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The Association between Online Health Activity and Knowledge of Human Papillomavirus

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The Association Between Online Health Activity and Knowledge of Human Papillomavirus

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2015

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An abstract of a thesis submitted to the Faculty of the Rollins School of Public Health of Emory University in partial fulfillment of the requirements for the degree of Master of Public Health in the Hubert Department of Global Health, 2017

Abstract

Introduction: Previous research has indicated that internet use is associated with an increase in awareness of HPV, but there has been no analysis of how HPV knowledge varies with different online health information seeking behaviors. The purpose of this study is to examine the relationship between online health information activity and knowledge of HPV.

Methods: We analyzed data from cycle three of the fourth National Cancer Institute Health Information National Trends Survey (HINTS). Weighted logistic regression was used to describe the association of specific online health information seeking activities with awareness of HPV, the HPV vaccine, and HPV's link with cervical cancer for the total sample and by first source of health information (internet or other).

Results: Using the internet as a first source of health information was associated with higher odds of being aware of HPV, the HPV vaccine, and HPV's connection with cervical cancer. Writing in an online blog or diary was associated with higher odds of being aware of HPV's connection with cervical cancer. While not statistically significant, the stratified analysis provides evidence for differences in the association between online health activity and HPV knowledge for respondents who use the internet as the first source of health information and respondents who use other sources.

Conclusion: Respondents who use the internet as a first source of health information might be more receptive to online HPV information than respondents who use other sources first. More research into the effects of online health activities on HPV knowledge is needed.

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2017

Acknowledgments

My deepest gratitude first goes to my advisor, Robert Bednarczyk, for the guidance and support he has given me during my time at Rollins. I also would like to thank the faculty, staff, and my fellow students at the Rollins School of Public Health for their dedication to the field of public health and for the privilege of learning from them. In particular, I would like to thank my professor, Paul Weiss, for everything I learned in his excellent statistics classes and my fellow MPH student, Rebecca Ramshaw, for her friendship and for acting as a writing companion. I am grateful for the constant encouragement of my boyfriend, Mark Artz, during the writing of this thesis. Finally, I would like to thank my family, especially my parents, Richard and Pamela Lee, and my sister, Stephanie Lee. Any success I may have is entirely due to their love and support.

Table of Contents

List of Tables and Figures

Chapter 1: Introduction and Literature Review

Human Papillomavirus (HPV)

HPV is the most common sexually transmitted disease in the United States. Prior to the introduction of the HPV vaccine, there were nearly 79 million people in the United States infected with HPV, with 14 million people being newly infected each year (Satterwhite et al., 2013). HPV is a cause of cervical, penile, anal, vaginal and vulvar, and oropharyngeal cancers. Nearly all cervical cancers are caused by HPV, and HPV DNA is found in over 90% of anal cancers, 63% of penile cancers, 75% of vaginal cancers, 69% of vulvar cancers, and 70% of oropharyngeal cancers (Saraiya et al., 2015). Between 2008-2012, nearly 40,000 cases of HPV-associated cancers were diagnosed annually. Cervical cancer (11,771 cases/year on average) and oropharyngeal squamous cell cancer (12,638 cases/year on average for men and 3,100 cases/year on average for women) were the most commonly diagnosed HPV-associated cancers during this time period (Viens, 2016).

HPV is an epithelial virus spread through sexual skin-to-skin contact. The risk of HPV exposure is highest after initiation of sexual activity, and the prevalence of HPV infection is highest for women under 25 years of age (Dunne et al., 2007; Smith, Melendy, Rana, & Pimenta, 2008; Trottier & Franco, 2006; Winer et al., 2003). Over 100 strains of HPV exist, and of the 40 strains known to infect the genital tract, 12 have been identified as carcinogenic (Chelimo, Wouldes, Cameron, & Elwood, 2013). Worldwide, HPV 16 is associated with 57% of invasive cervical cancers, and HPV 18 is associated with 16% of invasive cervical cancers (N. Li, Franceschi, Howell-Jones, Snijders, & Clifford, 2011). While most cervical HPV infections are

asymptomatic and clear on their own, persistent HPV infections are associated with an increased risk of developing cervical cancer (Castle et al., 2009; Kjær, Frederiksen, Munk, & Iftner, 2010; Schlecht et al., 2001; Wallin et al., 1999). Risk factors for HPV infection, persistence, or carcinogenesis include having a higher number of lifetime sexual partners, high parity, smoking, and co-infection with other sexually transmitted diseases (Castellsague, Bosch, & Muñoz, 2002).

The worldwide prevalence of HPV infections in women is 10.4% (De Sanjosé et al., 2007). A cross-sectional study of the distribution of HPV prevalence among sexually active women between the ages of 15-44 in 15 areas of the world found that HPV prevalence decreases with increasing age in most higher-income countries (Franceschi et al., 2006) which may be explained by changes in sexual behavior with age or increased resistance to new HPV infections in individuals that have previously been infected with HPV due to an adaptive immune response (Trottier & Franco, 2006). In the United States, there is an increase in the prevalence of HPV infections each year among women from ages 14-24 years followed by a decline in prevalence until 59 years of age. The overall pre-vaccine prevalence of HPV infection for women in the United States between 14-59 years of age was 42.5%, but the prevalence of HPV strains that are prevented by the quadravalent vaccine has dropped significantly among women younger than 24 years of age since the HPV vaccine was introduced (Hariri et al., 2011; Markowitz et al., 2016). Nearly half (45.2%) of men in the United States between 18-59 years of age have a genital HPV infection, with the highest prevalence found among men between 28 to 32 years of age and 58 to 59 years of age (Han, Beltran, Song, Klaric, & Choi, 2017). Since the introduction of the HPV vaccine in 2006, the prevalence of quadravalent HPV vaccine types (HPV-6, -11, -16,-18) has decreased among women between 14-24 years of age in the United States (Markowitz et al.,

2016). Women who have received the HPV vaccine have a lower prevalence of infection with HPV vaccine types than women who have not been vaccinated (Guo, Hirth, & Berenson, 2015).

Burden of Cervical Cancer

Cervical cancer is the fourth most common cancer among women, with the highest burden impacting women in lower-income countries (Ferlay et al., 2012). The age-adjusted incidence rate for cervical cancer in the United States was 7.8 cases per 100,000 people between 2007-2011(Benard et al., 2014). Although the overall U.S. incidence rate has decreased, there are disparities in incidence in mortality by socioeconomic status, race and ethnicity, and geographic location. Non-Hispanic African American women, Hispanic women, and American Indian and Alaska Native have repeatedly been shown to have the worse survival relative to White women (Horner et al., 2011; D. A. Patel et al., 2005; Sheppard, El-Zein, Ramanakumar, Ferenczy, & Franco, 2016; Watson et al., 2008). The southern United States also experiences a particularly high burden of cervical cancer relative to the rest of the county, with Appalachia experiencing some of the highest cervical cancer incidence in the country (Reiter et al., 2013). Rural women throughout the United States are more likely to be diagnosed and die from cervical cancer than urban women, although race and socioeconomic status may contribute more to this disparity than location (Benard et al., 2014; Benard, Coughlin, Thompson, & Richardson, 2007; Watson et al., 2008). Women of lower socioeconomic status are more likely to be diagnosed with a later-stage cervical cancer and experienced slower declines in cervical cancer mortality between 1993-2007 relative to women with higher education levels and better access to healthcare (Simard, Fedewa, Ma, Siegel, & Jemal, 2012).

Prevention

Due to the fact that HPV infection causes nearly all cervical cancer cases, and cervical cancer accounts for half of the HPV-related cancer cases among women in the United States, significant attention has been given to the detection and prevention of cervical cancer through screening programs and vaccination against HPV(Jemal et al., 2013). Until the introduction of the HPV vaccine, cervical cancer prevention was mainly centered on secondary prevention through screening to detect precancerous and cancerous lesions in the cervix.

Screening

Screening for cervical cancer can be done using various technologies, most commonly molecular detection of HPV DNA and Pap smears (conventional cytology). Cytologic sampling of cervical cells for the purposes of diagnosing cervical cancer or cervical dysplasia was first developed in 1924 by Dr. George Papanicolaou and introduced to the broader medical community in the 1940's. A pap smear is performed by collecting squamous epithelial cells from the cervix and endocervix and fixing these samples to a glass microscope slide. The cells are stained and then examined in the laboratory for abnormalities (Koss, 1989). Concerns about the sensitivity and reproducibility of Pap smears lead to the development of other screening technologies, especially those that would permit detection of the causal agent of cervical cancer, HPV, rather than just cellular changes that were the result of HPV infection. HPV DNA tests were adopted in the early 2000s after previous use as a method of triaging women who had abnormal pap smears (Saraiya, Steben, Watson, & Markowitz, 2013). The U.S. Preventive Services Task Force recommends that women between 21-65 years of age be screened for cervical cancer with a Pap smear every three years, and recommends screening every five years

with Pap smears in combination with HPV co-testing for women between the ages of 30 and 65 who want to lengthen the screening interval (U.S. Preventative Services Task Force, 2016).

HPV Vaccine

Three vaccines are currently licensed in the United States to protect against infection with HPV (Gardasil, Gardasil 9, and Cervarix) (FDA, n.d.). The newest vaccine, Gardasil 9, protects against nine of the twelve oncogenic strains of HPV. All the vaccines currently on the market protect against HPV-16 and HPV-18, the two strains that cause the majority of cervical cancer cases. While the vaccine has demonstrated high efficacy for the prevention of cervical dysplasia caused by HPV infection, HPV vaccination coverage is low (Petrosky et al., 2015). In 2015, only 28.1% of adolescent males aged 13-17 and 41.9% of adolescent females aged 13-17 completed the three dose HPV vaccine series (Reagan-Steiner, 2016). Parental hesitance to vaccinate adolescents against HPV is related to concerns about the safety and efficacy of the HPV vaccine along with values-based concerns related to vaccinating young adolescents against a sexually transmitted disease. The lack of a strong physician recommendation may also be an explanation for low HPV vaccine coverage (Hansen, Credle, Shapiro, & Niccolai, 2016; Holman et al., 2014; Perkins et al., 2014).

Health Information Seeking Behavior (HISB)

General Health Information Seeking Behavior

The dialogue around the physician-patient relationship has shifted in recent decades to be focused on the idea of "patient centered care" where the physician and patient relationship is focused on the patient's needs and wants rather than the physician's autonomy when making

decisions about patient care (Bardes, 2012; Taylor, 2009). HISB refers to actively seeking out health related information rather than passive exposure (Anker, Reinhart, & Feeley, 2011). HISB by patients is a fundamental aspect of patient centered care, and research on HISB has increased as the concept of patient centered care has grown in importance. Health information seeking behavior (HISB) by a patient can reflect an interest in shared-decision making with a physician, be the result of an attempt to cope with a health threat, an antecedent step prior to engaging in preventative behavior or behavior change, or may simply reflect a desire to address a knowledge gap about a health topic (Anker et al., 2011; Lambert & Loiselle, 2007; Longo & Woolf, 2014). Most research on HISB is focused on HISB within the context of a specific disease, and models of HISB that transcend specific contexts are rare. Most theoretical frameworks and models that have focused on general HISB focus on the individual or contextual factors that motivate HISB and the steps or phases associated with this behavior (Johnson, Donohue, Atkin, & Johnson, 1995; Lenz, 1984; Longo, 2005). Others focus on the relationship between risk or threat management and information seeking (Grasso & Bell, 2015; Griffin, Dunwoody, & Neuwirth, 1999; Kahlor, 2010; Miller, Brody, & Summerton, 1988). Given that HISB is a topic that is related to nearly every aspect of healthcare, the scope of this paper will be limited to online HISB, especially as it relates to HPV and HPV vaccination.

Online Health Information Seeking Behavior

The availability of health information on the internet has fundamentally changed the way patients access information about their own health. Over 70% of U.S. adults turned to the internet as their primary source of health information in 2012, with the majority of internet users searching for information on specific diseases or certain treatments and procedures (Fox &

Duggan, 2013; Prestin, Vieux, & Chou, 2015). The ubiquity of online health information and its impact on patient care led to the inclusion of "Health Communication and Health Information Technology" as one of the topic areas in the Healthy People 2020 Goals, with specific objectives related to increasing access to the internet and increasing the number of quality health-related websites on the internet (U.S. Department of Health and Human Services, 2016). Beyond informational webpages, health support groups, websites of health professionals, and social media have also contributed to the impact of the internet on patient behavior. The advent of Web 2.0, marked by the increase in user-generated content and the continued growth of social media, has transformed the way health information is generated and disseminated. Social media has offered new platforms for health communication (Narayanaswami et al., 2015; Van de Belt et al., 2013), evaluation of health professionals (Lagu, Hannon, Rothberg, & Lindenauer, 2010), public health surveillance (Cinnamon & Schuurman, 2010; Corley, Cook, Mikler, & Singh, 2010; Scotch, Yip, & Cheung, 2008; Signorini, Segre, & Polgreen, 2011), and influencing health policy (Kovic, Lulic, & Brumini, 2008). Concerns about the quality of online health information and disparities in access have existed since use of the world wide web became widely accessible in the mid-1990's (Cline & Haynes, 2001; Culver, Gerr, & Frumkin, 1997; Kassirer, 1995; Reynolds, Sharma, & Jack, 1995), but the ability of users to generate content has intensified these concerns (Adams, 2010). Research on online HSIB has significantly increased since the beginning of the 21st century, but there has been limited development of theoretical or behavioral models for internet HSIB. Most research focuses on characteristics of patients who utilize the internet, describes the nature of health-related internet searches, assesses the quality of health information available on the internet, or assesses the impact of health-related internet use on the

physician/patient relationship, individual health, and healthcare utilization (Chisolm, 2010; F. Li, Li, Guan, Ma, & Cui, 2015; Marton & Wei Choo, 2012; Renahy & Chauvin, 2006).

HPV and the Internet

Online HPV-Related Content

While content analysis of search results and news sites have indicated that websites and news articles are fairly neutral and balanced, (Bodemer, Müller, Okan, Garcia-Retamero, & Neumeyer-Gromen, 2012; Dodd, Marlow, Forster, & Waller, 2016; Feinberg et al., 2015; Habel, Liddon, & Stryker, 2009; Madden, Nan, Briones, & Waks, 2012) other studies have found a significant percentage of critical websites and negative language contained in search results for topics related to HPV and the HPV vaccine (Fu, Zook, Spoehr-Labutta, Hu, & Joseph, 2016; Pias-Peleteiro, Cortes-Bordoy, & Martinon-Torres, 2013; Ruiz & Barnett, 2015). A content analysis of college websites revealed that less than 50% of a national sample of college websites mentioned HPV or the HPV vaccine and only 32% provided specific educational information related to HPV, although the information that was available was up to date and accurate (Fontenot, Fantasia, Sutherland, & Lee-St John, 2015). The lack of information on HPV on websites targeted towards a population that is at high risk of exposure of HPV is concerning, especially when viewed in light of the incompleteness in information on the HPV vaccine in content analysis of the top results from standard search engines (Madden et al., 2012). Two different studies found that 70% of internet articles and websites connected HPV and cervical cancer (Habel et al., 2009; Madden et al., 2012). This is an especially important theme when considering public acceptance of the HPV vaccine, as an emphasis on the importance of HPV vaccine for cancer prevention has been found to be an effective strategy for promoting interest in

learning about the vaccine (Friedman & Shepeard, 2007; Malo, Gilkey, Hall, Shah, & Brewer, 2016; National Cancer Institute, 2014).

Analysis of social media postings has revealed significantly more heterogeneity in the tone, quality of information shared, and topics related to HPV that are discussed by users (Ache & Wallace, 2008; Briones, Nan, Madden, & Waks, 2012; Dunn, Leask, Zhou, Mandl, & Coiera, 2015; Keelan, Pavri, Balakrishnan, & Wilson, 2010; Surian et al., 2016). While Facebook has been identified as a possible platform for HPV vaccine education, no studies have evaluated the content of HPV-related information in Facebook posts (Zhang, Tsark, Campo, & Teti, 2015). Content analysis of Twitter posts has indicated that positive tweets tend to be focused on advocating for HPV vaccination or the presentation of articles that provide evidence of the importance of the vaccine while negative tweets are focused on issues of vaccine safety, side effects or themes related to harm or conspiracy (Keim-Malpass, Mitchell, Sun, & Kennedy, 2017; Massey et al., 2016; Surian et al., 2016). When links are shared that are intended to provide information on HPV, they often do not link to peer-reviewed literature, but rather blogs written by lay people (Keim-Malpass et al., 2017). Negative tweets are more likely to originate from users who have previously been exposed to negative tweets about HPV (Dunn et al., 2015).

There has been limited research around the content of vaccine related videos or HPV-vaccine specific videos on YouTube. Of the four studies that specifically looked at videos discussing the HPV vaccine, three found that the majority of YouTube content related to the HPV vaccine was positive, while the remaining study found that slightly less than half of the YouTube videos were positive (Ache & Wallace, 2008; Briones et al., 2012; Keelan, Pavri-Garcia, Tomlinson, & Wilson, 2007; Tuells et al., 2015). Almost no analysis of the HPV-

specific content of more recent social media platforms have been conducted, although a study of the vaccine content on Pinterest found that 74% of Pinterest pins analyzed were strongly anti-vaccine (Guidry, Carlyle, Messner, & Jin, 2015).

Internet Use and HPV Knowledge Level

HPV is one of the most commonly searched terms relative to other women's health topics (Baazeem & Abenhaim, 2014). During the first two and a half years after the HPV vaccine was approved, increased internet search activity for HPV-related topics predicted an increase in HPV vaccine-associated reports submitted to the Vaccine Adverse Event Reporting System (VAERS) (Eberth, Kline, Moskowitz, Montealegre, & Scheurer, 2014). The volume of internet search activity for the term "vaccine" has also been shown to be correlated with HPV vaccine coverage at the state level (Kalichman & Kegler, 2015).

There has been limited investigation into the effect of online vaccine information on vaccine acceptability. One study found that exposure to vaccine-critical webpages increased the perception of vaccine's risk and decreased intention to vaccinate and the perception of risk of skipping vaccinations among German internet users (Betsch, Renkewitz, Betsch, & Ulshöfer, 2010). Another study found that participants' responses to HPV vaccine critical and HPV vaccine-positive websites depended on their perceptions of vaccines prior to the study as well as their need for "closure" (a need for firm answers and an intolerance of ambiguity) when searching for information. Participants who already had positive views of the HPV vaccine's efficacy viewed the HPV vaccine as more efficacious after exposure to both positive and critical vaccine webpages, while participants who did not believe the HPV vaccine to be effective had a decrease in their perceived effectiveness of the HPV vaccine after exposure to the mixed

webpages. This effect was more pronounced for individuals who had a high need for closure (Nan & Daily, 2015). Another study on the effect of exposure to negative and positive blogs about HPV vaccination found that exposure to negative blogs decreased perceived vaccine efficacy, safety, and intention to be vaccinated against HPV while exposure to positive blogs did not have a significant impact on HPV vaccine-related perceptions or intentions (Nan & Madden, 2012). While studies on the specific effects of specific online health behaviors are limited, there is more data available on the association of internet use and HPV knowledge. Previous studies have demonstrated notable differences between internet users and non-internet users in the knowledge level of HPV and the HPV vaccine, with non-internet users having lower levels of knowledge about HPV than internet users (E. Z. Kontos, Emmons, Puleo, & Viswanath, 2012; Mueller et al., 2012; Stevens, Caughy, Lee, Bishop, & Tiro, 2016). A survey of parents in 2007 indicated that internet use is associated with higher knowledge and intention to vaccinate against HPV among parents of adolescent daughters (McRee, Reiter, & Brewer, 2012). This contradicts other non-HPV specific studies that have indicated that parents whose children have vaccine exemptions or have negative views towards vaccines are more likely to use the internet for vaccine information (Jones et al., 2012; Salmon et al., 2005, 2009).

Problem Statement

While general knowledge of HPV and the HPV vaccine is high, knowledge of HPV is not associated with intention to vaccinate among mothers of adolescent girls (Lai, Tinker, & Cheung, 2013). Other studies have documented significant knowledge gaps related to specific knowledge of HPV such as transmission, the consequences of an HPV infection, and how HPV differs from other sexually transmitted disease (Marlow, Zimet, McCaffery, Ostini, & Waller, 2013; Unger et

al., 2015). Access to different sources of health information may affect the level of HPV knowledge, and racial differences in sources of HPV information have been previously documented (Hughes et al., 2009). While the internet is an important source of information about HPV, the relationship between specific online health-seeking behaviors and level of knowledge of HPV is not well defined (Almeida, Tiro, Rodriguez, & Diamant, 2012; Hughes et al., 2009; Jones et al., 2012).

Purpose Statement

The purpose of this study is to examine the association between online health information activity and knowledge of HPV. As the internet becomes an increasingly important source of health information, understanding how online health seeking behavior and specific knowledge of HPV are associated will allow public health practitioners and healthcare providers to use internet platforms to engage the public and disseminate accurate and educational information about the HPV vaccine.

Research Objectives

Specific objectives include:

1. Evaluate the association between online health information activities and specific measures of HPV knowledge
2. Evaluate the association between trust in online health information and specific measures of HPV knowledge.

Chapter 2: Manuscript

Lindsay Lee
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03/24/17

Dear Editor:
I am writing to submit our manuscript entitled "The Association between Online Health Activity and Knowledge of Human Papillomavirus" for consideration of publication in []. The manuscript is [] pages long and includes 4 tables. A separate document containing supplemental materials is also included in this submission. The supplemental materials are [] pages long and include [] tables.

The paper demonstrates that there are higher levels of knowledge of HPV among internet users and provides evidence for differences in the association of specific online health seeking behaviors and knowledge of HPV for respondents who use the internet as their first source of information and respondents who use other sources first when searching for health information. This paper should be of interest to researchers and public health practitioners working in health communication and education as well as those interested in developments in online health information behavior.

This manuscript contains original work and is not under consideration for publication at any other journal.

Thank you for receiving our manuscript. We look forward to your response.

Sincerely,
Lindsay Lee
MPH Candidate
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The Association between Online Health Activity and Knowledge of Human Papillomavirus

Lindsay Lee and Robert A. Bednarczyk, Rollins School of Public Health, Emory University

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Lindsay Lee was involved in analysis and interpretation of data and writing of this manuscript. Robert A. Bednarczyk was involved in study conception and design and in critical revision of this manuscript.

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Abstract

Introduction: Previous research has indicated that internet use is associated with an increase in awareness of HPV, but there has been no analysis of how HPV knowledge varies with different online health information seeking behaviors. The purpose of this study is to examine the relationship between online health information activity and knowledge of HPV.

Methods: We analyzed data from cycle three of the fourth National Cancer Institute Health Information National Trends Survey (HINTS). Weighted logistic regression was used to describe the association of specific online health information seeking activities with awareness of HPV, the HPV vaccine, and HPV's link with cervical cancer for the total sample and by first source of health information (internet or other).

Results: Using the internet as a first source of health information was associated with higher odds of being aware of HPV, the HPV vaccine, and HPV's connection with cervical cancer. Writing in an online blog or diary was associated with higher odds of being aware of HPV's connection with cervical cancer. While not statistically significant, the stratified analysis provides evidence for differences in the association between online health activity and HPV knowledge for respondents who use the internet as the first source of health information and respondents who use other sources.

Conclusion: Respondents who use the internet as a first source of health information might be more receptive to online HPV information than respondents who use other sources first. More research into the effects of online health activities on HPV knowledge is needed.

Keywords: **Human Papillomavirus, HPV, HPV Vaccine, cervical cancer, internet, online health**

Introduction

HPV is the most common sexually transmitted disease in the United States. Prior to the introduction of the HPV vaccine, there were nearly 79 million people in the United States infected with HPV, with 14 million people being newly infected each year (Satterwhite et al., 2013). HPV infections may be prevented by vaccination with one of the three prophylactic vaccines that are currently licensed in the United States. While the vaccine has demonstrated high efficacy for the prevention of HPV infections, HPV vaccination coverage is low, with only 28.1% of adolescent males aged 13-17 and 41.9% of adolescent females aged 13-17 having completed the three dose series in 2015 (Petrosky et al., 2015; Reagan-Steiner, 2016).

Previous studies have demonstrated notable differences between internet users and non-internet users in the knowledge level of HPV and the HPV vaccine (E. Z. Kontos et al., 2012; Mueller et al., 2012; Stevens et al., 2016). A survey of parents in 2007 indicated that internet use is associated with higher knowledge and intention to vaccinate against HPV among parents of adolescent daughters (McRee et al., 2012), although other studies have indicated that parents with negative views towards vaccines are more likely to use the internet for vaccine information (Jones et al., 2012). HPV is one of the most commonly searched terms relative to other women's health topics (Baazeem & Abenhaim, 2014), and volume of vaccine-related internet search activity has been shown to be correlated with HPV vaccine coverage at the state level (Kalichman & Kegler, 2015).

Some content analysis of search results for HPV-related terms and news sites have indicated that websites and news articles are fairly neutral and balanced (Bodemer et al., 2012; Dodd et al., 2016; Feinberg et al., 2015; Habel et al., 2009; Madden et al., 2012). Other studies have found a significant percentage of critical websites and negative language contained in

search results for topics related to HPV and the HPV vaccine (Fu et al., 2016; Pias-Peleteiro et al., 2013; Ruiz & Barnett, 2015). We are unaware of any studies that have examined the association between use of the specific online health seeking behaviors and knowledge of HPV, the HPV vaccine, and HPV's link to cervical cancer.

Methods

Data and Study Sample

This study is a secondary analysis of the 2013 Health Information National Trends Survey (HINTS) administered by the National Cancer Institute (NCI) with support from the Health Communication and Informatics Research Branch of the Division of Cancer Control and Population Sciences. This administration was the fourth iteration of HINTS (referred to as Hints 4) which included four data collection cycles over three years. The data analyzed in this manuscript is from the third cycle (hereafter, HINTS 4, Cycle 3). HINTS is intended to collect nationally representative data about cancer-related communication trends, needs, and usage and to illuminate cancer risk perceptions. HINTS 4, Cycle 3 was conducted by mail by sampling a database of all non-vacant residential addresses in the United States. The final sample size of HINTS 4, Cycle 3 was 3185 respondents, with an overall response rate of 35.19% (Westat, 2013).

Measures

HPV knowledge.

Three outcome variables were derived from questions measuring specific aspects of HPV knowledge. A binary variable measuring awareness of HPV was derived from the question "Have you ever heard of HPV? HPV stands for Human Papillomavirus. It is not HIV, HSV, or herpes". Awareness of the HPV vaccine was measured by deriving a binary variable from the

question “Before today, have you ever heard of the cervical cancer vaccine or HPV shot?” Respondents who had not heard of HPV were not asked any other questions about HPV. Respondents who indicated that they had heard of HPV were asked “Do you think HPV can cause cervical cancer?” For these three outcome variables, respondents who indicated that they were “Not sure” for any question were recategorized as “No”.

Key stratum.

Respondents who had previously indicated that they had ever looked for health or medical information from any source were asked “The most recent time you looked for information about health or medical topics, where did you go first?” We created a binary variable to assess a high preference for searching for health information on the internet by recategorizing responses as either “internet” or “other source”.

Online health activity.

Respondents who indicated that they had ever accessed the internet were asked a series of questions about their internet use. Utilization of social media was measured through two questions, one asking if the respondent had utilized a social networking site within the last year, and a second asking if the respondent had shared health information on social networking sites within the last year. Other health seeking behaviors were measured through questions asking if respondents had written in an online diary or blog, participated in an online support group for people with similar health conditions or issues, and watched a health-related video on YouTube. All respondents were asked to indicate on a four point Likert scale how much they trusted information about health or medical topics from the internet regardless of whether they had indicated they had ever used the internet.

Covariates.

Age was included as a continuous variable. Other categorical sociodemographic variables include gender (male, female), marital status (recatagorized into a binary "married/not married" variable), urbinicity (counties with a USDA Rural Urban designation of metro were recategorized as "urban", counties with a nonmetro designation were recategorized as "rural"), education (less than high school, high school graduate, some college, college graduate or more), race (Hispanic, Non-Hispanic White, African American or Black, and Other), income category ($20,000 to < $35,000, $35,000 to < $50,000, $50,000 to < $75,000, $75,000 or More), and having a regular healthcare provider (yes, no)

Statistical Analysis

All analysis was conducted in SAS-callable SUDAAN, version 11.0.1, to account for the multistage sampling design and sample weights. A full-sample weight was used to calculate population and subpopulation estimates. 50 replicate weights, calculated using the delete one jackknife (JK1) replication method, were used to calculate standard errors. We conducted our analysis in two phases - first, an analysis of the entire sample and second, an analysis stratified by where respondents first search for health information (internet or other). Descriptive statistics were examined for all outcome, predictive, and demographic variables. Bivariate analysis, including chi square tests and t-tests, were conducted to determine if there were any significant independent associations between the three outcome variables and predictor variables. Weighted logistic regression was conducted separately for each outcome variable with each variable measuring internet health activity. Unadjusted analysis was conducted to generate odds ratios (OR) and 95% confidence intervals (95% CI). Adjusted odds ratios (aOR) with 95% CI were calculated by including sociodemographic covariates in the model to control for any confounding

by sociodemographic characteristics. All analyses were conducted at a significance level of alpha = 0.05.

Results

Demographic characteristics of the study sample are presented in Table 1 for the sample in total as well as stratified by primary source of health information. HINTS respondents who use the internet as their first source of information were more likely to be female, married, have higher levels of education and income, be white, and have a regular healthcare provider than respondents who use other sources first for health information. Descriptive statistics of online health activities for the entire sample and the two strata are shown in the appendix (table A1). Respondents who use the internet as their first source of information were three years younger on average than respondents who use other sources as their first source of health information. Most of the sample of was aware of HPV (68%), had heard of the HPV vaccine (68%), and were aware that that HPV could cause cervical cancer (62%). When stratified by first source of health information, these values were higher for respondents who used the internet as their first source of health information (table A1)

For the whole sample, participants who were aware of HPV and the HPV vaccine were on average more likely to be female, live in an urban area, have a higher level of education, be white, have a higher income, and have a healthcare provider they regularly see. Gender, urbanicity, and education were similarly associated with knowing that HPV can cause cancer, but there was no association with race, income, or having a regular healthcare provider. Respondents who had heard of HPV, the HPV vaccine and were aware that HPV can cause cancer were younger on average than those who were unaware of those three HPV measures. Bivariate results for the association of demographic characteristics and measures of HPV

knowledge and for the association of online health seeking behaviors and measures of HPV knowledge are shown in the appendix for the entire sample and the two strata (tables A2-A4. While none of the stratified results from the logistic regression were statistically significant, there were differences in the direction of the association of online health activity and HPV knowledge between the two strata.

Awareness of HPV

Respondents who used the internet as their first source of health information had a 43% higher odds of being aware of HPV (Figure 1, table A5) than those who used other sources first when looking for health information after adjusting for sociodemographic characteristics. After stratification by first source of health information (internet or other), a positive relationship was found for using social media and being aware of HPV. This association was negative for respondents who use other sources first when searching for health information. A similar pattern was seen for respondents who had watched a health-related YouTube video within the last year when stratified by first source of health information.

Awareness of the HPV Vaccine

Respondents who used the internet as their first source of health information had a 39% higher odds of being aware of the HPV vaccine (Figure 2, table A6) than those who used other sources first when looking for health information after adjusting for sociodemographic characteristics. After stratification by first source of health information (internet or other), a positive relationship was found for using social media and being aware of the HPV vaccine. This

association was negative for respondents who use other sources first when searching for health information.

Awareness of HPV's Link to Cervical Cancer

Respondents who had written in an online diary or blog within the last year were significantly more likely to know that HPV can cause cancer than those who had not written in an online blog or diary (Figure 3, table A7). After stratification by first source of health information (internet or other), a positive relationship was found for using social media and being aware of HPV's ability to cause cervical cancer. This association was negative for respondents who use other sources first when searching for health information. A similar pattern was seen for respondents who had watched a health-related YouTube video within the last year and for respondents who reported participation in an online support group or forum when stratified by first source of health information.

Discussion

This exploratory study described the association with online internet health seeking behaviors and knowledge of HPV and compared the internet seeking health behaviors and HPV knowledge levels of users who search for health information on the internet first with participants who search for health information from other sources first. Our key findings are of particular interest to researchers and public health practitioners working in health communication and vaccine promotion. After controlling for demographic characteristics, using the internet as a first source of health information was associated with an increase in the odds of being aware of both HPV and the HPV vaccine and writing in an online blog or diary was associated with higher odds of being aware that HPV can cause cancer. While none of the adjusted stratified results

were statistically significant, they do indicate that there are differences in the online health behavior of users who turn to the internet first for health information and users who turn to more traditional resources (paper resources, doctors, etc.) that warrant more research. Online engagement through social media use, watching YouTube videos, or participating in online support groups or forums was associated with higher odds of HPV knowledge for the group of respondents who used the internet as their first source of information. These online activities all require higher levels of engagement from the participant, indicating that this subset of internet users may be particularly susceptible to online health information.

There has been limited research on specific online health seeking behaviors and their relationship to knowledge of HPV. Previous studies have demonstrated that internet users have higher levels of knowledge about HPV and the HPV vaccine than non-internet users (E. Z. Kontos et al., 2012; Mueller et al., 2012; Stevens et al., 2016). A survey of parents in 2007 indicated that internet use is associated with higher knowledge and intention to vaccinate against HPV among parents of adolescent daughters, but other non-HPV vaccine specific studies have found that parents of children with vaccine exemptions or parents with more negative views of vaccines were more likely to have used the internet for vaccine information (Jones et al., 2012; McRee et al., 2012; Salmon et al., 2005, 2009). In spite of the fact that HPV is one of the most commonly searched women's health topics, women's awareness and knowledge of HPV is low (Baazeem & Abenhaim, 2014; Tiro, Meissner, Kobrin, & Chollette, 2007). This may point to a lack of high quality materials available on the internet or indicate that the materials are available are not written at a reading level that is comprehensible to the average adult in the United States (D'alessandro, Kingsley, & Johnson-West, 2001; Walsh & Volsko, 2008). Additionally, communication inequalities resulting in disparities in internet access may drive some of the

differences in levels of HPV knowledge for different sociodemographic groups (E. Z. Kontos et al., 2012).

While this study does provide support for further investigation into the relationship between online health behavior and knowledge of HPV, there are several limitations that warrant discussion. The data are self-reported cross-sectional data and can only be used to describe the association between online health seeking behaviors and level of knowledge of HPV and cannot be used to determine causality. The low response rate may cause bias in the data and increase error due to sampling in our estimates. Additionally, HINTS does not measure frequency of internet or social media use. Respondents who use the internet as their first source of health information maybe heavier users of the internet than respondents who use other sources first, and the observed increase in HPV knowledge among this group is either the result of a higher frequency of internet use or more exposure to health information in general through higher levels of consumption of all forms of health information (E. Kontos, Emmons, & Puleo, 2010; E. Z. Kontos et al., 2012). Additionally, care should be taken when interpreting the results of this study. Higher levels of HPV knowledge do not necessarily indicate that a participant was more likely to be vaccinated against HPV or intend to be vaccinated against HPV, and no assumptions can be made regarding vaccination coverage among those who use the internet as their first source of information. Further research should be conducted to illuminate the relationship between knowledge of HPV, online health seeking behaviors, and vaccination intention or receipt. The inclusion of vaccination measures in national-level health surveys or linkage of behavioral or information-seeking indicators to data from immunization-focused surveys such as the National Immunization Survey (NIS) will allow researchers to study the association between these behaviors.

Findings of this study identify a need to further investigate the effects of specific online health behaviors on knowledge of HPV and the HPV vaccine. Interventions should be developed to target groups that may be particularly susceptible to health information and health education on the internet. Shifting to cancer-prevention messaging and increasing the quantity, relevance, and salience of high-quality educational materials and the presence of medical professionals on social media may be important for the promotion of HPV vaccination (Keim-Malpass et al., 2017; P. R. Patel & Berenson, 2014). When creating these materials, rather than focusing on presenting only the evidence for HPV vaccination, public health professionals should take care to appeal to two systems of reasoning: a data-based system and a values-based system (Carter et al., 2011; Raphael, 2000). Integrating both data and values-based arguments into online content for HPV vaccination promotion that appeals to a wide spectrum of moral and social values will maximize their effectiveness (Matthews, Burris, Ledford, & Baker, 2016). Additionally, there is a need for development of behavioral models for evaluating the engagement in HPV-prevention behaviors as a function of online health seeking behaviors.

In conclusion, as the internet continues to play an important role in health education, health researchers and public health professionals should continue to study and develop research methods for measuring the effect of online health information on HPV knowledge and HPV vaccine acceptability and develop effective interventions for promoting HPV knowledge and engagement in HPV preventive behaviors.

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Table 1.
Demographic characteristics [N, (weighted %)] for the total sample, and for respondents stratified by first source of health information; 2013 Health Information National Trends Survey (HINTS) administered by the National Cancer Institute (NCI)

Characteristic	Total Sample: n = 3185	Respondents who used Internet as first source of health information: n = 1334	Respondents who used other sources first for health information: n = 1851	p-value
Gender				
Male	1197 (48)	482 (44)	715 (52)	0.0036
Female	1906 (52)	839 (56)	1067 (48)	
Marital Status				
Married	1594 (59)	779 (66)	815 (53)	< 0.0001
Not married	1490 (41)	533 (34)	957 (47)	
Urbinicity				
Rural	475 (18)	173 (16)	303 (19)	0.3178
Urban	2709 (82)	1161 (84)	1548 (81)	
Education				
Less than High School	297 (10)	32 (3)	265 (16)	< 0.0001
High School Graduate	699 (25)	176 (15)	523 (32)	
Some College	933 (33)	407 (38)	526 (28)	
College Graduate or More	1167 (33)	704 (44)	463 (24)	
Race				
Hispanic	511 (15)	166 (11)	345 (75)	< 0.0001
White	1584 (67)	833 (74)	751 (61)	
African American or Black	421 (10)	153 (8)	268 (12)	
Other	209 (7)	89 (7)	120 (7)	
Income Category				
Less than $20,000	680 (20)	146 (11)	534 (28)	< 0.0001
$20,000 to < $35,000	418 (15)	138 (10)	280 (19)	
$35,000 to < $50,000	394 (15)	181 (16)	213 (13)	
$50,000 to < $75,000	446 (17)	247 (21)	199 (15)	
$75,000 or More	801 (33)	510 (42)	291 (25)	

Regular Provider				
Yes	2095 (64)	942 (67)	1153 (60)	0.0395
No	986 (36)	373 (33)	613 (40)	
Age (mean ± se)	45.5 ± 0.3	43.9 ± 0.5	46.9 ±0.7	0.0063

Note: P-values are for comparisons between the two strata. Comparisons were performed with a two sample t-test for age and chi-squared test for the all other variables.

Figure 1.
Association between online health activities and awareness of HPV.

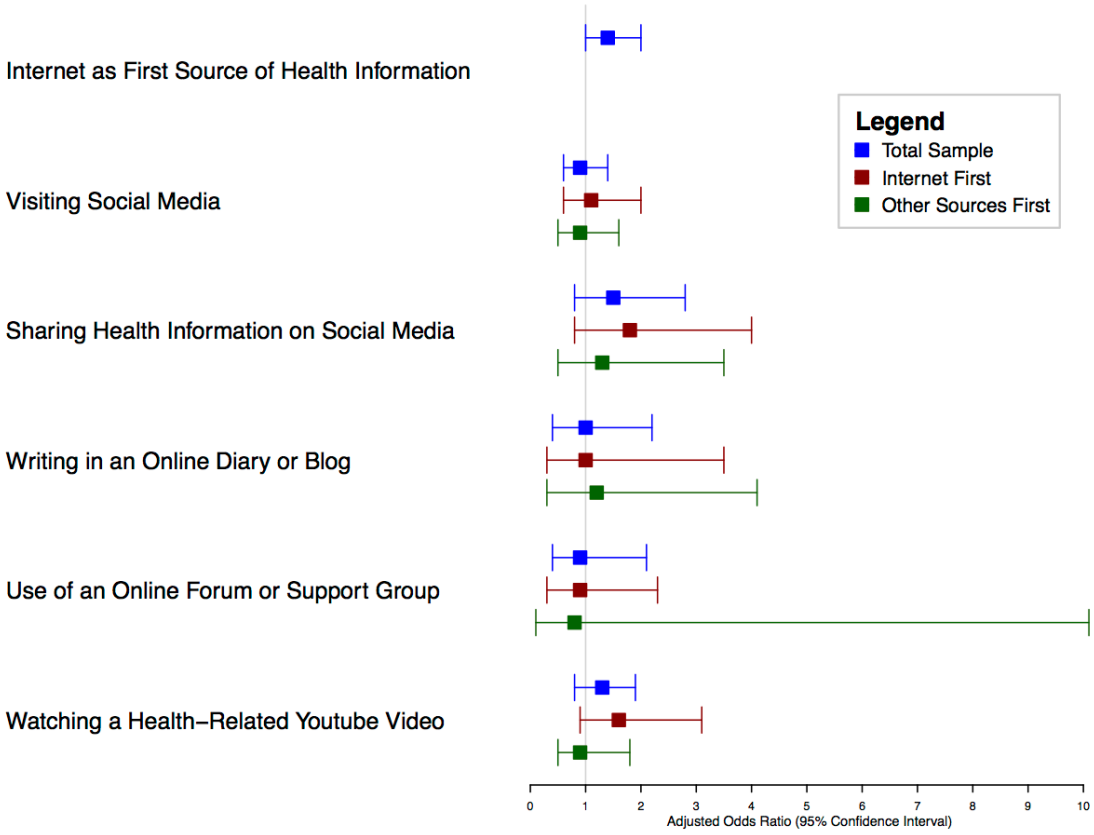

Figure 1. Adjusted odds ratios and confidence intervals for the association of online health activities and awareness of Human Papillomavirus (HPV). Analysis were first conducted for the entire sample and then stratified by where respondents first search for health information (internet or other). Data are from the 2013 Health Information National Trends Survey (HINTS) administered by the National Cancer Institute (NCI).

Figure 2.
Association between online health activities and awareness of the HPV Vaccine

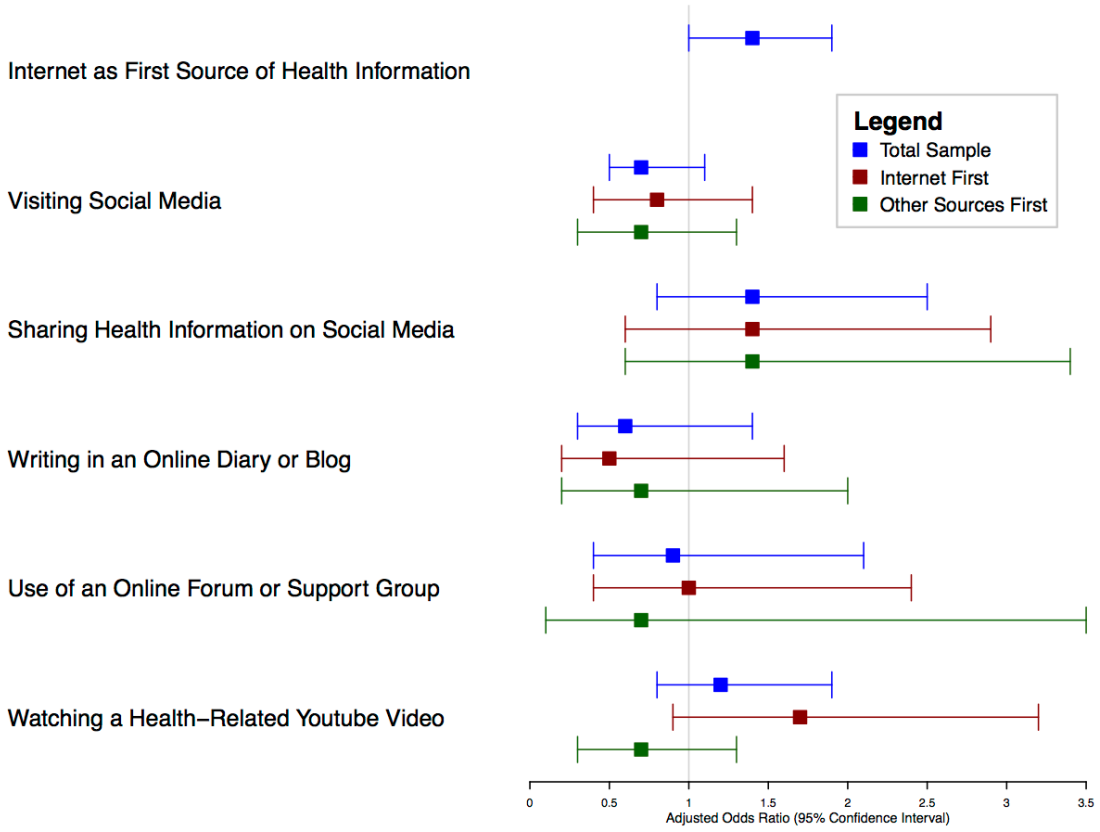

Figure 2. Adjusted odds ratios and confidence intervals for the association of online health activities and awareness of the Human Papillomavirus (HPV) vaccine. Analysis were first conducted for the entire sample and then stratified by where respondents first search for health information (internet or other). Data are from the 2013 Health Information National Trends Survey (HINTS) administered by the National Cancer Institute (NCI).

Figure 3.
Association between online health activities and awareness of the HPV's link to cervical cancer

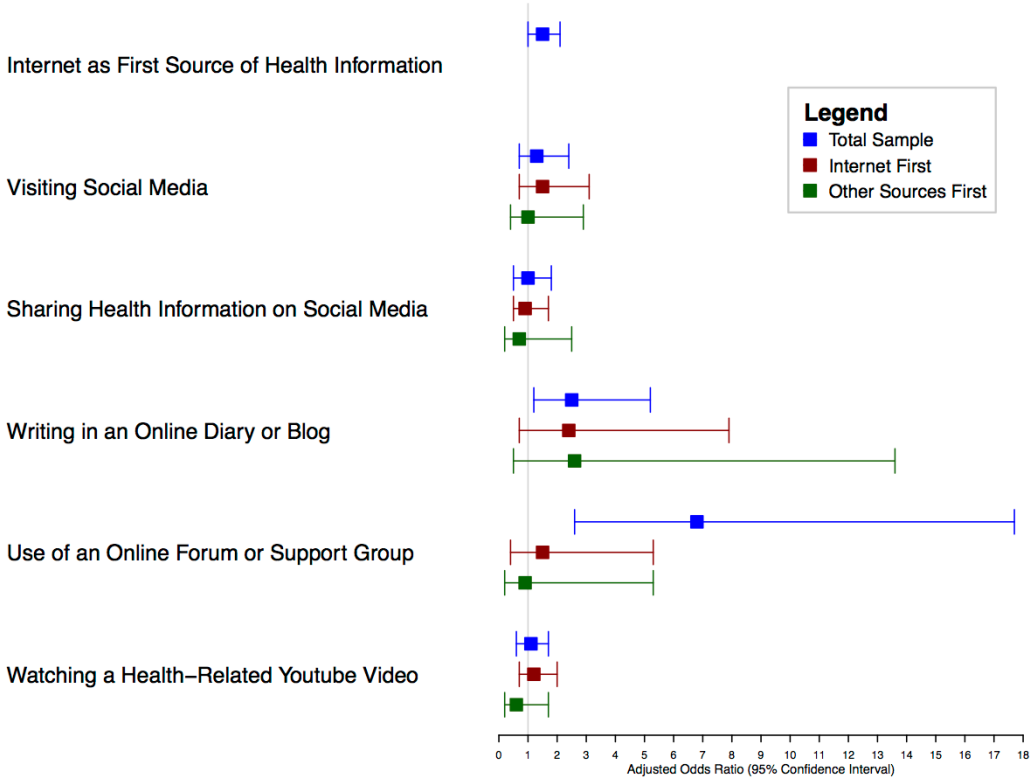

Figure 3. Adjusted odds ratios and confidence intervals for the association of online health activities and awareness of the link between cervical cancer and Human Papillomavirus (HPV) link to cervical cancer. Analysis were first conducted for the entire sample and then stratified by where respondents first search for health information (internet or other). Data are from the 2013 Health Information National Trends Survey (HINTS) administered by the National Cancer Institute (NCI).

Chapter 3: Conclusion and Recommendations

This study examined the association between specific online health behaviors and knowledge of HPV, the HPV vaccine, and HPV's association with cervical cancer. Using the internet as a first source of health information was associated with higher odds of being aware of HPV, the HPV vaccine, and HPV's connection with cervical cancer. Writing in an online blog or diary was associated with higher odds of being aware of HPV's connection with cervical cancer. When the data were stratified by respondents first source of health information (internet or other), the results indicated that there are differences in the association of specific online health activities and HPV knowledge among those who use the internet as their first source of health information and those that use other sources first when searching for health information.

More research into the effects of specific online health seeking behaviors on HPV knowledge and engagement in HPV and cervical cancer preventative behaviors and online interventions for increasing HPV knowledge and HPV vaccine acceptability are needed. Increased provider engagement with online health education materials will help guide patients towards high quality information and could improve patient's ability to evaluate the quality of online health information. Increasing healthcare provider and HPV experts' presence on social media will increase access to high quality information about HPV and combat inaccurate information from anti-vaccine websites. Use of novel online and mobile platforms such as Facebook, Pinterest, Instagram, Snapchat, and YouTube by healthcare professionals should be investigated to determine their potential use in HPV education efforts. Finally, special care should be taken when developing online HPV educational materials to ensure that it is written in a way that is accessible to non-scientific audiences.

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Chapter 5: Appendix

Table A1.

Online health activity and knowledge of HPV [N, (weighted %)] for the total sample, and for respondents stratified by first source of health information; 2013 Health Information National Trends Survey (HINTS) from the National Cancer Institute.

Online Health Activity	Total Sample: n = 3185	Respondents who used Internet as first source of health information: n = 1334	Respondents who used other sources first for health information : n = 1851	p-value
The most recent time you looked for information about health or medical topics, where did you go first?				
Internet	1334 (46)	-	-	-
Other Source	1851 (54)	-	-	-
In the last 12 months, have you visited a social networking site such as Facebook or LinkedIn?				
Yes	1632 (76)	1005 (81)	627 (69)	0.0005
No	638 (24)	295 (19)	343 (31)	
In the last 12 months, have you shared health information on social networking sites, such as Facebook or Twitter?				
Yes	447 (24)	276 (28)	171 (17)	0.0003
No	1819 (77)	1022 (72)	797 (83)	
In the last 12 months, have you written in an online diary or blog (i.e. Web log?)				
Yes	140 (6)	82 (7)	58 (6)	0.8019
No	2123 (94)	1218 (93)	905 (94)	
In the last 12 months, have you participated in an online forum or support group for people with a similar health or medical issue?				
Yes	150 (7)	95 (8)	55 (6)	0.2945
No	2114 (93)	1203 (92)	911 (94)	

In the last 12 months, have you watched a health-related video on YouTube?				
Yes	709 (35)	450 (41)	259 (28)	0.0026
No	1553 (65)	848 (59)	705 (72)	
In general, how much would you trust information about health or medical topics from the internet?				
A lot	419 (12)	260 (17)	159 (8)	< 0.0001
Some	1531 (54)	861 (67)	670 (43)	
A little	693 (24)	185 (15)	508 (32)	
Not At All	329 (9)	15 (1)	314 (17)	
Have you ever heard of HPV? HPV stands for Human Papillomavirus. It is not HIV, HSV, or herpes.				
Yes	2009 (68)	1038 (79)	971 (58)	< 0.0001
No	1097 (32)	287 (21)	810 (42)	
Before today, have you ever heard of the cervical cancer vaccine or HPV shot?				
Yes	2022 (68)	1026 (78)	996 (60)	< 0.0001
No	1048 (32)	294 (22)	754 (40)	
Do you think HPV can cause cervical cancer?				
Yes	1149 (62)	674 (69)	475 (54)	0.0003
No	822 (38)	352 (31)	470 (46)	

Note: P-values are for comparisons between the two strata. Comparisons were performed with a chi-squared test.

Table A2.

Bivariate Results for the association between online health characteristics and awareness of HPV and the association between demographics and awareness of HPV for the total sample and stratified by first source of health information; 2013 Health Information National Trends Survey (HINTS) from the National Cancer Institute.

Online Health Activity or Characteristic	Total Sample who are aware of HPV: weighted %, (95% CI)	Respondents who used Internet as first source of health information and who are aware of HPV: weighted % , (95% CI)	Respondents who used other sources first for health information and who are aware of HPV: weighted % , (95% CI)
The most recent time you looked for information about health or medical topics, where did you go first?			
Internet	78.7 (74.8, 82.2)	-	-
Other Source	58.1 (53.8, 62.3)	-	-
In the last 12 months, have you visited a social networking site such as Facebook or LinkedIn?			
Yes	78.3 (74.9, 81.4)	80.9 (76.8, 84.4)	74.2 (67.6, 79.8)
No	66.8 (59.6, 73.3)	72.3 (63, 80)	62.1 (52.5, 70.9)
In the last 12 months, have you shared health information on social networking sites, such as Facebook or Twitter?			
Yes	85.2 (79.5, 89.5)	86.3 (79.5, 91.1)	82.5 (71.1, 90.1)
No	72.5 (68.9, 75.9)	76.4 (71.7, 80.5)	68 (61.4, 73.9)
In the last 12 months, have you written in an online diary or blog (i.e. Web log?)			
Yes	80.6 (68.5, 88.7)	82.8 (65.2, 92.5)	77.2 (54.9, 90.4)
No	75.3 (72.1, 78.1)	79 (75.1, 82.5)	70.1 (64.3, 75.3)
In the last 12 months, have you participated in an online forum or support group for people with a similar health or medical issue?			
Yes	81.7 (66.8, 90.9)	84.1 (71.7, 91.7)	77.6 (36.2, 95.5)

No	75.1 (71.9, 78.1)	78.8 (74.8, 82.4)	70.1 (64, 75.5)
In the last 12 months, have you watched a health-related video on YouTube?			
Yes	79.5 (74.1, 84)	83.7 (77.3, 88.5)	71.2 (61.6, 79.2)
No	73.4 (69.5, 77)	76.2 (71.3, 80.6)	70.2 (63.8, 75.9)
In general, how much would you trust information about health or medical topics from the internet?			
A lot	72.2 (64.6, 78.6)	75.7 (67.2, 82.6)	64.9 (49.4, 77.8)
Some	73.6 (69.7, 77.2)	80.7 (76.4, 84.4)	63.4 (56.5, 69.9)
A little	61.6 (54.8, 67.9)	72.6 (61.5, 81.4)	56.8 (48, 65.2)
Not At All	50.5 (41.4, 59.6)	77.5 (39.8, 94.7)	48.9 (39.3, 58.5)
Gender			
Male	58.1 (53.3, 62.7)	67.6 (60.9, 73.6)	51.1 (44.6, 57.5)
Female	77.1 (74.4, 79.6)	87.5 (83.6, 90.5)	66.5 (61.1, 71.5)
Marital Status			
Married	69 (65.7, 72.2)	78.4 (73.6, 82.5)	58.7 (53.3, 63.9)
Unmarried	66.8 (62.3, 70.9)	80.6 (73.7, 86.0)	58.1 (51.6, 64.3)
Urbinicity			
Rural	60 (53.1, 66.6)	72.9 (61.6, 81.8)	50.6 (41.4, 59.8)
Urban	69.3 (66.1, 72.4)	79.9 (76.1, 83.1)	59.9 (55, 64.7)
Education			
Less than High School	47.7 (38.6, 56.8)	64.7 (44.6, 80.6)	45 (35.1, 55.4)
High School Graduate	54.2 (48, 60.3)	64.0 (53.8, 73.2)	50.2 (42.4, 58)
Some College	75.6 (70.7, 79.9)	82.4 (75.8, 87.5)	67.6 (61.1, 73.6)
College Graduate or More	23.4 (19.7, 27.7)	81.7 (76.1, 86.3)	68.2 (61.6, 74.2)
Race			
Hispanic	62.03 (55.5, 68.2)	78.6 (68.4, 86.2)	53.4 (45.4, 61.2)
White	75.1 (71.9, 77.9)	81.0 (76.4, 84.8)	68.4 (63.2, 73.1)
African American or Black	64.7 (5.4, 73.1)	80.4 (68.4, 88.6)	54.8 (41, 67.8)
Other	56.8 (41.8, 70.7)	68.2 (52.3, 80.7)	45.2 (26.8, 65)
Income Category			
Less than $20,000	59.9 (53.9, 65.5)	80.1 (69.2, 87.8)	52.5 (45.7, 59.1)
$20,000 to < $35,000	59.9 (50.2, 68.8)	74.5 (63.1, 83.3)	52.5 (40.3, 64.4)
$35,000 to < $50,000	74.2 (66.8, 80.4)	79.4 (69.2, 86.9)	68.3 (57, 77.8)
$50,000 to < $75,000	65 (56.9, 72.4)	65.2 (53.7, 75.2)	64.8 (52.9, 75)
$75,000 or More	81.5 (76.8, 85.4)	87.6 (82.8, 91.2)	72.3 (63.6, 79.5)
Regular Provider			
Yes	70.3 (67.1, 73.3)	80 (75.4, 84)	60.9 (56.3, 65.3)
No	63.3 (58, 68.4)	76.1 (68.6, 82.3)	53.9 (47.3, 60.5)

Age (mean ± se)	43.6 ± 0.4	43.5 ± 0.5	43.7 ± 0.9

Table A3.

Bivariate Results for the association between online health characteristics and awareness of the HPV vaccine and the association between demographics and awareness of the HPV vaccine for the total sample and stratified by first source of health information; 2013 Health Information National Trends Survey (HINTS) from the National Cancer Institute.

Online Health Activity or Characteristic	Total Sample who are aware of the HPV vaccine: weighted %, (95% CI)	Respondents who used Internet as first source of health information and who are aware of the HPV vaccine: weighted % , (95% CI)	Respondents who used other sources first for health information and who are aware of the HPV vaccine: weighted % , (95% CI)
The most recent time you looked for information about health or medical topics, where did you go first?			
Internet	77.8 (74, 81.2)	-	-
Other Source	59.7 (55.1, 64.1)	-	-
In the last 12 months, have you visited a social networking site such as Facebook or LinkedIn?			
Yes	75.7 (72, 79)	79.1 (74.7, 82.8)	70.2 (63.3, 76.3)
No	69 (61.8, 75.4)	73.8 (65.1, 80.9)	64.9 (55.8, 73.1)
In the last 12 months, have you shared health information on social networking sites, such as Facebook or Twitter?			
Yes	83.3 (77.6, 87.8)	83.8 (76.4, 89.2)	82.2 (73.7, 88.4)
No	71.1 (66.9, 75.1)	75.7 (70.8, 79.9)	65.7 (59, 71.9)
In the last 12 months, have you written in an online diary or blog (i.e. Web log?)			
Yes	72.7 (58.5, 83.5)	75.3 (56, 88)	68.9 (45.8, 85.3)
No	74.2 (70.7, 77.4)	78.3 (74.4, 81.7)	68.5 (62.8, 73.7)
In the last 12 months, have you participated in an online forum or support group for people with a similar health or medical issue?			
Yes	79.5 (64.7, 89.2)	85.8 (74, 92.8)	68.6 (34, 90.2)

No	73.7 (70, 77.1)	77.4 (73.3, 81)	68.6 (62.5, 74.1)
In the last 12 months, have you watched a health-related video on YouTube?			
Yes	77.6 (72.4, 82)	82.9 (76.7, 87.7)	66.8 (56.8, 75.5)
No	72.2 (67.7, 76.3)	74.8 (69.5, 79.4)	69.3 (62.3, 75.5)
In general, how much would you trust information about health or medical topics from the internet?			
A lot	70 (62.7, 76.3)	75.4 (66.6, 82.5)	58.6 (42.9, 72.6)
Some	73.9 (69.6, 77.7)	80.4 (75.6, 84.4)	64.6 (58.2, 70.6)
A little	62.8 (57.8, 67.6)	71.6 (60.6, 80.5)	59 (52.3, 65.3)
Not At All	56.6 (47.4, 65.4)	79.4 (41.1, 95.5)	55.2 (45.7, 64.3)
Gender			
Male	57.7 (52.5, 62.8)	66 (58.9, 72.4)	51.5 (45, 58)
Female	78.4 (75.5, 81.1)	87.3 (84.2, 89.9)	69.3 (64, 74.2)
Marital Status			
Married	70.6 (66.9, 74)	78.9 (74.5, 82.7)	61.2 (55.7, 66.4)
Unmarried	66.1 (61.2, 70.6)	77 (69.8, 82.9)	59.2 (52.5, 65.5)
Urbinicity			
Rural	62.1 (55, 68.6)	72.8 (59.4, 83)	54.1 (44.4, 63.5)
Urban	69.5 (66.1, 72.7)	78.8 (75.4, 81.9)	61.1 (56.4, 65.6)
Education			
Less than High School	52.7 (43.1, 62.1)	63.5 (39.4, 82.2)	51 (39.6, 62.2)
High School Graduate	56.3 (49.2, 63.2)	67.8 (58.5, 75.9)	51.5 (42.7, 60.3)
Some College	74 (68.8, 78.6)	79 (71.6, 84.9)	68 (60.6, 74.5)
College Graduate or More	76.6 (72.3, 80.4)	81.3 (76.5, 85.3)	68.9 (61.7, 75.2)
Race			
Hispanic	57.9 (50.6, 64.8)	81.6 (74.4, 87.2)	45.4 (36.3, 54.8)
White	75.3 (71.6, 78.6)	79.2 (74.3, 83.4)	70.7 (64.9, 75.9)
African American or Black	65.9 (56.3, 74.4)	75.8 (62.8, 85.3)	59.6 (45, 72.7)
Other	66 (51.3, 78.2)	76.4 (62.5, 86.3)	55.3 (35, 73.9)
Income Category			
Less than $20,000	63.7 (57.4, 69.5)	81.6 (70.7, 89.1)	57 (49.6, 64)
$20,000 to < $35,000	60 (50.1, 69.2)	75.6 (64.2, 84.3)	51.9 (39.6, 64)
$35,000 to < $50,000	71.1 (64.2, 77.1)	76.4 (66.1, 84.3)	65.1 (54.4, 74.4)
$50,000 to < $75,000	63.5 (54.9, 71.4)	64.7 (52.3, 75.3)	62.1 (50.1, 72.7)
$75,000 or More	81.4 (75.9, 85.8)	85.6 (79.7, 89.9)	74.8 (67.3, 81.1)
Regular Provider			
Yes	71.1 (67.4, 74.5)	80.4 (76.3, 84)	61.9 (56.2, 67.3)

No	63.5 (58, 68.7)	73 (65.4, 79.4)	56.5 (49.8, 63)
Age (mean ± se)	44.7 ± 0.4	43.9 ± 0.5	45.7 ± 0.9

Table A4

Bivariate Results for the association between online health characteristics and awareness of HPV's link to cervical cancer and demographic characteristics and awareness of HPV's link to cervical cancer for the total sample and stratified by first source of health information; 2013 Health Information National Trends Survey (HINTS) from the National Cancer Institute.

Online Health Activity or Characteristic	Total Sample who are aware of HPV's link to cervical cancer: weighted %, (95% CI)	Respondents who used Internet as first source of health information and who are aware of HPV's link to cervical cancer: weighted % , (95% CI)	Respondents who used other sources first for health information and who are aware of HPV's link to cervical cancer: weighted % , (95% CI)
The most recent time you looked for information about health or medical topics, where did you go first?			
Internet	69.2 (64.7, 73.3)	-	-
Other Source	53.9 (47.7, 59.8)	-	-
In the last 12 months, have you visited a social networking site such as Facebook or LinkedIn?			
Yes	67.4 (63.2, 71.2)	72.4 (67.3, 77)	58.5 (50.2, 66.4)
No	54.1 (44, 63.9)	56.8 (46.1, 66.9)	51.5 (35.7, 67)
In the last 12 months, have you shared health information on social networking sites, such as Facebook or Twitter?			
Yes	68.4 (61, 74.9)	72 (61.3, 80.7)	59.7 (42, 75.2)
No	63.1 (57.9, 68)	68.5 (63.7, 72.9)	55.9 (46.9, 64.6)
In the last 12 months, have you written in an online diary or blog (i.e. Web log?)			
Yes	81.6 (70.4, 89.2)	85.5 (70.7, 93.5)	75.3 (52.2, 89.5)
No	63.4 (59.4, 67.1)	68.6 (64.1, 72.8)	55.3 (47.5, 62.8)
In the last 12 months, have you participated in an online forum or support group for people with a similar health or medical issue?			
Yes	73.4 (58.2, 84.5)	82.1 (62.8, 92.6)	56.5 (31.6, 78.5)
No	63.8 (59.7, 67.8)	68.6 (64.1, 72.7)	56.7 (48.6, 64.5)

In the last 12 months, have you watched a health-related video on YouTube?			
Yes	67.5 (60.5, 73.7)	73 (65.5, 79.3)	54.5 (40.5, 67.8)
No	62.8 (56.9, 68.4)	67.3 (61.2, 72.9)	57.3 (47, 67)
In general, how much would you trust information about health or medical topics from the internet?			
A lot	61.3 (50.3, 71.2)	67.2 (56.2, 76.5)	47.3 (24.2, 71.5)
Some	65.2 (60.4, 69.6)	69.5 (63.3, 75)	57.4 (48.9, 65.5)
A little	62.4 (53.4, 70.7)	73.4 (62.7, 82)	56.4 (44, 68.1)
Not At All	47.6 (36.9, 58.4)	44.7 (6, 91.1)	47.9 (37, 58.9)
Gender			
Male	57.4 (51.5, 63.1)	65.4 (57.9, 72.1)	49.6 (39.3, 59.9)
Female	65.7 (61.9, 69.3)	71.8 (66.4, 76.7)	57.4 (49.7, 64.7)
Marital Status			
Married	63.4 (59.1, 67.5)	67.8 (63, 72.4)	56.8 (49, 64.4)
Unmarried	60.7 (54.5, 66.5)	72.4 (65, 78.7)	50.3 (39.5, 61.1)
Urbinicity			
Rural	51 (41.3, 60.7)	60.1 (45.5, 73.2)	41.3 (27.7, 56.4)
Urban	64.3 (60.8, 67.6)	70.8 (66.4, 74.9)	56.4 (50.2, 62.4)
Education			
Less than High School	55.4 (40.6, 69.4)	50.6 (18.4, 82.4)	56.6 (40.8, 71.1)
High School Graduate	46.2 (36.2, 56.5)	53 (41.8, 63.9)	42.6 (29.4, 56.9)
Some College	62.3 (55.6, 68.6)	69.5 (61.1, 76.7)	52 (41.2, 62.6)
College Graduate or More	71.7 (68, 75.2)	74.2 (68.8, 79)	66.9 (59.4, 73.6)
Race			
Hispanic	59.8 (48.0, 70.6)	67.3 (49.2, 81.4)	54.1 (46.7, 63.2)
White	64.2 (59.6, 68.5)	70.9 (65.2, 76.1)	55.1 (46.7, 63.2)
African American or Black	54.1 (43.6, 64.3)	59.4 (44.6, 72.7)	49.1 (32.4, 66.1)
Other	70.1 (55.1, 81.7)	71.9 (51.4, 86.1)	67.2 (45.2, 83.5)
Income Category			
Less than $20,000	57.7 (47.3, 67.4)	63.6 (44.5, 79.2)	54.3 (41.7, 66.3)
$20,000 to < $35,000	54.9 (43.9, 65.4)	66.6 (49.7, 80.1)	46.2 (28, 65.5)
$35,000 to < $50,000	63.5 (54.4, 71.7)	70.7 (60.3, 79.3)	54.3 (34.6, 72.7)
$50,000 to < $75,000	62.7 (53.1, 71.4)	66.1 (53.9, 76.5)	58.2 (43.5, 71.6)
$75,000 or More	66.7 (60.5, 72.4)	71.2 (62.9, 78.3)	58.3 (46.2, 69.5)
Regular Provider			
Yes	63.7 (59.4, 67.8)	71.4 (66, 76.1)	53.9 (46.2, 61.4)
No	59.4 (53.1, 65.5)	64.6 (55.6, 72.7)	54.1 (44.5, 63.4)
Age (mean ± se)	42.4 ± 0.5	42.2 ± 0.7	42.6 ± 1.1

Table A5.

Unadjusted and adjusted logistic regression results for the association between internet use and awareness of HPV for the total sample, and for respondents stratified by first source of health information; 2013 Health Information National Trends Survey (HINTS) from the National Cancer Institute.

Online Health Activity	Total Sample:		Respondents who used the internet as first source of health information:		Respondents who used other sources first for health information:	
	OR (95% CI)	aOR (95% CI)	OR (95% CI)	aOR (95% CI)	OR (95% CI)	aOR (95% CI)
The most recent time you looked for information about health or medical topics, where did you go first?						
Internet	2.7 (2.0, 3.5)	1.4 (1.0, 2.0)	-	-	-	-
Other Source	ref	ref	-	-	-	-
In the last 12 months, have you visited a social networking site such as Facebook or LinkedIn?						
Yes	1.8 (1.3, 2.6)	0.9 (0.6, 1.4)	1.6, (1.0, 2.7)	1.1 (0.6, 2.0)	1.8 (1.1, 2.9)	0.9 (0.5, 1.6)
No	ref	ref	ref	ref	ref	ref

In the last 12 months, have you shared health information on social networking sites, such as Facebook or Twitter?						
Yes	2.2 (1.4, 3.3)	1.5 (0.8, 2.8)	2.0 (1.1, 3.4)	1.8 (0.8, 4.0)	2.2 (1.1, 4.7)	1.3 (0.5, 3.5)
No	ref	ref	ref	ref	ref	ref
In the last 12 months, have you written in an online diary or blog (i.e. Web log?)						
Yes	1.4 (0.7, 2.6)	1.0 (0.4, 2.2)	1.2 (0.4, 3.8)	1.0 (0.3, 3.5)	1.4 (0.5, 4.2)	1.2 (0.3, 4.1)
No	ref	ref	ref	ref	ref	ref
In the last 12 months, have you participated in an online forum or support group for people with a similar health or medical issue?						
Yes	1.5 (0.6, 3.6)	0.9 (0.4, 2.1)	1.4 (0.6, 3.2)	0.9 (0.3, 2.3)	1.5 (0.1, 19.5)	0.8 (0.1, 10.1)
No	ref	ref	ref	ref	ref	ref
In the last 12 months,						

have you watched a health-related video on YouTube?						
Yes	1.4 (1.0, 2.0)	1.3 (0.8, 1.9)	1.6 (1.0, 2.6)	1.6 (0.9, 3.1)	1.0 (0.7, 1.7)	0.9 (0.5, 1.8)
No	ref	ref	ref		ref	
In general, how much would you trust information about health or medical topics from the internet?						
A lot	2.5 (1.6, 4.1)	1.1 (0.6, 2.3)	0.9 (0.2, 5.0)	0.8 (0.1, 5.0)	1.9 (0.9, 4.2)	1.0 (0.4, 2.4)
Some	2.7 (1.8, 4.1)	1.2 (0.7, 2.3)	1.2 (0.2, 6.9)	0.9 (0.1, 5.9)	1.8 (1.1, 3.0)	1.1 (0.5, 2.3)
A little	1.6 (1.0, 2.5)	0.9 (0.4, 1.9)	0.8 (0.1, 4.5)	0.8 (0.1, 5.4)	1.4 (0.8, 2.3)	0.8 (0.4, 1.8)
Not At All	ref	ref	ref	ref	ref	ref

Table A6

Unadjusted and adjusted logistic regression results for the association between internet use and awareness of the HPV vaccine for the total sample, and for respondents stratified by first source of health information; 2013 Health Information National Trends Survey (HINTS) from the National Cancer Institute.

Online Health Activity	Total Sample:		Respondents who used the internet as first source of health information:		Respondents who used other sources first for health information:	
	OR (95% CI)	aOR (95% CI)	OR (95% CI)	aOR (95% CI)	OR (95% CI)	aOR (95% CI)
The most recent time you looked for information about health or medical topics, where did you go first?						
Internet	2.4 (1.8, 3.0)	1.4 (1.0, 1.9)	-	-	-	-
Other Source	ref	ref	-	-	-	-
In the last 12 months, have you visited a social networking site such as Facebook or LinkedIn?						
Yes	1.4 (1.0, 2.0)	0.7 (0.5, 1.1)	1.3 (0.8, 2.2)	0.8 (0.4, 1.4)	1.3 (0.8, 2.1)	0.7 (0.3, 1.3)
No	ref	ref	ref	ref	ref	ref
In the last 12 months, have you shared health						

information on social networking sites, such as Facebook or Twitter?						
Yes	2.0(1.3, 3.2)	1.4 (0.8, 2.5)	1.7 (0.9, 2.9)	1.4 (0.6, 2.9)	2.4 (1.3, 4.4)	1.4 (0.6, 3.4)
No	ref	ref	ref	ref	ref	ref
In the last 12 months, have you written in an online diary or blog (i.e. Web log?)						
Yes	0.9 (0.5, 1.8)	0.6 (0.3, 1.4)	0.9 (0.3, 2.2)	0.5 (0.2, 1.6)	1.0 (0.4, 2.7)	0.7 (0.2, 2.0)
No	ref	ref	ref	ref	ref	ref
In the last 12 months, have you participated in an online forum or support group for people with a similar health or medical issue?						
Yes	1.4 (0.6, 3.2)	0.9 (0.4, 2.1)	1.8 (0.8, 4.1)	1.0 (0.4, 2.4)	1 (0.2, 5.6)	0.7 (0.1, 3.5)
No	ref	ref	ref	ref	ref	ref
In the last 12 months, have you watched a health-related						

video on YouTube?						
Yes	1.3 (0.9, 1.9)	1.2 (0.8, 1.9)	1.6 (1.0, 2.7)	1.7 (0.9, 3.2)	0.9 (0.5, 1.5)	0.7 (0.3, 1.3)
No	ref	ref	ref		ref	ref
In general, how much would you trust information about health or medical topics from the internet?						
A lot	1.8 (1.1, 3.0)	0.8 (0.4, 1.5)	0.8 (0.1, 5.1)	0.9 (0.1, 6.1)	1.2 (0.5, 2.6)	0.5 (0.2, 1.3)
Some	2.2 (1.5, 3.2)	1.2 (0.7, 2.1)	1.1 (0.2, 6.1)	1.2 (0.2, 7.7)	1.5 (1.0, 2.3)	1.1 (0.6, 2.1)
A little	1.3 (0.8, 2.0)	0.9 (0.5, 1.5)	0.7 (0.1, 4.1)	1.0 (0.1, 6.7)	1.2 (0.7, 1.8)	0.8 (0.4, 1.5)
Not At All	ref	ref	ref	ref	ref	ref

Table A7.

Unadjusted and adjusted logistic regression results for the association between internet use and awareness of HPV's link with cervical cancer for the total sample, and for respondents stratified by first source of health information; 2013 Health Information National Trends Survey (HINTS) from the National Cancer Institute.

Online Health Activity	Total Sample:		Respondents who used the internet as first source of health information:		Respondents who used other sources first for health information:	
	OR (95% CI)	aOR (95% CI)	OR (95% CI)	aOR (95% CI)	OR (95% CI)	aOR (95% CI)
The most recent time you looked for information about health or medical topics, where did you go first?						
Internet	1.9 (1.4, 2.7)	1.5 (1.0, 2.1)	-	-	-	-
Other Source	ref	ref	-	-	-	-
In the last 12 months, have you visited a social networking site such as Facebook or LinkedIn?						
Yes	1.8 (1.1, 2.7)	1.3 (0.7, 2.4)	2.0 (1.2, 3.3)	1.5 (0.7, 3.1)	1.3 (0.7, 2.7)	1 (0.4, 2.9)
No	ref	ref	ref	ref	ref	ref
In the last 12 months, have you shared health information on social networking sites, such as Facebook or Twitter?						
Yes	1.3 (0.8, 1.9)	1.0 (0.5, 1.8)	1.2 (0.7, 2.0)	0.9 (0.5, 1.7)	1.2 (0.5, 2.7)	0.7 (0.2, 2.5)
No	ref	ref	ref	ref	ref	ref
In the last 12 months, have you written in an						

online diary or blog (i.e. Web log?)						
Yes	2.6 (1.4, 4.8)	2.5 (1.2, 5.2)	2.7 (1.1, 7.0)	2.4 (0.7, 7.9)	2.5 (0.9, 6.8)	2.6 (0.5, 13.6)
No	ref	ref	ref	ref	ref	ref
In the last 12 months, have you participated in an online forum or support group for people with a similar health or medical issue?						
Yes	1.6 (0.8, 3.2)	6.8 (2.6, 17.7)	2.1 (0.7, 6.4)	1.5 (0.4, 5.3)	1 (0.3, 3.1)	0.9 (0.2, 5.3)
No	ref	ref	ref	ref	ref	ref
In the last 12 months, have you watched a health-related video on YouTube?						
Yes	1.2 (0.8, 1.9)	1.1 (0.6, 1.7)	1.3 (0.8, 2.1)	1.2 (0.7, 2)	0.9 (0.4, 1.9)	0.6 (0.2, 1.7)
No	ref	ref	ref	ref	ref	ref
In general, how much would you trust information about health or medical topics from the internet?						
A lot	1.7 (0.9, 3.4)	1.1 (0.4, 2.9)	2.5 (0.2, 36.1)	3.9 (0.2, 70.1)	1 (0.3, 2.9)	0.7 (0.1, 4.2)
Some	2.1 (1.3, 3.4)	1.2 (0.6, 2.4)	2.8 (0.2, 41.4)	3.7 (0.2, 71.3)	1.5 (0.8, 2.6)	0.9 (0.4, 2)
A little	1.8 (1.1, 3.1)	1.4 (0.7, 3.0)	3.4 (0.3, 43.0)	5.7 (0.4, 84.1)	1.4 (0.8, 2.6)	1.1 (0.5, 2.5)
Not At All	ref	ref	ref	ref	ref	ref