettner, 2008). The low levels of knowledge pre-intervention emphasize the need for educational interventions among young adults. Males had lower levels of knowledge than females pre-intervention which is also consistent with the literature (Klug et al., 2008). Female participants still had higher levels of knowledge compared to males post intervention, however both genders increased in knowledge.

The second objective was to examine the effectiveness of educational interventions in improving HPV vaccination intentions. The written and video interventions significantly increased vaccination intentions in comparison to the control group. Considering that the vaccine has been available for several years, and vaccination rates among young adults remain low, it is promising that both interventions were effective in improving vaccination intent which may facilitate uptake.

Lastly, the present study tested whether an HPV video intervention delivered by an HCP could be more efficacious in increasing knowledge and vaccination intentions than the same information delivered in a pamphlet format. The video intervention was not superior to the written intervention in increasing knowledge and intentions. The video was designed to provide information that was identical to the written intervention to control for additional variables and allow for a direct comparison of a video and pamphlet format.

One possible explanation for the lack of difference is that the video did not include elements such as music and images, as well as factors that might trigger strong emotional reactions (Albarracín et al., 2005; Riley, Obermayer, & Jean-Mary, 2008). In addition, although the video intervention aimed to capitalize on an HCP's pivotal role in informing individuals about HPV and increasing vaccination intentions (Rosenthal et al., 2011), it may have lacked elements of a real-life HCP's recommendation, such as the personalized provision of information (Albada, Ausemsb, Bensinga, & van Dulmen, 2009) and shared decision making that allows for two-way communication (Anhang et al., 2004).

Limitations of this study include high socioeconomic status of the sample, and therefore results may not be generalizable to a wider population of young adults. Participants were self-selected, which may have also limited generalizability as the sample may be representative of individuals who are interested in health and sexual health. Additionally, participants were administered the post-intervention questionnaire immediately after receiving the intervention, limiting conclusions on the long-term effects of the intervention on knowledge and intentions.

Future studies could improve both video and written interventions by tailoring them to the target audience's gender, culture, age, and sexual experience. As there are mixed findings regarding the relation between knowledge and vaccination intentions, alternative constructs such as social norms, maybe important factors to explore. This approach may include incorporating peer influences and peer support in interventions designed for young college students. HIV/AIDS education campaigns have successfully incorporated targeted, theory-

based interventions, using a variety of active and passive strategies (Albarracín et al., 2005) and these techniques should be considered when designing future HPV interventions. Another future direction for HPV interventions includes the innovative use of media technology. While the present findings suggest that written and video interventions are efficacious and should continue to be developed, consideration should be given to the wide reaching potential of the internet and the popularity of mass media. Educational messages may be more effectively delivered through media such as cell phones, text messages, You-tube videos, and Twitter. In a recent study, cell phone text messages were effective in decreasing smoking in young adults (Riley et al., 2008). A recent review indicated that technology based interventions are effective and economical means of health promotion (Noar, Black, & Pierce, 2009) and would benefit from further research and application.

Conclusions

As evidence of the efficacy of the HPV vaccines in preventing HPV infection and related cancers continues to grow (Giuliano, Palefsky, et al., 2011; Haupt & Sattler, 2010), it is critical that college students be informed about their HPV risks and the methods of prevention available. The present study is the first randomized-control design study comparing the efficacy of written and video HPV interventions that are guided by a theoretical framework. Both the written and video interventions facilitate consistent delivery of HPV education and were successful in increasing knowledge and vaccination intentions. The written and video formats were equally effective in the present study, suggesting that for some populations a cost-effective pamphlet may be sufficient to increase knowledge

and intentions to receive the HPV vaccine. It remains to be seen whether the video format might prove to be a superior HPV intervention, particularly when incorporating all of the advantages available to multimedia-video formats. Assessments of the long-term effectiveness of these interventions may be critical elements in the promotion of HPV vaccination. Consequently, efforts should be directed to continue to improve educational HPV interventions which could significantly prevent and reduce morbidity and mortality from cervical and HPV-related cancers.

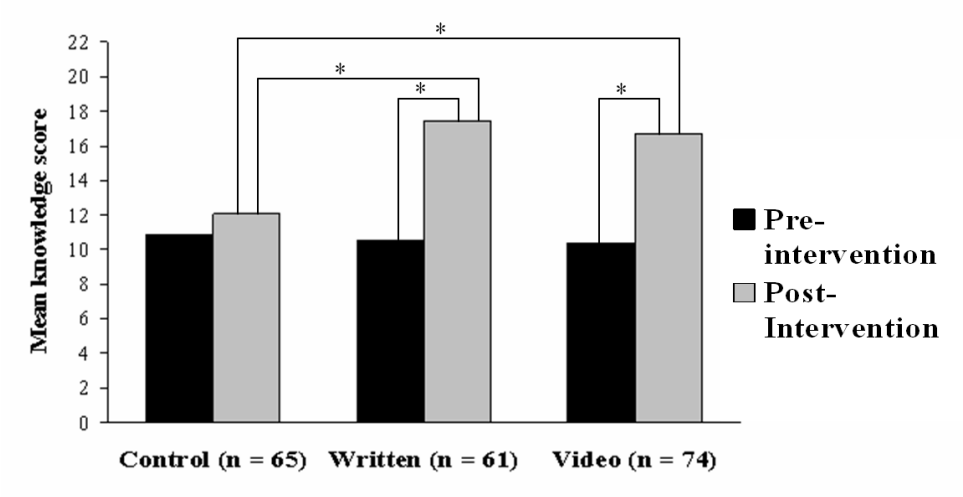
Table 1.

Demographic, Health, and Sexual Health Characteristics

Variable	n (%)	Variable	n (%)
Gender		**Ever engaged in sexual intercourse**	
Male	60 (30)	No	40 (20.0)
Female	140 (70)	Yes	150 (75.0)
Language		**Currently has a sexual partner**	
English	120 (60.0)	No	94 (47.0)
French	26 (13.0)	Yes	106 (53.0)
Other	53 (26.5)	**Currently has more than one sexual partner**	
Ethnicity			
White (Caucasian)	122 (61.0)	No	196 (98.0)
Other	77 (38.5)	Yes	4 (2.0)
Religion		**Frequency of condom use**	
Christian	75 (37.5)	Never	19 (12.7)
Jewish	38 (19.0)	Occasionally	41 (27.3)
Muslim	10 (5.0)	Mostly	36 (24.0)
Other	14 (7.0)	Always	50 (33.3)
Not affiliated	62 (31.0)	**Ever had an STI test**	
Family income		No	129 (64.5)
Less than $40,000	17 (8.5)	Yes	71 (35.5)
$40,000-$59,999	25 (12.5)	**Ever had an STI**	
$60,000-$79,999	28 (14.0)	No	193 (96.5)
$80,000-$99,999	28 (14.0)	Yes	7 (3.5)
$100,000-$150,000	46 (23.0)	**Knows anyone who has had cervical cancer**	
More than $150,000	46 (23.0)		
Marital status		No	182 (91.0)
Single	192 (96.0)	Yes	17 (8.5)
Common law	2 (1.0)	**Ever heard of HPV**	
Married	4 (2.0)		
Divorced	1 (0.5)	No	22 (11.0)
Received most childhood vaccines		Yes	178 (89.0)
		Ever heard of the HPV vaccine	
No	5 (2.5)		
Yes	194 (97.0)	No	41 (20.5)
Currently in a relationship		Yes	159 (79.5)
		HPV vaccine covered by health insurance	
No	90 (45.0)		
Yes	109 (54.5)	No	23 (11.5)
Sexual orientation		Yes	27 (13.5)
Heterosexual	188 (94.0)	Don't Know	150 (75.0)
Homosexual	7 (3.5)		
Bisexual	4 (2.0)		
Other	1 (0.5)		

Figure 1.

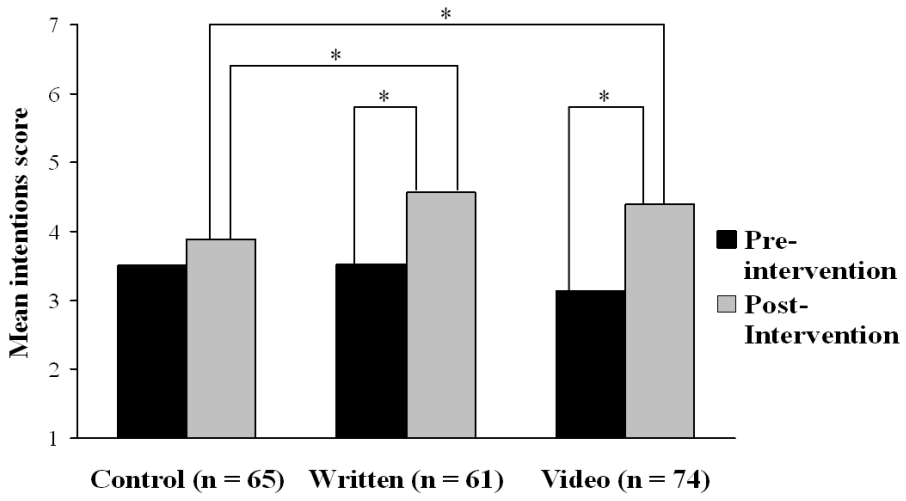
Mean HPV and Vaccine Knowledge Scores Pre- and Post-Intervention



* $p < .05$

Figure 2.

Mean HPV Vaccination Intentions Pre- and Post-Intervention



* $p < .05$

TRANSITION TO MANUSCRIPT 4

While understanding HPV vaccination decision-making in young adults is important, parents' decisions regarding whether to accept the vaccine for their daughters is an additional critical component of HPV prevention.

Indeed, parents' vaccination decisions influence their child's future health. To ensure vaccination prior to initiation of sexual activity, the HPV vaccine is especially recommended for children and young adolescents aged 9 to 14 parental acceptance of the vaccine is required. Clearly, it is important to understand factors that affect parental acceptance or rejection of available immunizations for their children. In particular, decisions regarding the HPV vaccine can be difficult for some parents. While the vaccine is recommended by professional and public health agencies, individual attitudes about the HPV vaccine may influence their vaccination. In the context of an universal vaccination program conducted in the province of Québec, study 4 explored factors related to parental vaccination decision-making.

Study 4:

Parental HPV Vaccine Decision-Making: The Role of Vaccination Safety

Andrea L. Krawczyk, Bärbel Knäuper, Vladimir Gilca, Eve Dubé & Zeev Rosberger

Abstract

Objective: Vaccination against the human papillomavirus (HPV) is an effective primary prevention measure for HPV-related cancers. However, for children and young adolescents, the uptake of the vaccine is contingent on parental vaccination consent. This study seeks to identify key differences between parents who accept and parents who refuse the HPV vaccine for their daughters.

Methods: A random sample of 2500 parents of 9-10 year old girls, who were offered the HPV vaccine at no cost in the context of a universal school vaccination program, were invited to participate in the study by mail. Participants completed a questionnaire based on the theoretical constructs of the health belief model (HBM) and additional relevant factors identified in the literature.

Results: Most respondents (88.2%) reported accepting the HPV vaccine for their daughter. The HBM constructs (perceived susceptibility of daughters to HPV infection, perceived benefits of the vaccine, perceived barriers, and cues to action) distinguished between parents who accepted and parents who refused the HPV vaccine. In particular, parental perception of vaccine safety was the strongest factor associated with acceptance. Further, perceived safety was a significant independent contributor beyond all other HBM constructs. Other significant factors associated with parental intention and not included in the theoretical framework were vaccination attitudes, anticipated regret, adherence to other routinely recommended vaccines, social norms, and positive media influence.

Conclusions: The HBM provided a useful, but not sufficient, framework to identify the potential critical factors related to parental vaccination decision

making. Comprehensive theories of vaccination decision making that include behavioural, social, and cognitive factors are warranted.

Introduction

What factors determine whether parents accept or refuse the human papillomavirus (HPV) vaccine for their daughters? Despite the fact that this question has received significant research and media attention over the past few years, the answer remains uncertain. The present study aims to contribute to the future theoretical and clinical understanding of parental HPV vaccination decision making.

The HPV vaccine protects against sexually transmitted infections caused by high-risk subtypes of the HPV accounting for approximately 70% of cervical cancers. In addition, a quadrivalent vaccine also protects against non-carcinogenic low-risk subtypes of the virus, which are responsible for 70-95% of genital warts (GW). Although GW are not a life-threatening condition, they can have a significant negative impact on the quality of life of patients.

Because of the sexually transmitted nature of HPV, the vaccine is more effective if administered before the inception of sexual activity, and parents are prompted to vaccinate their daughters with the vaccine at an early age. Most guidelines recommend vaccinating girls aged 9 to 14 years (Center for Disease Control and Prevention, 2007; National Advisory Committee on Immunization, 2007).

During the last decade, several new vaccines were approved and recommended for routine use in industrialized countries and about twenty new or improved vaccines are expected to be available by 2015 (Center for Disease Control and Prevention, 2011; National Advisory Committee on Immunization, 2006). Thus, increasingly, parents need to consider and authorize a greater

number of vaccinations for their children. Parental vaccination decision making involves wishes to protect children against potential future diseases, concerns about new vaccines and their consequences, and interactions between social-environmental, institutional, structural, and individual factors (Sturm et al., 2005).

HPV vaccine acceptability research is rapidly growing, with many studies examining factors related to not only parental intention to vaccinate daughters but also actual acceptance (Trim et al., 2012). Two main problems with previous studies are the lack of theoretical frameworks to underpin hypotheses and contradictory findings across studies. Factors identified in these studies as being associated with parental vaccine acceptance include: parent characteristics (educational level, race/ethnicity, religion); child characteristics (age, sexual behavior); household characteristic (income, location); access to medical care (having a general practitioner, routine medical visits); social-environmental factors (media influence, social norms, health professional recommendations, vaccine cost) and parent-specific factors (beliefs, attitudes, knowledge, worries about the vaccine's impact on girls' sexuality, anticipated regret, trust in pharmaceutical companies, uptake of other vaccines, lack of knowledge, and personal doubts about the vaccine safety; Allen, 2010; Brewer et al., 2011; Cates et al., 2010; Dempsey et al., 2009; Gerend et al., 2009; Gottlieb et al., 2009; Guerry et al., 2011; Hughes et al., 2009; Reiter et al., 2009; Reiter et al., 2011; Rosenthal et al., 2008; Ziarnowski, Brewer, & Weber, 2009).

In the few studies that examine parental HPV vaccine acceptance from a theoretical perspective (Brewer et al., 2011; G. Ogilvie et al., 2010), the most commonly employed theory is the health belief model (HBM) (Rosenstock,

1974). Indeed, the HBM is one of the most widely used theoretical frameworks to study a range of health-related behaviours (K. Glanz, Rimer, & Viswanath, 2008), including cancer preventive behaviours (Janz & Becker, 1984; Tanner-Smith & Brown, 2010). According to this model, HPV vaccination acceptability is determined by five factors: 1) perceived susceptibility to HPV, 2) perceived severity of HPV, 3) the belief that the HPV vaccine will be beneficial in preventing the illness, 4) the belief that the barriers to the HPV vaccine will be outweighed by the benefits, and 5) external influences prompting HPV vaccine uptake.

The current study addresses two critical questions. First, what are the key differences between parents who accept and parents who refuse the HPV vaccine for their daughters? Second, is the HBM as a theoretical framework adequate for guiding understanding of parental vaccination decision making?

Based on the HBM, we hypothesized that parental acceptance of the HPV vaccine will be related to greater perceived susceptibility of daughters to HPV infection, greater perceived severity of the infection, more perceived benefits of the vaccine, fewer perceived barriers, and more cues to action (after controlling for socio-demographic factors). Second, beyond the HBM constructs, we hypothesized that facilitating, individual factors such as positive vaccination attitudes, perceived vaccine safety, anticipated inaction regret (worry about regretting not accept the vaccine) and HPV and HPV vaccine knowledge; behavioural factors, including adherence to routinely recommended vaccination; and social factors, including positive media exposure and social norms, would be associated with vaccine acceptability. Lastly, we expected that perceived safety

and HPV knowledge would be significant independent contributors beyond all other HBM constructs and would improve the overall fit of the model.

Method

Participants & Procedures

The present study is a cross-sectional survey of parents whose daughters were in grade 4 (9-10 years old) during the 2008-2009 school year in Quebec, Canada. Since 2008, in Quebec, all grade 4 girls have become eligible for the HPV vaccine in a school-based, universal, opt-in vaccination program free of charge. A stratified random sample of 2500 parents of 9-10 year old girls was identified using the Régie de l'assurance maladie du Québec (RAMQ) database, and parents invited to participate in the study by mail. Invitation letters and questionnaires were sent in either French or English according to the family's preferred language of correspondence provided by RAMQ. Participants who returned their completed questionnaires were compensated with a CAN$15.00 gift certificate from a local bookshop. The study was approved by the Commission d'accès à l'information du Québec (CAIQ) and received ethical approval from the McGill University Institutional Review Board.

Measures

The questionnaire development was guided by the HBM and enriched by adding questions assessing other relevant information found in the literature. Questions assessing each theoretical construct were based on previous parental HPV vaccine acceptability research, adapted for the purpose of this study with authors' permission (Dempsey et al., 2006; Krawczyk et al., 2012). A preliminary

questionnaire was administered to 10 parents to ensure comprehension, reading ease, and scale reliability. The outcome measure of the study, HPV vaccine uptake, was assessed with the question: "Has your daughter received the HPV vaccine?" Response to this question was dichotomous (yes, no).

Potential HBM constructs related to vaccination acceptance were assessed using 7-point Likert scales ranging from 1 (strongly disagree) to 7 (strongly agree). Constructs that were measured using three or more items were evaluated for internal consistency using Cronbach's alpha. *Perceived daughter's susceptibility to HPV* was assessed using a 3-item scale (α = .88; e.g. "it was likely that my daughter would contract HPV"). *Perceived severity of HPV* was assessed using a 4-item scale (α = .83; e.g." I believed that it would be serious if my daughter contracted HPV"). *Perceived benefits of the HPV vaccine* were assessed using a 3-item scale (α = .74; e.g. "I believed that the HPV vaccine is effective in preventing HPV"). *Perceived barriers to the HPV vaccine* were assessed using a 9-item scale (α = .73; e.g. "the HPV vaccine would encourage sexual activity"). *Cues to action* were assessed using a 5-item scale (α = .69; e.g. "I was prompted to get the vaccine for my daughter by a health care provider"). In addition potential cognitive, behavioural, and social factors related to vaccination acceptance found in the literature were assessed: *General vaccination attitudes* (positive and negative attitudes) were measured with a 10-item scale (Fazekas et al., 2008). *Perceived safety of the HPV vaccine* was assessed with the statement: "Before I made the decision about the vaccine I believed that the HPV vaccine is safe"; *Fear of regret about the decision* was assessed with two statements: "Before I made the decision about the vaccine, I worried that I would

regret having my daughter vaccinated" and "Before I made the decision about the vaccine, I worried that I would regret not having my daughter vaccinated"; *Positive and negative media influence* were assessed with two statements: "Before I made the decision about the vaccine, what I had heard about the HPV vaccine in the media (TV, radio, newspapers, magazines, the internet, etc.) had been positive/negative". *Perceived social norms* was evaluated with the statement: "Most people who are important to me thought I should have my daughter receive the HPV vaccine". All the above factors were measured using a 7-point scale ranging from 1 (strongly disagree) to 7 (strongly agree). *HPV and HPV vaccine objective knowledge* were assessed using a 16-item knowledge test based on information from the Society of Obstetricians and Gynecologists of Canada (2009). Participants answered, "true", "false", or "don't know" to each of the 16 statements (e.g. "HPV is the most common sexually transmitted infection" and "The HPV vaccine protects against genital warts"). Correct answers were summed to create a total knowledge score for each participant. Finally, *Mistrust in pharmaceutical companies* was assessed with the statement: "I am concerned that my daughter's health is not the primary objective of the HPV vaccine's manufacturers" with dichotomous (yes, no) response options.

Participant's demographic information included: age, gender, ethnicity, language, marital status, educational level, annual family income, and religious affiliation. Contribution of religion affiliation towards the vaccination decision was evaluated with the statement: "My religious affiliation affected my decision about the vaccine" and measured using a 7-point scale ranging from 1 (strongly disagree) to 7 (strongly agree). Finally, participants were asked questions

regarding previous experience with cancer and STI's and at what age they anticipate that their daughter would become sexually active (Table 1).

Statistical Analyses

Before testing the study's hypotheses, we performed basic descriptive statistics, and chi-square and independent-sample *t*-tests to identify socio-demographic differences between parents who accepted the vaccine for their daughters (acceptors) and parents who did not accept the vaccine (non-acceptors). To test our first and second hypotheses (that the HBM constructs will be related to vaccination acceptance and that additional constructs identified as relevant in the literature will be also related to vaccination acceptance, respectively) we conducted univariate logistic regression analyses. To test our third hypothesis, namely whether perceived safety and knowledge are independent contributors beyond other HBM constructs, a multivariate logistic regression model was conducted. Discrimination and calibration of the logistic regression models were assessed with the c-index and Hosmer-Lemeshow goodness-of-fit test statistic (HL), respectively (Hosmer & Lemeshow, 2000). The c-index for the model reflects the percentage of comparisons where parents who have high values of a specific variable, had a higher probability of vaccine acceptance than parents who endorsed low levels of the later variables for all possible pairs of parents in the sample, one of whom reported high values and the other of whom reported low values. The HL is a measure of the accuracy of the predicted number of cases of vaccination acceptance compared to the number of parents who actually reported vaccine acceptance across the spectrum of probabilities. A large *p* value indicates

a good model fit. All analyses were conducted using SPSS version 20.0 for Mac, and all statistical tests were 2-sided with a $p < .05$ significance level.

Results

A total of 834 parents returned the questionnaire. The overall response rate was 33%, which is similar to other studies of this type (Middleman & Tung, 2010; Petty, Callahan, Chen, Edwards, & Dempsey, 2010). Five questionnaires were discarded due to missing the outcome variable. Of the 829 parents who reported their decision whether to accept or reject the vaccine for their daughters 774, (92.8%) had complete data for all relevant items and were included in the present analyses.

Participants Characteristics

As shown in Table 2, the sample was quite homogenous consisting of 95.7% female, 88.5% white, 90.6% French speaking, and 84% Christian parents. Participants' ages ranged from 26 to 58 ($M = 40.2$, $SD = 5.97$).

A total of 683 (88.2%) parents reported accepting the HPV vaccine for their daughters. French speaking participants were more likely to accept the vaccine than English speaking participants, χ^2 (1, $N = 774$) = 34.65, $p < .001$. White/European and Christian participants were more likely to accept the vaccine than Non-White/European or Non-Christian participants, χ^2 (2, $N = 774$) = 12.26, $p < .01$, and χ^2 (2, $N = 774$) = 10.70, ($p < .01$), respectively. No significant differences were found between acceptors and non-acceptors when comparing education attainment (those who achieved some university or higher degree of

schooling compared those with lower levels of education) or income (below or above CAD 100,000 a year).

Factors related to vaccination acceptance

As predicted by our first hypothesis, on an unadjusted basis, vaccination acceptance was associated with four of the five HBM constructs: higher perceived susceptibility, more benefits, less barriers, and more cues to action (Table 3). In accordance with our second hypothesis, beyond the HBM constructs, facilitating individual behavioural, social factors found in the literature were related to HPV vaccination acceptance including, general vaccination attitudes, HPV vaccine safety, perceived regret, trust in pharmaceutical companies, adherence to recommended vaccines, media exposure about the HPV vaccine, and perception of social norms towards the vaccination decision (Table 2).

In regards to our third hypothesis, perceived safety was a significant independent contributor beyond all other HBM constructs and improved the final model fit. Parents who perceived higher levels of vaccine safety were almost twice as likely to accept the vaccine compared with parents who perceived lower levels of vaccine safety. The HBM constructs included in the multivariate model had good discriminative power (c-index = .89), calibration (p = .53 for the HL statistic) and model fit (NagelkerkeR^2 = 0.51). Knowledge, while not significantly related to vaccine acceptance in the univariate analysis (p = .53), was related to vaccine acceptance in the context of the multivariate model (Table 3). The possible interaction between knowledge and perception of safety was tested *post hoc* and was not statistically significant.

Discussion

In accordance with our first hypothesis, the results of this study provide further support for the relationship between individual cognitive variables proposed by the HBM (perceived susceptibility of daughters to HPV infection, perceived benefits of the vaccine, perceived barriers, and cues to action) and health behaviour, in this instance, to the uptake of the HPV vaccine. However, in line with our second hypothesis, the results show that behavioural factors (past vaccination behaviour), social factors (media influence, social support), and other cognitive factors beyond the ones proposed by the HBM (general vaccination attitudes, perceived safety of the vaccine, anticipated regret, trust in pharmaceutical companies), were also associated with vaccination uptake. These results suggest that the HBM may be useful but not sufficient to fully understand vaccination decision making.

Particularly, parental perception of vaccine safety appears to be a pre-requisite for vaccine acceptance; indeed, a deal breaker beyond perceived risk of the actual disease. Parents may be reluctant to vaccinate their children when they perceive that a vaccine may cause negative outcomes, even if the disease that would be prevented is worse (Ritov & Baron, 1990).

Due to the novelty of the HPV vaccine, some parents may not be convinced about its long-term safety and may prefer to wait until the results long-term research (beyond 10 years) are available. To date, two types of HPV vaccines are currently licensed in over 100 countries and have been shown to be highly efficacious in the short to medium term (Einstein et al., 2011). The bivalent vaccine protects against two HPV types (HPV-16/18) that lead to cervical cancer

and the quadrivalent vaccine protects against these same two HPV types plus two other HPV types (HPV-6/11) that cause genital warts. Among published studies, the bivalent vaccine has been shown to be effective up to 7.3 years (De Carvalho et al., 2010) while the quadrivalent vaccine (the vaccine that was received by the daughters of this study's participants) has been shown to be effective up to 5 years post-vaccination for the licensed vaccine (Villa et al., 2006) and up to 8.5 years for a HPV-16 monovalent vaccine prototype (Rowhani-Rahbar et al., 2009). Serious adverse events have been spontaneously and voluntarily reported following vaccination, but because these reports come from an uncertain size population, it is impossible to reliably estimate their frequency or to establish a causal relationship to vaccine exposure (Merck Sharp & Dohme Corporation, 2011). Several studies evaluating adverse events after vaccination have concluded that there is no evidence to date of severe adverse events occurring after vaccination (Bonanni et al., 2011; Gee et al., 2011; Haupt & Sings, 2011).

In the particular case of newly approved vaccines, it is important to understand and acknowledge that parental concerns regarding the long-term safety of the vaccine are understandable and that parents, when accepting to vaccinate their children with "new vaccines", are faced with a difficult decision and much uncertainty. Parents' worries need to be taken seriously and addressed appropriately, for example with public health messages communicating the results of studies on long-term safety as they become available. Longer-term studies will continue to gather safety information and with time, parental perception of the HPV vaccine safety will likely increase. However, it will also be important to address parents' emotional reactions to anxiety-provoking events reported by the

media or trusted individuals (e.g. individual examples of adverse effects followed vaccination, but unrelated to the vaccine) because parents may base their future vaccination decisions on not only scientific evidence but also intuitive judgements (Slovic, 1987). Nevertheless, in this study, the majority of parents had their daughters vaccinated. Therefore, while safety concerns are related to vaccination refusal, they were not prevalent in this sample.

This study found that parents who were more knowledgeable about the HPV and vaccine were not more likely to accept the vaccine. Although a clear critical factor in enabling informed decisions, the role of HPV and HPV vaccine knowledge in parental vaccination decision making remains unclear with some studies showing a positive relationship (Allen, Othus, et al., 2010; Brewer et al., 2011; Guerry et al., 2011) and others showing no or negative relationships (Gerend et al., 2009; Leader, Weiner, Kelly, Hornik, & Cappella, 2009). The heterogeneity of study results may be explained by the fact that information of the HPV vaccine is continually being updated. For example, since the original vaccination approval in 2006, HPV vaccine approval/recommendations have changed several times (approved for older women, approved and recommended for young men; Center for Disease Control and Prevention, 2010; Einstein et al., 2011). In addition, research limitations such as the lack of consistent use of validated measures across studies (Allen, Coronado, et al., 2010), or differences in conceptualization of knowledge constructs (measures of factual information versus parental subjective believes that they have sufficient information) may further contribute to the different results across studies.

Contrary to our expectations, a small but significant decrease in likelihood of parental vaccine acceptability was found when parental level of knowledge was added to the other factors in the HBM model. Although these results should be interpreted with caution because of the lack of significance of knowledge when evaluated at the univariate level, the following questions should be addressed in future research. Do parents who already have doubts about the vaccine seek more information? What is the role of individual differences such as information-seeking style in vaccination decision making? Is it that for some parents having high amount of information actually predicts vaccine refusal? Is vaccination refusal related to the quality of information obtained from untrusted sources (e.g. untrusted internet websites)?

According to our final hypothesis, when perceived vaccine safety and HPV knowledge factors were included in the theoretical model, results indicated a better model fit and the particular contribution of parental perception of vaccine safety beyond all other factors. Vaccination safety indeed appears to be currently at the heart of parents who did not accept the vaccine.

Further, the HBM may not be a sufficient model to fully explain parental vaccination decision-making. In fact, despite its intuitive relevance to immunization behaviour, the HBM has important limitations. In a recent study (Brewer et al., 2011), critical health belief model constructs (perceived risk, perceived severity, and physician recommendation as a cue to action) were not associated with vaccination acceptance despite contrary results in previous studies from the same group (Brewer & Fazekas, 2007; Reiter et al., 2009; Ziarnowski et al., 2009) supporting the idea that the HBM may be not an adequate model to

explain parental vaccination decision making. The HBM does not specify how different beliefs influence one another (Rutter & Quine, 2002). Further, this model does not stipulate how to operationalize each of its constructs. Overall, different studies have utilized different combinations of variables, treated variables differently in the analysis, or applied different operational definitions to the model constructs (Rutter & Quine, 2002).

In this study, 88% of our sample reported accepting the vaccine. French-speaking parents were significantly more likely than English speaking parents to accept the HPV vaccine. There were also differences in uptake between parents who self-reported their religious affiliation as Christian and those who reported other non-Christian religions. Results should be interpreted with caution because the study did not have enough power to evaluate distinctions between non-Christian religious sub-groups. Indeed, the results may be reflecting the degree that parents are practicing their religion – the higher parents rated their religion as influencing their decision, the less likely they were to accept the HPV vaccine, regardless of their religious affiliation. The complex cultural and language issues of the province of Quebec are beyond the scope of this study. However, future studies exploring language, religious, and cultural differences of parents in relation to vaccination uptake are needed.

Research implications

In spite of its many limitations including lack of operational definitions and specification of relations between its factors, the HBM is still being widely used in various health research areas including HPV vaccine decision making. Nevertheless, health behaviour change theories should not be considered static

and used only in the manner they were initially formulated, but should dynamically evolve over time (Weinstein & Rothman, 2005). Despite its usefulness for identifying the relationship between already well-established factors (e.g. perceived susceptibility to a disease) and parental HPV vaccination acceptance, the HBM as originally proposed combined with cross-sectional study designs, does not allow for causal explanations of parental vaccination decision making. New models that incorporate critical components beyond individual health beliefs, such as social-environmental factors, family's interface with the health care system, institutional policies, and physical environment should be developed and tested (Sturm et al., 2005). Parental decision-making styles (e.g. active vs. passive decision making) as well as interaction between parents and their daughters have also been described as important factors involved in parental HPV decision-making behaviour (Cooper Robbins, Bernard, McCaffery, Brotherton, & Skinner, 2010). Future research should develop and test new, integrated, and expanded conceptual frameworks of parental vaccination decision making. Importantly, parental perceived safety as well as perceived risks, not only about the HPV but also about the HPV vaccine should be taken into consideration as a central concept in parental decision making.

Strengths and Limitations

The study has several strengths including the evaluation of a theoretical model in a population-based sample of parents who already had made a “real life” decision about vaccinating their daughters with the HPV vaccine as opposed with studies of only intentions to vaccinate. Further, the study allowed for exploration of barriers to vaccination beyond the high cost of the vaccine because parents

were offered the vaccine at no cost in the context of a universal school-based program.

At the same time several limitations of this study should be considered. The cross-sectional design and the correlational nature of the data do not allow for causal attribution that the factors proposed in the study are determinants of parental decision making. Only well-controlled experimental studies would be able to answer this question. The retrospective nature of the study design it also limits the validity of the results, and longitudinal studies (pre-post vaccination) should be developed in the future. Although the response rate was similar to other surveys of this type, generalizability of the results is a concern.

Conclusions

This study advances the understanding of parental HPV vaccination decision making by showing that although the HBM is a useful framework to identify possible factors related to parental vaccination acceptance, it is not sufficient to encompass the complexities of this decision-making process. Specifically, perceived vaccine safety currently appears to be an important factor in parents' decisions of whether or not to have their daughters vaccinated against HPV. New theories should be developed to explain how parents decide to accept or reject the HPV vaccine for their daughters. In addition to the prevention of HPV, this research will contribute to the study of acceptability of new vaccines against other oncogenic and/or sexually transmitted infections (e.g. HIV) that may likely be developed in the near future. Without a doubt, perception of vaccine safety is a critical factor for vaccination acceptance. Future explanatory theories of parental vaccination decision making should build on previous research and

test potentially critical and modifiable factors in well-controlled experimental and longitudinal studies. By informing the development of targeted interventions to increase vaccination acceptability, understanding the causes behind parental vaccination decisions will promote the success of future vaccination programs.

Table 1

Demographic and other Parental Characteristics

Characteristics *n* (%)	Total sample (*N*=774)	Acceptors (*n* = 683)	Non-acceptors (*n* = 91)
Language			
French	701 (90.6)	634 (92.8)	67 (73.6)
English	73 (9.4)	49 (7.2)	24 (26.4)
Ethnicity			
White / European	685 (88.5)	614 (89.9)	71 (78.0)
Arabic / Middle Eastern / North African	14 (1.8)	12 (1.8)	2 (2.2)
Black / Caribbean / African	11 (1.4)	7 (1.0)	4 (4.4)
First Nations/ Metis / Aboriginal	16 (2.1)	14 (2.0)	2 (2.2)
Other	19 (2.5)	12 (1.8)	
Missing	29 (3.7)	24 (3.5)	7 (7.7)
			5 (5.5)
Religion			
Christian	644 (83.2)	579 (84.8)	65 (71.4)
Jewish	6 (0.8)	3 (0.4)	3 (3.3)
Muslim	11 (1.4)	8 (1.2)	3 (3.3)
Eastern non-Christian	21 (2.7)	18 (2.6)	3 (3.3)
Other	82 (10.6)	66 (9.7)	16 (17.6)
Not affiliated	2 (0.3)	2 (0.3)	0.0 (0)
Missing	8 (1.0)	7 (1.0)	1.0 (1.1)
Family income (CAD $)			
Less than $30,000	72 (9.3)	63 (9.2)	9 (9.9)
$30,000-$59,999	204 (26.4)	184 (26.9)	20 (22.0)
$60,000-$100,000	236 (30.5)	210 (30.7)	26 (28.6)
Above $100,000	234 (30.2)	203 (29.7)	31 (34.1)
Missing	28 (3.6)	23 (3.4)	5 (5.5)
Marital status			
Single	67 (8.7)	59 (8.6)	8 (8.8)
Married	358 (46.3)	308 (45.1)	50 (54.9)
Common law	264 (34.1)	245 (35.9)	19 (20.9)
Divorced / Separated	68 (8.8)	56 (8.2)	12 (13.2)
Widowed	11 (1.4)	10 (1.5)	1 (1.1)
Missing	6 (0.8)	5 (0.7)	1 (1.1)

Characteristics n (%)	Total sample (N=774)	Acceptors (n = 683)	Non-acceptors (n = 91)
Educational attainment			
Elementary school or some high school	30 (3.9)	26 (3.8)	4 (4.4)
High school graduate	91 (11.8)	79 (11.6)	12 (13.2)
CEGEP or professional school	285 (36.8)	261 (38.2)	24 (26.4)
Some university	80 (10.3)	69 (10.1)	11 (12.1)
University graduate	283 (36.6)	243 (35.6)	40 (44.0)
Missing	5 (0.6)	5 (0.7)	0.0 (0)
Ever had or know anyone close who has had an STI			
Yes	252 (32.6)	224 (32.8)	28 (30.8)
No	517 (66.8)	454 (66.5)	63 (69.2)
Missing	5 (0.6)	5 (0.7)	0.0 (0)
Ever had or know anyone close who has had had cancer			
Yes	527 (68.1)	464 (67.9)	63 (69.2)
No	247 (31.9)	219 (32.1)	28 (30.8)

Table 2

Univariate Logistic Regression Analysis for Variables Related to Parental HPV Vaccine Acceptability

Variable	*Odds Ratio*	*(95% CI)*	*p*
Participants Characteristics			
Language (French-English)	*4.63*	*(2.67-8.02)*	*<.001*
Religion influence on decision	*0.87*	*(0.75-0.98)*	*<.05*
Past Vaccination behaviour			
Complied with all the recommended vaccines for their children in the past	0.14	(0.07-0.25)	<.001
Have refused a vaccine for their child in the past	*1.96*	*(1.24-3.10)*	*<.001*
Social norms			
"Most people that are important to me thought that I should have my daughter received the HPV vaccine"	*1.65*	*(1.43-1.91)*	*<.001*
General vaccination attitudes			
Positive attitudes	*1.13*	*(1.08-1.18)*	*<.001*
Negative attitudes	*0.89*	*(0.86-0.92)*	*<.001*
Worry about vaccine sexual consequences			
The vaccine would encourage sexual activity	*0.77*	*(0.66-0.90)*	<.001
Sexually active at an earlier age	*0.76*	*(0.65-0.88)*	<.001
"My daughter will be judged if she receives the vaccine"	*0.80*	*(0.65-0.99)*	<.001

Variable	*Odds Ratio*	*(95% CI)*	*p*
Fear of regret decision			
Regret accepting vaccine	*0.61*	*(0.54-0.69)*	<.001
Regret not accepting vaccine	*1.69*	*(1.50-1.91)*	<.001
Media Influence			
Positive media influence	*1.64*	*(1.43-1.90)*	<.001
Negative media influence	*0.65*	*(0.56-0.75)*	<.001

Table 3

Univariate and Multivariate Logistic Regressions Comparing Acceptors and Non-acceptors

Variable	*Univariate Odds Ratio (95% CI)*	*p*	*Model 1 Multivariate Odds Ratio (95% CI)*	*p*	*Model 2 Multivariate Odds Ratio (95% CI)*	*p*
Susceptibility	1.12 (1.06-1.18)	<.001	1.06 (0.97-1.12)	.108	1.07 (1.00-1.15)	.061
Severity	1.05 (1.00-1.11)	.074	1.01 (0.94-1.08)	.848	1.01 (0.94-1.09)	.773
Benefits	1.27 (1.20-1.36)	<.001	1.15 (1.06-1.24)	<.001	1.03 (0.93-1.15)	.571
Barriers	0.92 (0.90-0.95)	<.001	0.93 (0.90-0.96)	<.001	0.94 (0.91-0.98)	<.01
Cues to Action	1.23 (1.18-1.28)	<.001	1.21 (1.15-1.26)	<.001	1.19 (1.14-1.25)	<.001
Knowledge	0.98 (0.91-1.05)	.526	-	-	0.87 (0.80-0.96)	<.01
Safety	2.30 (1.96-2.71)	<.001	-	-	1.73 (1.36-2.21)	<.001

Note: Adjusted for language, ethnicity, and religion

GENERAL DISCUSSION

This dissertation sought to examine psychosocial and behavioural factors involved in the decision-making related to uptake of the human papillomavirus vaccine. Using the health belief model (HBM) and theory of planned behaviour (TPB) as theoretical frameworks in a sample of female university students, the aim of Study 1 was to explore differences between correlates of HPV vaccination intentions and uptake. The study found that several factors were significant correlates of vaccination intentions including: negative health consequences of the vaccine, physician's recommendation, positive attitudes toward the vaccine, and subjective norms. When comparing correlates of vaccination intentions to correlates of vaccination uptake, physician's recommendation, subjective norms, and perceived susceptibility to HPV were unique correlates of uptake (Krawczyk et al., 2012).

The objective of Study 2 was to examine the relationship between objective HPV and HPV vaccination knowledge and young men's HPV vaccination intentions. The study demonstrated that higher levels of perceived knowledge and objective HPV vaccine knowledge were associated with vaccination intentions. In particular, perceived knowledge was significantly associated with vaccination intentions even when accounting for objective HPV and HPV vaccine knowledge. Study 3 sought to build on these previous findings by developing and comparing two modalities of an educational intervention designed to increase HPV knowledge and vaccine acceptability. The study found that the written and video interventions were successful in increasing knowledge and vaccination intentions in young men and women, but no differences were

found between written and video interventions (Krawczyk et al., in press). Finally, Study 4 aimed to identify key differences between parents who accept and parents who refuse the HPV vaccine for their daughters. The study found that the HBM constructs (perceived susceptibility of daughters to HPV infection, perceived benefits of the vaccine, perceived barriers, and cues to action) successfully distinguished between parents who accept and parents who refuse the HPV vaccine. Importantly, parental perception of vaccine safety was the strongest factor associated with vaccination acceptance and a significant independent contributor beyond all other HBM constructs. In addition, the study demonstrated that other factors were also associated with parental vaccination acceptance including: general vaccination attitudes, anticipated regret, adherence to other routinely recommended vaccines, social support, and positive media influence.

It is well established that persistent infection with HPV causes most cervical cancers and is associated with many other types of cancers and genital warts. As with other serious communicable diseases that were eradicated through vaccination in the past, fostering HPV vaccination uptake to eradicate HPV and ensure population health is critical. However, despite the fact that cervical cancer is a particularly deadly threat in resource-poor countries, the vaccine remains too expensive to be introduced in those countries (Tota et al., 2011).

In Quebec, where the vaccine is typically covered by the government or by private insurance, parents and young adults' vaccination attitudes and beliefs are important barriers to vaccination uptake. To better understand how people's beliefs are related to HPV vaccination acceptance, the present dissertation explored not only correlates of vaccination intentions, but also correlates of

vaccination uptake. Study 1 is the first to compare factors related to young women's HPV vaccination intentions versus actual behaviours using a theoretical framework. Study 4 is the first to explore HPV vaccination uptake in the context of the universal vaccination program in Quebec. The findings from these studies provided new knowledge about the critical psychosocial and behavioural factors that influence whether or not parents decide to vaccinate their daughter against HPV. Likewise, the findings also provided knowledge about factors related to vaccination uptake in young adults. Therefore, results of these studies could advise the development of innovative interventions to increase informed HPV vaccination decision making. By enhancing physician-patient communication, and fostering provision of accurate, sensitive and clear information, future interventions could enhance vaccination uptake. Importantly, the present results could also inform public health practice about acceptability of new vaccines against other oncogenic and/or sexually transmitted infections that may likely be developed in the near future.

From a theoretical perspective, this dissertation contributed to the understanding of the complex decision-making process regarding a particular cancer preventive behaviour: acceptance of the HPV vaccine. In particular, it provided not only insight on how the health belief model constructs are related to vaccination intentions and uptake, but also how other important factors are related to vaccination decisions. Therefore, in order to understand HPV vaccination behaviour, new and all-encompassing explanatory theories should be developed and tested using experimental and longitudinal designs. The results of this study open some questions for future exploration. First, is the HPV vaccination

decision-making process different when it is personal (deciding for one self) from when it involves deciding for someone else (in particular parent deciding for their child)? According to the present results, while social norms and significant others recommendations appear to be critical for young adults deciding for themselves, perception that the vaccine is safe for their children is a critical factor for parents.

Second, do individuals have more difficulty deciding to accept a vaccine that protects against long term risks and provides long term benefits (e.g. parents having to make a decision when daughter is 10 years old in order to prevent a disease that might occur much later in her life) than vaccination decisions that involve an imminent risk?

Third, are decisions about vaccines that target an STI different from decisions about other vaccines? Parents are forced to think about their daughters eventually engaging in sexual activity and young adults are made aware of possible dangers of sexual encounters. Does the fact that HPV is an STI affect vaccination decision-making? For example, although there is no evidence that a STI vaccine will promote sexual activity, parental perceptions that the vaccine's protection will permit increases in sexual activity may influence their decisions.

Finally, any vaccination decision has social consequences. Sometimes what is best for an individual is not best for the whole population and vice versa. What is the role of altruism and individualism in influencing vaccination decisions when perceptions of personal risk are low?

A limitation of the present body of work is the cross-sectional and correlational nature of the study designs. Therefore, conclusions regarding causal

factors that determine vaccination are unfeasible. Future longitudinal, randomized lab and field experiments are needed (Noar & Mehrotra, 2011).

An important strength of the present dissertation is the inclusion of studies in different populations to obtain an overall view of the various barriers and facilitators involved in HPV vaccination decision-making. Currently, more than thirty vaccines against infectious diseases are used and new vaccines will become increasingly available in the near future. The benefits of vaccinations are outstanding. However, no vaccine offers 100% safety and extremely rare side effects may occur (Kwok, 2011). Understanding how to help individuals and groups make informed decision to protect their own and their family's health by uptake of new vaccines is an ongoing challenge and a worthwhile effort.

References

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes, 50*(2), 179-211. doi: 10.1016/0749-5978(91)90020-t

Albada, A., Ausemsb, M., Bensinga, J. M., & van Dulmen, S. (2009). Tailored information about cancer risk and screening: A systematic review. *Patient Education and Counseling, 77*(2), 155. doi: 10.1016/j.pec.2009.03.005

Albarracín, D., Gillette, J. C., Earl, A. N., Glasman, L. R., Durantini, M. R., & Ho, M. H. (2005). A Test of Major Assumptions About Behavior Change: A Comprehensive Look at the Effects of Passive and Active HIV-Prevention Interventions Since the Beginning of the Epidemic. *Psychological Bulletin, 131*(6), 856-897. doi: 10.1037/0033-2909.131.6.856

Allen, J. D., Coronado, G. D., Williams, R. S., Glenn, B., Escoffery, C., Fernandez, M., . . . Mullen, P. D. (2010). A systematic review of measures used in studies of human papillomavirus (HPV) vaccine acceptability. *Vaccine, 28*(24), 4027-4037. doi: 10.1016/j.vaccine.2010.03.063

Allen, J. D., Mohllajee, A. P., Shelton, R. C., Othus, M. K. D., Fontenot, H. B., & Hanna, R. (2009). Stage of adoption of the human papillomavirus vaccine among college women. *Preventive Medicine, 48*(5), 420-425.

Allen, J. D., Othus, M. K. D., Shelton, R. C., Li, Y., Norman, N., Tom, L., & del Carmen, M. G. (2010). Parental decision making about the HPV vaccine. *Cancer Epidemiol Biomarkers Prev, 19*(9), 2187-2198. doi: 10.1158/1055-9965.Epi-10-0217

Anhang, R., Goodman, A., & Goldie, S. J. (2004). HPV communication: Review of existing research and recommendations for patient education. *CA: A Cancer Journal for Clinicians, 54*(5), 248-259. doi: 10.3322/canjclin.54.5.248

Arbyn, M., Castellsagué, X., de Sanjosé, S., Bruni, L., Saraiya, M., Bray, F., & Ferlay, J. (2011). Worldwide burden of cervical cancer in 2008. *Annals of Oncology, 22*(12), 2675-2686. doi: 10.1093/annonc/mdr015

Armstrong, A. W., Idriss, N. Z., & Kim, R. H. (2011). Effects of video-based, online education on behavioral and knowledge outcomes in sunscreen use: A randomized controlled trial. *Patient Education and Counseling, 83*(2), 273-277. doi: 10.1016/j.pec.2010.04.033

Baer, H., Allen, S., & Braun, L. (2000). Knowledge of human papillomavirus infection among young adult men and women: Implications for health education and research. *Journal of Community Health, 25*(1), 67-78.

Baron, R. M., & Kenny, D. A. (1986). The moderator–mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. *Journal of Personality and Social Psychology, 51*(6), 1173.

Barr, E., Gause, C. K., Bautista, O. M., Railkar, R. A., Lupinacci, L. C., Insinga, R. P., . . . Haupt, R. M. (2008). Impact of a prophylactic quadrivalent human papillomavirus (types 6, 11, 16, 18) L1 virus-like particle vaccine in a sexually active population of North American women. *American Journal of Obstetrics and Gynecology, 198*(3), 261.e1-261.e11. doi: 10.1016/j.ajog.2007.09.001

Barr, E., & Sings, H. L. (2008). Prophylactic HPV vaccines: New interventions for cancer control. *Vaccine, 26*(49), 6244-6257. doi: 10.1016/j.vaccine.2008.07.056

Baseman, J. G., & Koutsky, L. A. (2005). The epidemiology of human papillomavirus infections. *Journal of Clinical Virology, 32* (Suppl 1), S16-24.

Bendik, M., Mayo, R., & Parker, V. (2011). Knowledge, perceptions, and motivations related to HPV vaccination among college women. *Journal of Cancer Education*, *26*(3) 459-464. doi: 10.1007/s13187-011-0200-8

Boehner, C. W., Howe, S. R., Bernstein, D. I., & Rosenthal, S. L. (2003). Viral sexually transmitted disease vaccine acceptability among college students. *Sexually Transmitted Diseases, 30*(10), 774-778. doi: 10.1097/01.OLQ.0000078823.05041.9E

Bonanni, P., Cohet, C., Kjaer, S. K., Latham, N. B., Lambert, P., Reisinger, K., & Haupt, R. M. (2011). A summary of the post-licensure surveillance

initiatives for GARDASIL/SILGARD®. *Vaccine*, *28(30)*, 4719-4730. doi: 10.1016/j.vaccine.2010.04.070

Bornstein, J. (2009). The HPV vaccines--which to prefer? *Obstetrical and Gynecological Survey, 64*(5), 345-350. doi: 10.1097/OGX.0b013e31819f992e

Brabin, L., Roberts, S. A., Stretch, R., Baxter, D., Chambers, G., Kitchener, H., & McCann, R. (2008). Uptake of first two doses of human papillomavirus vaccine by adolescent schoolgirls in Manchester: prospective cohort study. *BMJ, 336*(7652), 1056-1058. doi: 10.1136/bmj.39541.534109.BE

Brandt, H. M., McCree, D. H., Lindley, L. L., Sharpe, P. A., & Hutto, B. E. (2005). An evaluation of printed HPV educational materials. *Cancer Control, 12*(Supplement). Retrieved from http://www.moffitt.org/CCJRoot/v12s5/pdf/103.pdf

Brewer, N. T., & Fazekas, K. I. (2007). Predictors of HPV vaccine acceptability: A theory-informed, systematic review. *Preventive Medicine 45*(2-3), 107-114. doi: 10.1016/j.ypmed.2007.05.013

Brewer, N. T., Gottlieb, S. L., Reiter, P. L., Mcree, A. L., Liddon, N., Markowitz, L., & Smith, J. S. (2011). Longitudinal predictors of human papillomavirus vaccine initiation among adolescent girls in a high-risk geographic area. *Sexually Transmitted Diseases, 38*(3), 197-204. doi: 10.1097/Olq.0b013e3181f12dbf

Brewer, N. T., Ng, T. W., McRee, A. L., & Reiter, P. L. (2010). Men's beliefs about HPV-related disease. *Journal of Behavioral Medicine, 33*(4), 274-281. doi: 10.1007/s10865-010-9251-2

Burchell, A. N., Richardson, H., Mahmud, S. M., Trottier, H., Tellier, P. P., Hanley, J., . . . Franco, E. L. (2006). Modeling the sexual transmissibility of human papillomavirus infection using stochastic computer simulation and empirical data from a cohort study of young women in Montreal, Canada. *American Journal of Epidemiology, 163*(6), 534-543. doi: 10.1093/aje/kwj077

Campbell, R., Starkey, F., Holliday, J., Audrey, S., Bloor, M., Parry-Langdon, N., . . . Moore, L. (2008). An informal school-based peer-led intervention for smoking prevention in adolescence (ASSIST): a cluster randomised trial. *The Lancet, 371*(9624), 1595-1602. doi: 10.1016/S0140-6736(08)60692-3

Canadian Cancer Society. (2010, March 8, 2010). Human papillomavirus (HPV). Retrieved September 13, 2010, from http://www.cancer.ca/Quebec/Prevention/Infectious%20agents/Human%20papillomavirus%20HPV.aspx?sc_lang=en&r=1

Canadian Cancer Society. (2011). *Canadian Cancer Statistics*. Available at http://www.cancer.ca/canada-wide/about%20cancer/cancer%20statistics.aspx

Canadian Immunization Committee. (2007). Recommendations on a human papillomavirus immunization program. Retrieved from http://www.phac-

aspc.gc.ca/publicat/2008/papillomavirus-papillome/papillomavirus-papillome-index-eng.php

Cancer Advocacy Coalition of Canada. (2008). Report card on cancer in Canada. *11*. Retrieved from http://www.advocacysolutions.ca/media/CACC%20Report%20Card%202008.pdf#page=7

Carlson, J. P., Vincent, L. H., Hardesty, D. M., & Bearden, W. O. (2009). Objective and subjective knowledge relationships: A quantitative analysis of consumer research findings. *Journal of Consumer Research, 35*(5), 864-876. doi: 10.1086/593688

Caskey, R., Lindau, S. T., & Alexander, G. C. (2009). Knowledge and early adoption of the HPV vaccine among girls and young women: Results of a national survey. *Journal of Adolescent Health, 45*(5), 453-462. doi: 10.1016/j.jadohealth.2009.04.021

Castellsague, X., Drudis, T., Canadas, M., Gonce, A., Ros, R., Perez, J., . . . Bosch, F. X. (2009). Human papillomavirus (HPV) infection in pregnant women and mother-to-child transmission of genital HPV genotypes: A prospective study in Spain. *BMC Infectious Diseases, 9*(1), 74. doi:10.1186/1471-2334-9-74

Cates, J. R., Shafer, A., Carpentier, F. D., Reiter, P. L., Brewer, N. T., McRee, A. L., & Smith, J. S. (2010). How parents hear about human papillomavirus

vaccine: Implications for uptake. *Journal of Adolescent Health, 47*(3), 305-308. doi:10.1016/J.Jadohealth.2010.04.003

Center for Disease Control and Prevention. (2007). Quadrivalent human papillomavirus vaccine: Recommendations of the Advisory Committee on Immunization Practices (ACIP). *Morbidity and Mortality Weekly Report, 56*(RR02), 1-24.

Center for Disease Control and Prevention. (2010). FDA licensure of quadrivalent human papillomavirus vaccine (HPV4, Gardasil) for use in males and guidance from the Advisory Committee on Immunization Practices (ACIP). *Morbidity and Mortality Weekly Report 59*, 630-632.

Center for Disease Control and Prevention. (2011). General Recommendations on Immunization: Recommendations of the Advisory Committee on Immunization Practices (ACIP). *Morbidity and Mortality Weekly Report, 60*(RR02), 1-60.

Centers for Disease Control and Prevention. (2010, May 28). FDA Licensure of Bivalent Human Papillomavirus Vaccine (HPV2, Cervarix) for Use in Females and Updated HPV Vaccination Recommendations from the Advisory Committee on Immunization Practices (ACIP). *Morbidity and Mortality Weekly Report* Retrieved June 20, 2010, from http://www.cdc.gov/mmwr/preview/mmwrhtml/mm5920a4.htm

Centers for Disease Control and Prevention. (2011). HPV Vaccines. *Human Papillomavirus (HPV)* Retrieved Feb 15, 2011, from http://www.cdc.gov/hpv/vaccine.html

Chapman, E., Venkat, P., Ko, E., Orezzoli, J. P., del Carmen, M., & Garner, E. I. O. (2010). Use of multimedia as an educational tool to improve human papillomavirus vaccine acceptability-A pilot study. *Gynecologic Oncology, 118*(2), 103-107. doi: 10.1016/j.ygyno.2010.04.010

Chaturvedi, A. K. (2010). Beyond cervical cancer: Burden of other HPV-related cancers among men and women. *Journal of Adolescent Health, 46*(4 SUPPL.), S20-S26. doi:10.1016/j.jadohealth.2010.01.016

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Hillsdale, N.J: Erlbaum Associates.

Conroy, K., Rosenthal, S. L., Zimet, G. D., Jin, Y., Bernstein, D. I., Glynn, S., & Kahn, J. A. (2009). Human papillomavirus vaccine uptake, predictors of vaccination, and self-reported barriers to vaccination. *Journal of Women's Health, 18*(10), 1679-1686.

Cooper Robbins, S. C., Bernard, D., McCaffery, K., Brotherton, J. M. L., & Skinner, S. R. (2010). "I just signed": Factors influencing decision-making for school-based HPV vaccination of adolescent girls. *Health Psychology, 29*(6), 618-625. doi: 10.1037/a0021449

Copenhaver, M. M., Johnson, B. T., Lee, I. C., Harman, J. J., & Carey, M. P. (2006). Behavioral HIV risk reduction among people who inject drugs: Meta-analytic evidence of efficacy. *Journal of Substance Abuse Treatment, 31*(2), 163-171. doi:10.1016/j.jsat.2006.04.002

Crosby, R. A., DiClemente, R. J., Salazar, L. F., Nash, R., & Younge, S. (2011). Gardasil for guys: correlates of intent to be vaccinated. *Journal of Men's Health, 8*(2), 119-125. doi: 10.1016/j.jomh.2011.03.001

Cuijpers, P. (2002). Effective ingredients of school-based drug prevention programs: A systematic review. *Addictive Behaviors, 27*(6), 1009-1023. doi: 10.1016/s0306-4603(02)00295-2

D'Urso, J., Thompson-Robinson, M., & Chandler, S. (2007). HPV knowledge and behaviors of black college students at a historically black university. *Journal of American College Health, 56*(2), 159-163. doi: 10.3200/JACH.56.2.159-164

Daley, E. M., Marhefka, S. L., Buhi, E. R., Vamos, C. A., Hernandez, N. D., & Giuliano, A. R. (2010). Human papillomavirus vaccine intentions among men participating in a human papillomavirus natural history study versus a comparison sample. *Sexually Transmitted Diseases, 37*(10), 644-652. doi: 10.1097/OLQ.0b013e3181e1a14c

Davis, K., Dickman, E. D., Ferris, D., & Dias, J. K. (2004). Human papillomavirus vaccine acceptability among parents of 10- to 15- year-old adolescents. *Journal of Lower Genital Tract Disease, 8*(3), 188-194.

Dawar, M., Deeks, S., & Dobson, S. (2007). Human papillomavirus vaccines launch a new era in cervical cancer prevention. *Canadian Medical Association Journal, 177*(5), 456-461. doi: 10.1503/cmaj.070771

De Carvalho, N., Teixeira, J., Roteli-Martins, C., Naud, P., De Borba, P., Zahaf, T., . . . Schuind, A. (2010). Sustained efficacy and immunogenicity of the HPV-16/18 AS04-adjuvanted vaccine up to 7.3 years in young adult women. *Vaccine, 28*, 6247-6255. doi: 10.1016/j. vaccine.2010.07.007

de Visser, R., Waites, L., Parikh, C., & Lawrie, A. (2011). The importance of social norms for uptake of catch-up human papillomavirus vaccination in young women. *Sexual Health, 8*(3), 330-337. doi: 10.1071/Sh10155

Dempsey, A. F., Abraham, L. M., Dalton, V., & Ruffin, M. (2009). Understanding the reasons why mothers do or do not have their adolescent daughters vaccinated against human Papillomavirus. *Annals of Epidemiology, 19*(8), 531-538. doi: 10.1016/J.Annepidem.2009.03.011

Dempsey, A. F., Gebremariam, A., Koutsky, L. A., & Manhart, L. (2008). Using risk factors to predict human papillomavirus infection: Implications for targeted vaccination strategies in young adult women. *Vaccine, 26*(8), 1111-1117. doi: 10.1016/j.vaccine.2007.11.088

Dempsey, A. F., Zimet, G. D., Davis, R. L., & Koutsky, L. (2006). Factors that are associated with parental acceptance of human papillomavirus vaccines: A randomized intervention study of written information about HPV. *Pediatrics, 117*(5), 1486-1493. doi: 10.1542/peds.2005-1381

Di Giuseppe, G., Abbate, R., Liguori, G., Albano, L., & Angelillo, I. F. (2008). Human papillomavirus and vaccination: Knowledge, attitudes, and behavioural intention in adolescents and young women in Italy. *British Journal of Cancer, 99*(2), 225-229.

Doherty, K., & Low, K. G. (2008). The Effects of a Web-Based Intervention on College Students' Knowledge of Human Papillomavirus and Attitudes toward Vaccination. *International Journal of Sexual Health, 20*(4), 223-232. doi: 10.1080/19317610802411177

Dunn, R. A., Shenouda, P. E., Martin, D. R., & Schultz, A. J. (1998). Videotape increases parent knowledge about poliovirus vaccines and choices of polio vaccination schedules. *Pediatrics, 102*(2), e26.

Dunne, E. F., Unger, E. R., Sternberg, M., McQuillan, G., Swan, D. C., Patel, S. S., & Markowitz, L. E. (2007). Prevalence of HPV Infection Among Females in the United States. *JAMA: The Journal of the American Medical Association, 297*(8), 813-819. doi: 10.1001/jama.297.8.813

Einstein, M. H., Baron, M., Levin, M. J., Chatterjee, A., Fox, B., Scholar, S., . . . Dubin, G. (2011). Comparative immunogenicity and safety of human papillomavirus (HPV)-16/18 vaccine and HPV-6/11/16/18 vaccine: Follow-up from Months 12–24 in a Phase III randomized study of healthy women aged 18–45 years. *7*(12), 1343 –1358. doi: http://dx.doi.org/10.4161/hv.7.12.18281

Fazekas, K. I., Brewer, N. T., & Smith, J. S. (2008). HPV vaccine acceptability in a rural Southern area. *Journal of Women's Health, 17*(4), 539-548. doi: 10.1089/jwh.2007.0489

Federal Drug Administration. (2006). FDA licenses new vaccine for prevention of cervical cancer and other diseases in females caused by human papillomavirus. Retrieved June 08, 2006 from http://www.fda.gov/NewsEvents/Newsroom/PressAnnouncements/2006/ucm108666.htm

Federal Drug Administration. (2009). FDA approves new indication for Gardasil to prevent genital warts in men and boys. Retrived October 16, 2009 from http://www.fda.gov/NewsEvents/Newsroom/PressAnnouncements/2009/ucm187003.htm

Ferlay, J., Shin, H.-R., Bray, F., Forman, D., Mathers, C., & Parkin, D. M. (2010). Estimates of worldwide burden of cancer in 2008: GLOBOCAN 2008. *International Journal of Cancer, 127*(12), 2893-2917. doi: 10.1002/ijc.25516

Ferris, D. G., Waller, J. L. M., J., Patel, P., Jackson, L., Price, G. A., & Wilson, C. (2008). Men's attitudes toward receiving the human papillomavirus vaccine. *Journal of Lower Genital Tract Disease, 12*(4), 276-281.

Fishbein, M. (2000). The role of theory in HIV prevention. *AIDS Care, 12*(3), 273-278. doi: 10.1080/09540120050042918

Fishbein, M., & Ajzen, I. (1975). *Belief, attitude, intention, and behavior: An introduction to theory and research*: Addison-Wesley Pub. Co. (Reading, Mass.)

Fisher, J. D., & Misovich, S. J. (1990). Social influence and AIDS-preventive behavior. In J. Edwards, R. S. Tindale, L. Heath & E. J. Posavac (Eds.), *Applying Social Influence Processes in Preventing Social Problems* (pp. 39-70). New York: Plenum Press.

Flynn, L. R., & Goldsmith, R. E. (1999). A short, reliable measure of subjective knowledge. *Journal of Business Research, 46*(1), 57-66. doi: 10.1016/s0148-2963(98)00057-5

Franco, E. L., & Harper, D. M. (2005). Vaccination against human papillomavirus infection: a new paradigm in cervical cancer control. *Vaccine, 23*(17-18), 2388-2394. doi: 10.1016/j.vaccine.2005.01.016

Frazer, I. H., Leggatt, G. R., & Mattarollo, S. R. (2011). Prevention and treatment of papillomavirus-related cancers through immunization. *Annual Review of Immunology, 29*(1), 111-138. doi: 10.1146/annurev-immunol-031210-101308

Garson, N., Chomez, P., & Van Mechelen, M. (2007). GlaxoSmithKline Adjuvant Systems in vaccines: Concepts, achievements and perspectives. *Expert Review of Vaccines, 6*(5), 723-739. doi: 10.1586/14760584.6.5.723

Gee, J., Naleway, A., Shui, I., Baggs, J., Yin, R., Li, R., Kulldorff, M., Lewis, E., Fireman, B., Daley, M., Klein, N. P., & Weintraub, E. S. (2011) Monitoring the safety of quadrivalent human papillomavirus vaccine: Findings from the Vaccine Safety Datalink. *Vaccine, 29*(46), 8279-8284. doi: 10.1016/j.vaccine.2011.08.106

Gerend, M. A., & Barley, J. (2009). Human papillomavirus vaccine acceptability among young adult men. *Sexually Transmitted Diseases, 36*(1), 58-62. doi: 10.1097/OLQ.1090b1013e31818606fc.

Gerend, M. A., & Magloire, Z. F. (2008). Awareness, knowledge, and beliefs about human papillomavirus in a racially diverse sample of young adults. *Journal of Adolescent Health, 42*(3), 237-242. doi: 10.1016/j.jadohealth.2007.08.022

Gerend, M. A., Weibley, E., & Bland, H. (2009). Parental response to human papillomavirus vaccine availability: Uptake and intentions. *Journal of Adolescent Health, 45*(5), 528-531. doi: 10.1016/J.Jadohealth.2009.02.006

Giede, C., McFadden, L. L., Komonoski, P., Agrawal, A., Stauffer, A., & Pierson, R. (2010). The acceptability of HPV vaccination among women attending the University of Saskatchewan Student Health Services. *Journal of Obstetrics and Gynaecology Canada, 32*(7), 679-686.

Gilbert, P., Brewer, N. T., Reiter, P. L., Ng, T. W., & Smith, J. S. (2011). HPV vaccine acceptability in heterosexual, gay, and bisexual men. *American Journal of Men's Health, 5*(4), 297-305. doi: 10.1177/1557988310372802

Gillison, M. L., Chaturvedi, A. K., & Lowy, D. R. (2008). HPV prophylactic vaccines and the potential prevention of noncervical cancers in both men and women. *Cancer, 113*(S10), 3036-3046. doi: 10.1002/cncr.23764

Giuliano, A. R., Lee, J. H., Fulp, W., Villa, L. L., Lazcano, E., Papenfuss, M. R., . . . Smith, D. (2011). Incidence and clearance of genital human papillomavirus infection in men (HIM): A cohort study. *The Lancet, 377*(9769), 932-940. doi: 10.1016/S0140-6736(10)62342-2

Giuliano, A. R., Lu, B., Nielson, C. M., Flores, R., Papenfuss, M. R., Lee, J. H., . . . Harris, R. B. (2008). Age-specific prevalence, incidence, and duration of human papillomavirus infections in a cohort of 290 US men. *Journal of Infectious Diseases, 198*(6), 827-835. doi: 10.1086/591095

Giuliano, A. R., Palefsky, J. M., Goldstone, S., Moreira Jr, E. D., Penny, M. E., Aranda, C., . . . Guris, D. (2011). Efficacy of quadrivalent HPV vaccine against HPV infection and disease in males. *New England Journal of Medicine, 364*(5), 401-411. doi: 10.1056/NEJMoa0909537

Glanz, K., & Rimer, B. (2005). Theory at a glance: A guide for health promotion practice Retrieved from http://www.cancer.gov/cancertopics/cancerlibrary/theory.pdf

Glanz, K., Rimer, B. K., & Viswanath, K. (2008). *Health Behavior and Health Education: Theory, Research, and Practice* (4th ed.). San Francisco, CA: Jossey-Bass.

Gollwitzer, P. M. (1999). Implementation intentions: Strong effects of simple plans. *American Psychologist, 54*(7), 493-503. doi: 10.1037/0003-066x.54.7.493

Gollwitzer, P. M., & Sheeran, P. (2006). Implementation intentions and goal achievement: A meta-analysis of effects and processes. *Advances in Experimental Social Psychology, 38*, 69-119. doi: 10.1016/S0065-2601(06)38002-1

Gottlieb, S. L., Brewer, N. T., Sternberg, M. R., Smith, J. S., Ziarnowski, K., Liddon, N., & Markowitz, L. E. (2009). Human papillomavirus vaccine initiation in an area with elevated rates of cervical cancer. *Journal of Adolescent Health, 45*(5), 430-437. doi: 10.1016/J.Jadohealth.2009.03.029

Gottvall, M., Tydé, T., Hoglund, A. T., & Larsson, M. (2010). Knowledge of human papillomavirus among high school students can be increased by an educational intervention. *International Journal of STD & AIDS, 21*(8), 558-562. doi: 10.1258/ijsa.2010.010063

Greer, C. E., Wheeler, C. M., Ladner, M. B., Beutner, K., Coyne, M. Y., Liang, H., . . . Ralston, R. (1995). Human papillomavirus (HPV) type distribution and serological response to HPV type 6 virus-like particles in patients with genital warts. *Journal of Clinical Microbiology, 33*(8), 2058- 2063.

Guerry, S. L., De Rosa, C. J., Markowitz, L. E., Walker, S., Liddon, N., Kerndt, P. R., & Gottlieb, S. L. (2011). Human papillomavirus vaccine initiation

among adolescent girls in high-risk communities. *Vaccine, 29*(12), 2235-2241. doi: 10.1016/J.Vaccine.2011.01.052

Gulli, C. (2007). Our girls are not guinea pigs - Is an upcoming mass inoculation of a generation unnecessary and potentially dangerous? *Maclean's, 120*(33), 38-42.

Harrison, J. A., Mullen, P. D., & Green, L. W. (1992). A meta-analysis of studies of the Health Belief Model with adults. *Health Education Research, 7*(1), 107-116. doi: 10.1093/her/7.1.107

Haupt, R. M., & Sattler, C. (2010). HPV vaccine continues to be safe and effective, and its benefits continue to outweigh its risks. *Expert Review of Vaccines, 9*(7), 697-701. doi: 10.1586/erv.10.56

Haupt, R. M., & Sings, H. L. (2011). *Journal of Adolescent Health 49*(5) 467-475, doi: 10.1016/j.jadohealth.2011.07.003

Health Canada. (2010a, Sept 8). Human Papillomavirus (HPV) Retrieved Feb 14, 2012, from http://www.hc-sc.gc.ca/hl-vs/iyh-vsv/diseases-maladies/hpv-vph-eng.php

Health Canada. (2010b, Oct 29). Summary Basis of Decision (SBD) CERVARIX™ Retrieved Feb 14, 2012, from http://www.hc-sc.gc.ca/dhp-mps/prodpharma/sbd-smd/drug-med/sbd_smd_2010_cervarix_127987-eng.php

Heffner, L. J., & Schust, D. J. (2010). *The Reproductive System at a Glance* (3rd ed.). West Sussex: Wiley-Blackwell.

Hesse, B. W., Nelson, D. E., Kreps, G. L., Croyle, R. T., Arora, N. K., Rimer, B. K., & Viswanath, K. (2005). Trust and sources of health information: The impact of the internet and its implications for health care providers: Findings from the first Health Information National Trends Survey. *Archives of Internal Medicine, 165*(22), 2618-2624. doi: 10.1001/archinte.165.22.2618

Holcomb, B., Bailey, J. M., Crawford, K., & Ruffin, M. T. (2004). Adults' knowledge and behaviors related to human papillomavirus infection. *Journal of the American Board of Family Practice, 17*(1), 26-31. doi: 10.3122/jabfm.17.1.26

Hosmer, D. W., & Lemeshow, S. (2000). *Applied logistic regression* (2 ed.). New York: John Wiley & Sons.

Hou, S.-I. (2004). Objective and subjective knowledge and HIV testing among college students. *Journal of Health Education, 35*(6), 328-335.

Hughes, J., Cates, J. R., Liddon, N., Smith, J. S., Gottlieb, S. L., & Brewer, N. T. (2009). Disparities in how parents are learning about the human papillomavirus vaccine. *Cancer Epidemiol Biomarkers Prev, 18*(2), 363-372. doi: 10.1158/1055-9965.Epi-08-0418

Humiston, S. G., Albertin, C., Schaffer, S., Rand, C., Shone, L. P., Stokley, S., & Szilagyi, P. G. (2009). Health care provider attitudes and practices regarding adolescent immunizations: A qualitative study. *Patient Education and Counseling, 75*(1), 121-127. doi: 10.1016/J.Pec.2008.09.012

Idriss, N. Z., Alikhan, A., Khalil, B., & Armstrong, A. W. (2009). Online, video-based patient education improves melanoma awareness: A randomized controlled trial. *Telemedicine Journal and E-health : The Official Journal of the American Telemedicine Association, 15*(10), 992-997. doi: 10.1089/tmj.2009.0055

Jain, N., Euler, G. L., Shefer, A., Lu, P., Yankey, D., & Markowitz, L. (2009). Human papillomavirus (HPV) awareness and vaccination initiation among women in the United States, National Immunization Survey-Adult 2007. *Preventive Medicine, 48*(5), 426-431. doi: 10.1016/j.ypmed.2008.11.010

Janz, N. K., & Becker, M. H. (1984). The Health Belief Model: A decade later. *Health Education Quarterly, 11*(1), 1-47.

Johnson, B. T., Scott-Sheldon, L. A., & Carey, M. P. (2010). Meta-synthesis of health behavior change meta-analyses. *American Journal of Public Health, 100*(11), 2193-2198. doi: 10.2105/ajph.2008.155200

Johnson, B. T., Scott-Sheldon, L. A., Huedo-Medina, T. B., & Carey, M. P. (2011). Interventions to reduce sexual risk for human immunodeficiency virus in adolescents: a meta-analysis of trials, 1985-2008. *Archives of*

Pediatrics and Adolescent Medicine, 165(1), 77-84. doi: 10.1001/archpediatrics.2010.251

Jones, M., & Cook, R. (2008). Intent to receive an HPV vaccine among university men and women and implications for vaccine administration. *Journal of American College Health, 57*(1), 23-32.

Juraskova, I., Bari, R. A., O'Brien, M. T., & McCaffery, K. J. (2011). HPV vaccine promotion: Does referring to both cervical cancer and genital warts affect intended and actual vaccination behavior? *Women's Health Issues, 21*(1), 71-79. doi: 10.1016/j.whi.2010.08.004

Kahn, J. A., Rosenthal, S. L., Hamann, T., & Bernstein, D. I. (2003). Attitudes about human papillomavirus vaccine in young women. *International Journal of STD & AIDS, 14*(5), 300-306. doi: 10.1258/095646203321605486

Kahn, J. A., Rosenthal, S. L., Jin, Y., Huang, B., Namakydoust, A., & Zimet, G. D. (2008). Rates of human papillomavirus vaccination, attitudes about vaccination, and human papillomavirus prevalence in young women. *Obstetrics and Gynecology, 111*(5), 1103-1110. doi: 10.1097/AOG.0b013e31817051fa

Kang, H. S., & Moneyham, L. (2010). Attitudes toward and intention to receive the human papilloma virus (HPV) vaccination and intention to use condoms among female Korean college students. *Vaccine, 28*(3), 811-816. doi: 10.1016/j.vaccine.2009.10.052

Kiely, M., De Wals, P., Sauvageau, C., Dube, E., & Deceuninck, G. (2010). *HPV: Immunization, screening and sexual behaviours*. Paper presented at the 26th International Papillomavirus Conference & Clinical and Public Health Workshops, July 3-8, 2010, Montreal, Quebec. http://hpv2010.org/main/index.php?option=com_conference&view=presentation&id=1085&conference=1&Itemid=101

Kjaer, S. K., van den Brule, A. J., Paull, G., Svare, E. I., Sherman, M. E., Thomsen, B. L., . . . Meijer, C. J. (2002). Type specific persistence of high risk human papillomavirus (HPV) as indicator of high grade cervical squamous intraepithelial lesions in young women: population based prospective follow up study. *BMJ, 325*(7364), 572-576. doi: 10.1136/bmj.325.7364.572

Klug, S. J., Hukelmann, M., & Blettner, M. (2008). Knowledge about infection with human papillomavirus: A systematic review. *Preventative Medicine, 46*(2), 87-98. doi: 10.1016/j.ypmed.2007.09.003

Krawczyk, A. L., Lau, E., Perez, S., Delisle, V., Amsel, R., & Rosberger, Z. (in press). How to inform: Comparing written and video education interventions to increase human papillomavirus knowledge and vaccination intentions in young adults. *Journal of American College Health*.

Krawczyk, A. L., Perez, S., Lau, E., Holcroft, C. A., Amsel, R., Knäuper, B., & Rosberger, Z. (2012, Jan 23). Human papillomavirus vaccination

intentions and uptake in college women. *Health Psychology*, Advanced online publication. doi: 10.1037/a0027012

Kreimer, A. R., Clifford, G. M., Boyle, P., & Franceschi, S. (2005). Human papillomavirus types in head and neck squamous cell carcinomas worldwide: a systematic review. *Cancer Epidemiology, Biomarkers, & Prevention, 14*(2), 467-475. doi: 10.1158/1055-9965.EPI-04-0551

Krishnan, S. S. (2008). *The HPV Vaccine Controversy. Sex, Cancer, God, and Politics: A Guide for Parents, Women, Men, and Teenagers.*Westport, CT, USA: Praeger Publishers.

Kwok, R. (2011). The real issuess in vaccine safety: Hysteria about false vaccine risks often overshadows the challenges of detecting the real ones. *Nature, 473*, 436-438. doi: doi:10.1038/473436a

Lambert, E. C. (2001). College students' knowledge of human papillomavirus and effectiveness of a brief educational intervention. *Journal of the American Board of Family Practice, 14*(3), 178-183.

Lau, R. R., Quadrel, M. J., & Hartman, K. A. (1990). Development and change of young adults' preventive health beliefs and behavior: Influence from parents and peers. *Journal of Health and Social Behavior, 31*(3), 240-259.

Lavoie, F., Goggin, P., Sauvageau, C., Dube, E., Gilca, V., & Deceuninck, G. (2010). *What do young women know, think and do about HPV prevention in Québec (Canada)?* Paper presented at the 26th International

Papillomavirus Conference & Clinical and Public Health Workshops, July 3-8, 2010, Montreal, Quebec. http://hpv2010.org/main/index.php?option=com_conference&view=presentation&id=1067&conference=1&Itemid=101

Leader, A. E., Weiner, J. L., Kelly, B. J., Hornik, R. C., & Cappella, J. N. (2009). Effects of information framing on human papillomavirus vaccination. *Journal of Women's Health, 18*(2), 225-233. doi: 10.1089/jwh.2007.0711

Lenselink, C. H., Gerrits, M. M. J. G., Melchers, W. J. G., Massuger, L. F. A. G., van Hamont, D., & Bekkers, R. L. M. (2008). Parental acceptance of Human Papillomavirus vaccines. *European Journal of Obstetrics & Gynecology and Reproductive Biology, 137*(1), 103-107. doi: 10.1016/j.ejogrb.2007.02.012

Lippman, A. (2008). Human papillomavirus (HPV) vaccination and the development of public policies. *Journal of Epidemiology and Community Health, 62*(7), 570-571. doi: 10.1136/jech.2008.074740

Lippman, A., Boscoe, M., & Scurfield, C. (2008). Do you approve of spending $300 million on HPV vaccination? *Canadian Family Physician, 54*(2), 175-177.

Lippman, A., Melnychuk, R., Shimmin, C., & Boscoe, M. (2007). Human papillomavirus, vaccines and women's health: Questions and cautions. *Canadian Medical Association Journal, 177*(5), 484-487. doi: 10.1503/cmaj.070944

Manhart, L. E., & Koutsky, L. A. (2002). Do condoms prevent genital HPV infection, external genital warts, or cervical neoplasia? A meta-analysis. *Sexually Transmitted Diseases, 29*(11), 725-735.

Marhefka, S. L., Daley, E. M., Anstey, E. H., C, A. V., Buhi, E. R., Kolar, S., & Giuliano, A. R. (2012). HPV-related information sharing and factors associated with US men's disclosure of an HPV test result to their female sexual partners. *Sexually Transmitted Infections, 88*(3), 171-176. doi: 10.1136/sextrans-2011-050091

Mays, R. M., Sturm, L. A., & Zimet, G. D. (2004). Parental perspectives on vaccinating children against sexually transmitted infections. *Social Science & Medicine, 58*(7), 1405-1413. doi: 10.1016/S0277-9536(03)00335-6

McRee, A. L., Brewer, N. T., Reiter, P. L., Gottlieb, S. L., & Smith, J. S. (2010). The Carolina HPV Immunization Attitudes and Beliefs Scale (CHIAS): Scale development and associations with intentions to vaccinate. *Sexually Transmitted Diseases, 37*(4), 234-239. doi: 10.1097/OLQ.0b013e3181c37e15

Merck Sharp & Dohme Corporation. (2011). USPPI Patient Information about GARDASIL® (pronounced “gard-Ah-sill”) Generic name: [Human Papillomavirus Quadrivalent (Types 6, 11, 16, and 18) Vaccine, Recombinant]. Whitehouse Station, NJ: Merck & Co. Inc.

Middleman, A. B., & Tung, J. S. (2010). At what sites are parents willing to have their 11 through 14-year-old adolescents immunized? *Vaccine, 28*(14), 2674-2678. doi: 10.1016/j.vaccine.2010.01.006

Moscicki, A.-B. (2011). HPV-associated cancers: It's not all about the cervix. *Preventive Medicine, 53*(Supplement 1), S3-S4. doi: 10.1016/j.ypmed.2011.08.014

Muñoz, N., Bosch, F. X., de Sanjosé, S., Herrero, R., Castellsagué, X., Shah, K. V., . . . Meijer, C. J. L. M. (2003). Epidemiologic Classification of Human Papillomavirus Types Associated with Cervical Cancer. *New England Journal of Medicine, 348*(6), 518-527. doi: doi:10.1056/NEJMoa021641

Muñoz, N., Castellsague, X., de Gonzalez, A. B., & Gissmann, L. (2006). Chapter 1: HPV in the etiology of human cancer. *Vaccine, 24S3*, S1-S10. doi: 10.1016/j.vaccine.2006.05.115

Nandwani, M. C. (2010). Men's knowledge of the human papillomavirus vaccine. *The Nurse Practitioner, 35*(11), 32-39.

National Advisory Committee on Immunization. (2006). Canadian Immunization Guide. Retrieved from http://www.phac-aspc.gc.ca/publicat/cig-gci/index-eng.php

National Advisory Committee on Immunization. (2007). Statement on human papillomavirus vaccine. *Canada Communicable Disease Report, 33*(ACS-

2). Retrieved from http://www.phac-aspc.gc.ca/publicat/ccdr-rmtc/07vol33/acs-02/index-eng.php

National Advisory Committee on Immunization. (2012). Update On Human Papillomavirus (HPV) Vaccines. *Canada Communicable Disease Report, 37*(ACS). Retrieved from http://www.phac-aspc.gc.ca/publicat/ccdr-rmtc/11vol37/acs-dcc-8/index-eng.php#a5

Noar, S. M., Black, H. G., & Pierce, L. B. (2009). Efficacy of computer technology-based HIV prevention interventions: a meta-analysis. *AIDS, 23*(1), 107 -115. doi: 10.1097/QAD.0b013e32831c5500

Noar, S. M., & Mehrotra, P. (2011). Toward a new methodological paradigm for testing theories of health behavior and health behavior change. *Patient Education and Counseling, 82*(3), 468-474. doi: 10.1016/j.pec.2010.11.016

Ogilvie, G., Anderson, M., Marra, F., McNeil, S., Pielak, K., Dawar, M., . . . Naus, M. (2010). A population-based evaluation of a publicly funded, school-based HPV vaccine program in British Columbia, Canada: Parental factors associated with HPV vaccine receipt. *PLoS Med, 7*(5). doi: 10.1371/Journal.Pmed.1000270

Ogilvie, G. S., Remple, V. P., Marra, F., McNeil, S. A., Naus, M., Pielak, K. L., . . . Patrick, D. M. (2007). Parental intention to have daughters receive the human papillomavirus vaccine. *Canadian Medical Association Journal, 177*(12), 1506-1512. doi: 10.1503/cmaj.071022

Oh, J. K., Lim, M. K., Yun, E. H., Lee, E. H., & Shin, H. R. (2010). Awareness of and attitude towards human papillomavirus infection and vaccination for cervical cancer prevention among adult males and females in Korea: A nationwide interview survey. *Vaccine, 28*(7), 1854-1860. doi: 10.1016/j.vaccine.2009.11.079

Olshen E, Woods E. R, Austin S. B, Luskin M, Bauchner H. (2005). Parental acceptance of the human papillomavirus vaccine. *Journal of Adolescent Health* 37, 248-251. doi:10.1016/j.jadohealth.2005.05.016

Palefsky, J. M. (2010). Human Papillomavirus-Related Disease in Men: Not Just a Women's Issue. *Journal of Adolescent Health, 46*(Suppl.4.), S12-S19. doi: 10.1016/j.jadohealth.2010.01.010

Parkin, D. M., & Bray, F. (2006). Chapter 2: The burden of HPV-related cancers. *Vaccine, 24* (Supplement 3), S11-S25. doi: 10.1016/j.vaccine.2006.05.111

Petrovic, K., Burney, S., & Fletcher, J. (2011). The relationship of knowledge, health value and health self-efficacy with men's intentions to receive the Human Papillomavirus (HPV) vaccine. *Journal of Health Psychology*. *16*(8), 1198-1207. doi: 10.1177/1359105311402861

Petty, T. J., Callahan, S. T., Chen, Q., Edwards, K. M., & Dempsey, A. F. (2010). Assessment of parental acceptance of a potential cytomegalovirus vaccine for adolescent females. *Vaccine, 28*(35), 5686-5690. doi: 10.1016/j.vaccine.2010.06.051

Phillips, K. A. (1993). Subjective Knowledge of AIDS and Use of HIV Testing. *American Journal of Public Health, 83*(10), 1460-1460.

Poland, G. A., & Jacobson, R. M. (2001). Understanding those who do not understand: A brief review of the anti-vaccine movement. *Vaccine, 19*(17–19), 2440-2445. doi: 10.1016/s0264-410x(00)00469-2

Prochaska, J. O., & DiClemente, C. C. (1983). Stages and processes of self-change of smoking: Toward an integrative model of change. *Journal of Consulting and Clinical Psychology, 51*(3), 390-395. doi: 10.1037/0022-006x.51.3.390

Prochaska, J. O., & Velicer, W. F. (1997). The transtheoretical model of health behavior change. *American Journal of Health Promotion, 12*(1), 38-48. doi: 10.4278/0890-1171-12.1.38

Public Health Agency of Canada. (2010, April 19). Human Papillomavirus (HPV) Retrieved Dec 1, 2011, from http://www.phac-aspc.gc.ca/std-mts/hpv-vph/fact-faits-eng.php

Reiter, P. L., Brewer, N. T., Gottlieb, S. L., McRee, A.-L., & Smith, J. S. (2009). Parents' health beliefs and HPV vaccination of their adolescent daughters. *Social Science & Medicine, 69*(3), 475-480. doi: 10.1016/j.socscimed.2009.05.024

Reiter, P. L., Brewer, N. T., McRee, A. L., Gilbert, P., & Smith, J. S. (2010). Acceptability of HPV vaccine among a national sample of gay and

bisexual men. *Sexually Transmitted Diseases, 37*(3), 197-203. doi: 10.1097/OLQ.0b013e3181bf542c

Reiter, P. L., Cates, J. R., McRee, A. L., Gottlieb, S. L., Shafer, A., Smith, J. S., & Brewer, N. T. (2010). Statewide HPV vaccine initiation among adolescent females in North Carolina. *Sexually Transmitted Diseases, 37*(9), 549-556. doi: 10.1097/OLQ.0b013e3181d73bf8

Reiter, P. L., McRee, A.-L., Gottlieb, S. L., & Brewer, N. T. (2011). Correlates of receiving recommended adolescent vaccines among adolescent females in North Carolina. *Human Vaccines & Immunotherapeutics, 7*(1), 67-73. doi: 10.4161.hv.V.I.13500

Riley, W., Obermayer, J., & Jean-Mary, J. (2008). Internet and mobile phone text messaging intervention for college smokers. *Journal of American College Health, 57*(2), 245-248. doi: 10.3200/JACH.57.2.245-248

Ritov, I., & Baron, J. (1990). Reluctance to Vaccinate: Omission Bias and Ambiguity. *Journal of Behavioral Decision Making, 3*, 263-277. doi: 10.1002/bdm.3960030404

Roberts, M. E., Gerrard, M., Reimer, R., & Gibbons, F. X. (2010). Mother-daughter communication and human papillomavirus vaccine uptake by college students. *Pediatrics, 125*(5), 982-989. doi: 10.1542/peds.2009-2888

Ronco, G., Giorgi-Rossi, P., Carozzi, F., Confortini, M., Palma, P. D., Del Mistro, A., . . . Cuzick, J. (2010). Efficacy of human papillomavirus testing for the detection of invasive cervical cancers and cervical intraepithelial neoplasia: a randomised controlled trial. *The Lancet Oncology, 11*(3), 249-257. doi: 10.1016/S1470-2045(09)70360-2

Rosen, N. O., Knäuper, B., Di Dio, P., Morrison, E., Tabing, R., Feldstain, A., . . . Rosberger, Z. (2010). The impact of intolerance of uncertainty on anxiety after receiving an informational intervention about HPV: A randomised controlled study. *Psychology and Health, 25*(6), 651-668. doi: 10.1080/08870440902822913

Rosenstock, I. M. (1974). Historical origins of the health belief model. *Health Education Monographs, 2*(4), 328 - 335.

Rosenthal, S. L., Kottenhahn, R. K., Biro, F. M., & Succop, P. A. (1995). Hepatitis B vaccine acceptance among adolescents and their parents. *Journal of Adolescent Health, 17*(4), 248-254. doi: 10.1016/1054-139X(95)00164-N

Rosenthal, S. L., Rupp, R., Zimet, G. D., Meza, H. M., Loza, M. L., Short, M. B., & Succop, P. A. (2008). Uptake of HPV vaccine: Demographics, sexual history and values, parenting style, and vaccine attitudes. *Journal of Adolescent Health, 43*(3), 239-245. doi: 10.1016/j.jadohealth.2008.06.009

Rosenthal, S. L., Weiss, T. W., Zimet, G. D., Ma, L., Good, M. B., & Vichnin, M. D. (2011). Predictors of HPV vaccine uptake among women aged 19-26:

Importance of a physician's recommendation. *Vaccine, 29*(5), 890-895. doi: 0.1016/j.vaccine.2009.12.063

Rosenthal, S. L., & Zimet, G. D. (2010). Adolescent males and human papillomavirus: Psychosexual development, infection, and vaccination. *Journal of Adolescent Health, 46*(4, Supplement 1), S1-S2. doi: 10.1016/j.jadohealth.2010.01.021

Rowhani-Rahbar, A., Mao, C., Hughes, J. P., Alvarez, F. B., Bryan, J. T., Hawes, S. E., . . . Koutsky, L. A. (2009). Longer term efficacy of a prophylactic monovalent human papillomavirus type 16 vaccine. *Vaccine, 27*(41), 5612-5619. doi: 10.1016/j.vaccine.2009.07.027

Rutter, D., & Quine, L. (2002). Social cognition models and changing health behaviours *Changing health behaviour: Intervention and research with social cognition models.* (Vol. viii, pp. 1-27). Buckingham · Philadelphia: Open University Press.

Saslow, D., Castle, P. E., Cox, J. T., Davey, D. D., Einstein, M. H., Ferris, D. G., . . . Garcia, F. (2007). American Cancer Society Guideline for human papillomavirus (HPV) vaccine use to prevent cervical cancer and its precursors. *CA: A Cancer Journal for Clinicians, 57*(1), 7-28. doi: 10.3322/canjclin.57.1.7

Sauvageau, C., Duval, B., Gilca, V., Lavoie, F., & Ouakki, M. (2007). Human Papilloma Virus vaccine and cervical cancer screening acceptability

among adults in Quebec, Canada. *BMC Public Health, 7*(1), 304. doi: 10.1186/1471-2458-7-304

Selnes, F., & Gr°nhaug, K. (1986). Subjective and objective measures of product knowledge contrasted. In R. J. Lutz (Ed.), *Advances in Consumer Research* (Vol. 13, pp. 67-71). Provo, UT: Association for Consumer Research.

Sheeran, P., Orbell, S., & Trafimow, D. (1999). Does the temporal stability of behavioral intentions moderate intention-behavior and past behavior-future behavior relations? *Personality and Social Psychology Bulletin, 25*(6), 724-734. doi: 10.1177/0146167299025006007

Sherris, J., Friedman, A., Wittet, S., Davies, P., Steben, M., & Saraiya, M. (2006). Chapter 25: Education, training, and communication for HPV vaccines. *Vaccine, 24, (*Supplement 3), S210-S218. doi: 10.1016/j.vaccine.2006.05.124

Shuman, A. G., & Wolf, G. T. (2010). Human papillomavirus status in head and neck cancer. C*ancer, 116*(18), 4221-4226. doi: 10.1002/cncr.25210

Slovic, P. (1987). Perception of risk. *Science, 236*(4799), 280-285. doi: 10.1126/science.3563507

Smith, L. M., Brassard, P., Kwong, J. C., Deeks, S. L., Ellis, A. K., & Levesque, L. E. (2011). Factors associated with initiation and completion of the quadrivalent human papillomavirus vaccine series in an Ontario cohort of

grade 8 girls. *BMC Public Health, 11*, 645. doi: 10.1186/1471-2458-11-645

Society of Obstetricians and Gynaecologists of Canada. (2007). *Teaching Tools for Educators* Retrived from http://www.hpvinfo.ca/teachers/teaching-tools-for-educators/

Society of Obstetricians and Gynaecologists of Canada. (2009). *Human Papillomavirus (HPV) Awareness* Retrieved August 23, 2010, from http://www.sogc.org/projects/hpv_e.asp

Society of Obstetricians and Gynaecologists of Canada. (2011a). *HPV DNA Testing* Retrieved February 13, 2012, from http://www.hpvinfo.ca/parents/hpv-dna-testing/

Society of Obstetricians and Gynaecologists of Canada. (2011b). *Incidence and Prevalence of HPV in Canada* Retrieved October 31, 2011, from http://www.hpvinfo.ca/health-care-professionals/what-is-hpv/incidence-and-prevalence-of-hpv-in-canada/

Sturm, L. A., Mays, R. M., & Zimet, G. D. (2005). Parental beliefs and decision making about child and ddolescent immunization: From polio to sexually transmitted infections. *Journal of Developmental & Behavioral Pediatrics, 26*(6), 441-452.

Sundström, K., Tran, T. N., Lundholm, C., Young, C., Sparén, P., & Dahlström, L. A. (2010). Acceptability of HPV vaccination among young adults aged

18-30 years-a population based survey in Sweden. *Vaccine, 28*(47), 7492-7500. doi: 10.1016/j.vaccine.2010.09.007

Tanner-Smith, E. E., & Brown, T. N. (2010). Evaluating the Health Belief Model: A critical review of studies predicting mammographic and pap screening. *Social Theory & Health, 8*(1), 95-125. doi: 10.1057/sth.2009.23

The Editors of The Lancet. (2010). Retraction—Ileal-lymphoid-nodular hyperplasia, non-specific colitis, and pervasive developmental disorder in children. *The Lancet, 375*(9713), 445. doi: 10.1016/s0140-6736(10)60175-4

Tota, J. E., Chevarie-Davis, M., Richardson, L. A., deVries, M., & Franco, E. L. (2011). Epidemiology and burden of HPV infection and related diseases: Implications for prevention strategies. *Preventive Medicine, 53,* (Supplement 1), S12-S21. doi: 10.1016/j.ypmed.2011.08.017

Trim, K., Nagji, N., Elit, L., & Roy, K. (2012). Parental knowledge, attitudes, and behaviours towards human papillomavirus vaccination for their children: A systematic review from 2001 to 2011. *Obstetrics and Gynecology International, 2012*, 921236. doi: 10.1155/2012/921236

Vallely, L. A., Roberts, S. A., Kitchener, H. C., & Brabin, L. (2008). Informing adolescents about human papillomavirus vaccination: What will parents allow? *Vaccine, 26*(18), 2203-2210. doi: 10.1016/j.vaccine.2008.02.055

Villa, L. L. (2011). HPV prophylactic vaccination: The first years and what to expect from now. *Cancer Letters, 305*(2), 106-112. doi: 10.1016/j.canlet.2010.12.002

Villa, L. L., Costa, R. L., Petta, C. A., Andrade, R. P., Paavonen, J., Iversen, O. E., . . . Barr, E. (2006). High sustained efficacy of a prophylactic quadrivalent human papillomavirus types 6/11/16/18 L1 virus-like particle vaccine through 5 years of follow-up. *British Journal of Cancer, 95*(11), 1459-1466. doi: 10.1038/sj.bjc.6603469

Wakefield, A. J., Murch, S. H., Anthony, A., Linnell, J., Casson, D. M., Malik, M., . . . Walker-Smith, J. A. (1998). RETRACTED: Ileal-lymphoid-nodular hyperplasia, non-specific colitis, and pervasive developmental disorder in children. *The Lancet, 351*(9103), 637-641. doi: 10.1016/s0140-6736(97)11096-0

Waller, J., Marlow, L. A. V., & Wardle, J. (2006). Mothers' attitudes towards preventing cervical cancer through human papillomavirus vaccination: A qualitative study. *Cancer Epidemiology, Biomarkers, & Prevention, 15*(7), 1257-1261. doi: 10.1158/1055-9965.epi-06-0041

Webb, T. L., & Sheeran, P. (2006). Does changing behavioral intentions engender behavior change? A meta-analysis of the experimental evidence. *Psychological Bulletin, 132*(2), 249-268. doi: 10.1037/0033-2909.132.2.249

Weinstein, N. D. (1988). The precaution adoption process. *Health Psychology, 7*(4), 355-386. doi: 10.1037/0278-6133.7.4.355

Weinstein, N. D., & Rothman, A. J. (2005). Commentary: Revitalizing research on health behavior theories. *Health Education Research 20*(3), 294–297. doi: 10.1093/her/cyg125

Weinstein, N. D., & Sandman, P. M. (1992). A model of the precaution adoption process: Evidence from home radon testing. *Health Psychology, 11*(3), 170-180. doi: 10.1037/0278-6133.11.3.170

Weinstein, N. D., Sandman, P. M., & Blalock, S. J. (2008). The precaution adoption process model. In K. Glanz, B. K. Rimer & K. Viswanath (Eds.), *Health Behavior and Health Education: Theory, Research, and Practice* (4 ed., pp. 123-148). San Francisco, CA: Jossey-Bass.

Weinstock, H., Berman, S., & Cates, W., Jr. (2004). Sexually transmitted diseases among American youth: incidence and prevalence estimates, 2000. *Perspectives on Sexual and Reproductive Health, 36*(1), 6-10. doi: 10.1363/3600604

Woodhall, S. C., Lehtinen, M., Verho, T., Huhtala, H., Hokkanen, M., & Kosunen, E. (2007). Anticipated acceptance of HPV vaccination at the baseline of implementation: A survey of parental and adolescent knowledge and attitudes in Finland. *Journal of Adolescent Health, 40*(5), 466-469. doi: 10.1016/j.jadohealth.2007.01.005

Yacobi, E., Tennant, C., Ferrante, J., Pal, N., & Roetzheim, R. (1999). University students' knowledge and awareness of HPV. *Preventive Medicine, 28*, 535-541. doi: 10.1006/pmed.1999.0486

Ziarnowski, K. L., Brewer, N. T., & Weber, B. (2009). Present choices, future outcomes: Anticipated regret and HPV vaccination. *Preventive Medicine, 48*(5), 411-414. doi: 10.1016/j.ypmed.2008.10.006

Zimet, G. D., Blythe, M. J., & Fortenberry, J. D. (2000). Vaccine characteristics and acceptability of HIV immunization among adolescents. *International journal of STD & AIDS, 11*(3), 143 - 149.

Zimet, G. D., & Rosenthal, S. L. (2010). HPV vaccine and males: Issues and challenges. *Gynecologic Oncology, 117*(2 Suppl), S26-31. doi: 10.1016/j.ygyno.2010.01.028

Zimet, G. D., Weiss, T. W., Rosenthal, S. L., Good, M. B., & Vichnin, M. D. (2010). Reasons for non-vaccination against HPV and future vaccination intentions among 19-26 year-old women. *BMC Women's Health*, 27. doi: 10.1186/1472-6874-10-27

Zur Hausen, H. (1977). Human papillomaviruses and their possible role in squamous cell carcinomas. *Current Topics in Microbiology and Immunology, 78*, 1-30

Appendix A

The Health Belief Model

The health belief model (HBM) is perhaps the most widely used model to study health-related behaviour. The HBM as originally proposed, involves the following dimensions (Janz & Becker, 1984):

1) *Perceived susceptibility:* The subjective belief of personal vulnerability to a disease, in other words, a person's perception of the risk of contracting certain disease (e.g. likelihood of self or daughter contracting HPV).

2) *Perceived severity:* The subjective belief concerning the seriousness of contracting a disease (e.g. severity of HPV).

3) *Perceived benefits*: The belief regarding the effectiveness of a health related-behaviours available in reducing the disease threat (e.g. Efficacy of the HPV vaccine).

4) *Perceived barriers:* The belief of potential negative aspects of performing a particular health-related behaviour (e.g. side effects of the HPV vaccine)

5) *Cues to action*: Internal (i.e., symptoms) or external (e.g., mass media communications, interpersonal interactions, or reminder postcards from health care providers).

6) Demographic, socio-psychological, and structural variables: Factors affecting the individual's perception and indirectly influence health-related behavior.

Appendix B

The Theory of Planned Behaviour

The theory of planned behaviuor (TPB), another widely use model in Health Psychology, proposes that determinants of behaviour are people's intention to engage in that behaviour and their perceptions of control over that particular behavior (Ajzen, 1991). Three factors are proposed as determinants of intentions:

1) *Positive attitudes to the behavior* (e.g. positive attitudes of receiving the HPV vaccine)

2) *Subjective norms* (beliefs about whether significant approve the bevaiour)

3) *Perceived behavioural control* (e.g. perception that the person can receive the HPV vaccine if they decide to)