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Are health care providers making the most of patient encounters to promote HPV vaccination among cigarette smokers?

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Abstract

Objective: To examine providers' HPV vaccine communication among adult cigarette smokers with household members aged ≥ 26 years.

Methods: In this cross-sectional study, we used 2017 Health Information National Trends Survey (HINTS 5, Cycle 1; N=3,191) data to derive a subsample (n=725/3,191; 22.7%) of adults with household members aged ≥ 26 years. Forward stepwise multivariable logistic regression analyses were performed to examine providers' HPV vaccine communication, adjusting for patients' smoking status (main independent variable); HPV awareness and knowledge; HPV vaccine awareness and beliefs; and sociodemographic characteristics that contribute to disparities in HPV vaccine coverage.

Results: Current/former smokers (35.0%) had lower HPV-related awareness/knowledge than nonsmokers (65%). Few reported providers discussed (27.4%) or recommended (24.0%) HPV vaccine. Non-Hispanic Whites who knew HPV was a sexually transmitted disease and heard of HPV vaccine were 2–6 times more likely to report provider HPV vaccine communication. Provider HPV vaccine communication differences by smoking status were not statistically significant.

Conclusion: Providers' HPV vaccine communication was higher among adults who had higher HPV-related awareness/knowledge. Although active/passive exposure to cigarette smoke increases cervical cancer risk, providers' HPV vaccine communication was not increased for current/former smokers.

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Conflicts of Interest: None.

Practice Implications: Current/former smokers' HPV-related awareness/knowledge and providers' HPV vaccine communication need to be increased.

Keywords

HPV vaccine; cigarette smoking; secondhand smoke; cervical cancer; provider recommendation; patient-provider communication

Introduction

Human papillomavirus (HPV) infection is a potentially oncogenic sexually transmitted infection (STI) [1]. In 2018, the American Social Health Association estimated that 14 million new cases of genital HPV infection occur among men and women in the United States (US) each year, and that 80% of American women between the ages of 15 and 49 have, at some point in their lifetime, acquired genital HPV infection [2]. Fortunately, HPV-related diseases and cancers are among a select few that are preventable due in part to a safe and effective nonavalent vaccine (i.e., Gardasil® 9). The Advisory Committee on Immunization Practices' (ACIP) current HPV vaccination recommendations are for persons aged 9 through 26 years [3–5]. In October 2018, the Food and Drug Administration (FDA) announced its approval of the expanded use of Gardasil® 9 for persons aged 27–45 years [6].

Anal, cervical, oral, penile, vaginal, and vulvar dysplasia and cancers are HPV-vaccine preventable diseases and cancers for which cigarette smoking is a risk factor [7]. HPV-related cervical diseases have further been associated to smoking, which, like HIV, may play a role in the progression of cervical disease, in part through an effect on the immune response to HPV [8]. Previous conducted research indicates that it is possible that the association among smoking and cancer is mediated by an effect on the incidence and/or persistence of HPV infection, which has been associated to cervical cancer [9–10]. One often overlooked cigarette smoking-related risk factor associated with HPV-related diseases and cancers is secondhand smoke (SHS) [11–13]. More than 94 million Americans are exposed to SHS in a variety of settings including home, vehicle, workplace, and public places [13]. While policy-level interventions have contributed to a decline in SHS exposure among all racial and ethnic groups, African Americans continue to have higher levels of SHS exposure than Whites or Hispanics [2]. As with smoking prevalence, there is an inverse relationship between SHS exposure and income [14].

Inhaling SHS while a cigarette is being smoked is the most visible, though not the only exposure risk. SHS chamber and field studies demonstrate that SHS components are swiftly dispersed after emission and undergo additional dynamic chemical reactions [15]. Vapor phase components deposit and are adsorbed into walls, furniture, clothes, and other inanimate objects as quickly as 10 minutes after cigarette smoke has been emitted. From there, the carcinogens are re-emitted into the air over the course of hours to months. Through this dynamic behavior, SHS can contaminate homes for weeks and months after SHS was emitted from a cigarette [13].

Findings from controlled chamber and field studies suggest that residential indoor environments become reservoirs for SHS, turning contaminated dust, carpets, and other household objects into potential sources of SHS exposure long after smoking has stopped [15–16]. As the danger of SHS exposure has become more apparent, many smokers have tried to protect household members from SHS exposure by only smoking outside the home. For example, concentrations of SHS markers (e.g., nicotine in household dust, indoor air, and on household surfaces) are 3–8 times greater in the homes of people who smoke indoors compared to the homes of those who smoke outdoors [8]. However, despite outdoor smokers' efforts to reduce nicotine exposure, the concentrations of SHS markers are 5–7 times higher in households of outdoor smokers compared to those of nonsmokers [13]. Thus, despite outdoor smokers' attempts to minimize SHS exposure, household members of outdoor smokers are still at greater SHS exposure risk than nonsmokers. HPV vaccination has the potential to be particularly important for adolescents and young adults exposed to SHS.

Several studies have shown that a strong recommendation from a health care provider is the strongest predictor of HPV vaccine uptake. However, previous studies have shown that providers do not consistently provide such recommendations for the HPV vaccine to the parents and caregivers of individuals within the recommended screening age range. Vaccine age eligible persons age 26 and younger may be at increased risk because they currently reside in a home where they may be exposed to SHS. Health care providers should take the initiative to advise parents strongly not to smoke around their child and/or to quit smoking, and to assist parents with strategies to protect their child from SHS. However, a gap remains in the literature regarding health care provider HPV vaccine communication with parents/caregivers who smoke or are former smokers. Using data from the Health Information National Trends Survey (HINTS) 5 Cycle 1 this study sought to determine if there was a difference in provider communication about the HPV vaccine among parents/caregivers who were current or former smokers, and parents/caregivers who were nonsmokers. HPV-related awareness, knowledge, and beliefs were also assessed.

Materials and Methods

Data Source

The Health Information National Trends Survey (HINTS) is a US population-based survey of adults aged 18+ years. HINTS has been administered by the National Cancer Institute since 2003. For this cross-sectional study, we analyzed data from the first cycle of the fifth HINTS iteration (HINTS 5, Cycle 1). Data were collected between January–May 2017 via self-administered, mailed surveys. To encourage participation, a \$2 financial incentive was included with the mailed survey. The overall response rate was 32.39%. Complete data were available for N=3,191/3,285 (97%) of survey respondents.

Participants

HINTS selected a stratified sample from a file of US residential mailing addresses. The next birthday method was used to select one adult household member from each sampled mailing address to complete the survey. An English and Spanish version of the survey were

available. For this study, we only included survey respondents (N=1,042) who were ages 18 through 27 years or had at least one family or household member through 27 years old. These respondents (or their immediate family member or household member) would have been ages 9 to 26 years in the previous year. Only survey respondents who themselves were or had a household member aged through 27 years were included. From this group, we excluded 317 survey respondents because either they: did not have an immediate family member aged 9–27 years (n=284), or this information was missing (n=1), or had missing information for one or more of the other variables that were included in this study (n=32). Based on these inclusion/exclusion criteria, the subsample for our study was N=725/3,285 (22%) survey respondents.

Measures

Outcomes of interest were survey respondent's perception/recollection of provider's HPV vaccine communication. One HINTS question asked if a provider had ever talk to them about the HPV vaccine, which was followed by a second question that asked if a provider had ever recommended the HPV vaccine for them or an immediate family member aged 9–26 years old in the past year (yes/no). Smoking status (current/former/never) was the exposure variable. HPV-related awareness, knowledge, and beliefs were covariates of provider communication about the HPV vaccine. Sociodemographic characteristics (age, sex, race/ethnicity, marital status), socioeconomic status (education, income), and health care access (insurance, non-emergency health care visits) were potential confounders.

Provider Communication.—Survey respondents were asked the following two questions about their communication with a provider about the HPV vaccine: *In the past 12 months, has a doctor or health care professional... (1) ever talked with you or an immediate family member about the HPV shot or vaccine, and ... (2) recommended that you or someone in your immediate family get an HPV shot or vaccine?* Yes, no, or don't know response options were dichotomized as 1=yes or 0=no/don't know.

Exposure Variable.—Smoking status was coded using the following two questions: (1) *Have you smoked at least 100 cigarettes in your entire life?* and (2) *How often do you now smoke cigarettes?* Response options were yes or no for the first smoking-related question, and every day, some days, or not at all for the second smoking-related question. We used these two items to create a new variable to categorize survey respondents as individuals who had smoked fewer than 100 cigarettes in their entire lifetime (nonsmokers) and those who had smoked at least 100 cigarettes in their lifetime and now smoke every day or some days (current smokers) or not at all (former smokers).

HPV.—Survey respondents were first asked: *Have you ever heard of HPV?* Response options were yes (1=aware) or no (0=unaware). Survey respondents who had heard of HPV were then asked the following six (6) questions, Do you think HPV: (1–4) *Can cause... {cervical/penile/anal/oral} cancer?* (5) *Is a sexually transmitted disease (STD)?* (6) *Requires medical treatment or will it usually go away on its own without treatment?* Response options were yes (correct answer), no, or not sure for the first five HPV-related questions. A response of no or not sure were both coded as an incorrect answer for the first five HPV-

related questions. For the sixth HPV-related question, requires medical treatment was the incorrect answer and will usually go away on its own (correct answer). A dichotomous variable (1=correct, 0=incorrect) was created for each of the six HPV-related knowledge questions, which were each considered in relation to the outcomes of interest. Because survey respondents who were unaware of HPV did not answer the subsequent knowledge questions, the six HPV-related knowledge questions were recoded as incorrect for survey participants who were unaware of HPV.

HPV Vaccine.—Survey respondents were asked: *Before today, have you ever heard of the cervical cancer vaccine or HPV shot?* Response options were yes (1=aware) or no (0=unaware). Survey respondents were also asked: *In your opinion, how successful is the HPV vaccine at preventing cervical cancer?* Response options were not at all successful, a little successful, pretty successful, very successful, or don't know. A little/pretty/very successful were recoded as 1=successful. Not at all successful and don't know responses were recoded as 0=unsuccessful.

Sociodemographic Characteristics.—Survey respondents were asked questions about their age (in years, open-ended responses), sex (male or female), race/ethnicity (Hispanic, Non-Hispanic African American or Black, American Indian or Alaska Native, Asian, or White), citizenship (US or foreign born), marital status (married/living as married, divorced/separated, widowed, or single/never been married).

Socioeconomic Status.

Survey respondents answered questions about the highest level of education attained (less than high school, high school graduate, some college, or college graduate or more), and their combined annual family income (<\$20,000, \$20–34,999, \$35,000–49,999, \$50,000–74,999, or \$75,000 or higher).

Health Care Access.—HINTS created a dichotomous health insurance variable that was used to categorize survey respondents being insured or uninsured. Health care access was based on the answer to the following question: *In the past 12 months, not counting times you went to an emergency room, how many times did you go to a doctor, nurse, or other health professional to get care for yourself?* Response options were none, 1, 2, 3, 4, 5–9, or 10 or more times.

Data Analysis

We compared awareness, knowledge, beliefs, provider communication about, and provider recommendation of the HPV vaccine among adult smokers and non-smokers who had HPV vaccine age-eligible children, adolescents, and young adults living in their households using HINTS 5, Cycle 1 data. Stata/SE 15.1 (State Corporation, College Station, TX) was used to perform all data analyses. We examined the association between adult smoking status on provider communication about and recommendation of the HPV vaccine. Multivariable logistic regression analyses were adjusted for HPV-related awareness, knowledge, and beliefs; sociodemographic characteristics (e.g., age, gender, race/ethnicity, birthplace, marital status); socioeconomic status (e.g., level of education, household income); and

health care access (e.g., health insurance). Replicate weights were used for consistent variance estimation based on the jackknife replication method. The replicate weights for HINTS survey data uses 50 replicate weights for each survey year to correct for nonresponse and nonconvergence biases [17, 18].

Results

The final sample consisted of 725 adults with children, adolescents, and young adults (aged 27 years and younger) living in their household, as well as adults who were eligible to receive the HPV vaccine. Ages ranged from 18 to 101 and the mean for the overall sample was 42.5 years (SE=0.59). Based on the Bonferroni adjusted p-value, the mean age differences between the 75 current (41.0 years, SE=1.75), 177 former (47.3 years, SE=1.17), and 473 nonsmokers (40.9 years, SE=0.88) were statistically significant ($p=0.0003$). These data are not reported in Table 1.

Only 10 percent (95% CI: 0.07–0.13) of the sample were current smokers. Most were Hispanic (62%, 95% CI: 59%–65%) or non-Hispanic Black or African American (20%, 95% CI: 17%–23%). More than half were females (58%, 95% CI: 54%–61%) who were married/living as married (66%, 95% CI: 62%–70%). These data and other sample characteristics are reported in Table 1.

In this sample, 27% (95% CI: 23%–32%) reported talking to their health care provider about the HPV vaccine, and 24% (95% CI: 20%–29%) reported that their health care provider had recommended the vaccine for an immediate family member between the ages of 9 and 27 years old in the past year. About 75% (95% CI: 71%–79%) of the sample reported they had heard of HPV, 25.2% ($p<0.001$) of which had discussed the vaccine with their provider, and 22.3% ($p<0.001$) had the vaccine recommended by a provider. Similarly, 73% (95% CI: 69%–77%) had heard of the HPV vaccine, 25.8% ($p<0.001$) of which had discussed the vaccine with their provider and 22.6% ($p<0.001$) had the vaccine recommended by their provider.

More than half of the sample knew that HPV could cause cervical cancer (62%; 95% CI: 58%–66%). Fewer knew that HPV could cause oral (22%; 95% CI: 18%–27%), anal (21%; 95% CI: 17%–25%), and penile cancers (24%; 95% CI: 20%–29%). Of those that were aware HPV could cause anal cancer, 8% ($p=0.035$) and 7.7% ($p=0.009$) had discussed the vaccine with their provider or had the vaccine recommended to them, respectively. Further, of those who knew HPV could cause cervical cancer, 22.0% ($p<0.001$) had discussed the HPV vaccine with their provider and 19.9% ($p<0.001$) reported their provider recommended the vaccine. Around 10% of those who knew HPV could cause penile cancer discussed the vaccine with their provider (10.5%, $p=0.002$), or had the vaccine recommended to them by a provider (9.4%, $p=0.001$). The proportions of those discussing the vaccine or having the vaccine recommended to them were not significantly related to being aware of HPV causing oral cancer.

More than half of the sample (54%, 95% CI: 49%–59%) knew HPV is a STD, and 38% (95% CI: 33%–42%) indicated that the HPV vaccine is a successful way to prevent cervical

cancer. Twenty percent (20.1%, $p<0.001$) of those who knew HPV was an STD had discussed the HPV vaccine with their provider, and 18.41% ($p<0.001$) had the vaccine recommended to them by a provider. Nearly 15% ($p=0.005$) of those who believed the HPV vaccine could prevent cervical cancer had discussed the vaccine with their provider, and 13.5% ($p=0.003$) had the vaccine recommended by their provider. See Table 1 for sample characteristics and Table 3 for proportions of awareness, beliefs, and knowledge of HPV based on provider communication.

HPV-related awareness, knowledge, and beliefs were mostly consistent across current, former, and nonsmokers, with the exception of knowing HPV can cause anal and penile cancers. Ten percent of nonsmokers and 8.4% of former smokers knew HPV could cause anal cancer as compared to 3.3% of current smokers ($p=0.0015$). Similarly, 11% of nonsmokers and 8.9% of former smokers knew HPV could cause penile cancer, as compared to 4.6% of current smokers ($p<0.0001$). See Table 2 for differences in sample characteristics by smoking status.

Multivariate regression analyses suggest that a respondent recalling a provider communicating about the HPV vaccine, as well as recalling a provider recommending the HPV vaccine, were related to HPV vaccine awareness, knowledge, and beliefs. Specifically, a person whose provider communicated about the HPV vaccine was 1.61 (95% CI: 1.42–24.3) times more likely to have heard of HPV, 9.0 (95% CI: 3.3–24.5) times more likely to have heard of the HPV vaccine, 3.13 (95% CI: 1.91–5.12) times more likely to know HPV is a sexually transmitted disease, and nearly 2–3 times more likely to know HPV can cause anal (OR=1.86; 95% CI: 1.05–3.31), cervical (OR=3.41; 95% CI: 1.68–6.93), oral (OR=1.73; 95% CI: 0.96–3.13), and penile (OR=2.67; 95% CI: 1.54–4.62) cancers compared to those whose providers did not communicate about the HPV vaccine. Those whose providers recommended the HPV vaccine were nearly 8 times more likely to have heard of the HPV vaccine (OR=7.97; 95% CI: 2.54–25.00), and also nearly 2–3 times more likely to know HPV can cause anal (OR=2.16; 95% CI: 1.24–3.77), cervical (OR=3.85; 95% CI: 1.79–8.25), oral (OR=1.8; 95% CI: 1.02–3.16), and penile (OR=2.64; 95% CI: 1.57–4.44) cancers compared to those whose providers had not recommended the HPV vaccine.

What respondents recalled about provider communication also varied by sex, marital status, race and ethnicity, and education. Females were 82% more likely (OR=1.82; 95% CI: 1.10–3.18) to report communicating with a provider about the HPV vaccine, and 86% more likely (OR=1.86; 95% CI: 1.1–3.2) to report a provider recommending the vaccine compared to males. Widows reported communicating with their providers about the HPV vaccine 84% (OR=0.16; 95% CI: 0.06–0.42) less than married or living as married persons, and the HPV vaccine was recommended to widows 80% (OR=0.20; 95% CI: 0.07–0.53) less. Finally, a person whose provider talked to them about the HPV vaccine was 1.78 times more likely to be non-Hispanic white (compared to Hispanic; 95% CI: 1.00–3.18), and 5–7 times more likely to have graduated high school (OR=6.19; 95% CI: 1.21–31.7), completed some college (OR=5.24; 95% CI: 1.09–25.1), or graduated from college (OR=7.15; 95% CI: 1.59–32.0). Those who never smoked, currently smoked, or formerly smoked did not report significantly different levels of provider communication regarding information or

recommendation about the HPV vaccine. See Tables 4 and 5 for multivariable logistic regression analyses results.

DISCUSSION

This study expands the current literature base by investigating the relationships between provider communication about and recommendation for HPV vaccines and patients' smoking status among household members aged 27 years. Smoking status was not associated with provider communication about or recommendation for the HPV vaccine. Considering that cigarette smoking (including exposure to second hand smoke and future uptake of cigarette smoking behavior) is a known risk factor for HPV-related cancers, providers should be consistently identifying these potentially at-risk adults and/or caregivers of HPV vaccine-age eligible adolescents and young adults. Smoking as a risk factor for HPV-related cancers should be emphasized in health education approaches in order to reach the most at-risk populations. Providers can easily identify current or former smokers through simple intake or health history forms and can tailor discussions based on this information. In-person discussions of smokers' elevated risk for HPV-related cancers can heighten patient awareness, as can paper-based health education brochures. These patients should be informed of the elevated need for HPV vaccination and safe sex practices for themselves and those that are exposed to secondhand smoke in or around the home.

Our study's findings also show that patients' knowledge of HPV was associated with provider communication about and recommendation for the HPV vaccine. Although cross sectional, these findings may indicate that provider communication about the HPV vaccine can increase patient knowledge, which can, in turn help to prevent HPV-related genital warts and some types of cancer. These interventions should occur at both the provider and patient level. Smokers in our study were less knowledgeable about HPV than nonsmokers, and few participants recalled/reported that their providers had talked to them about the HPV vaccine. Thus, more education may be needed in smokers, than in non-smokers.

Another insight from this study was the difference in communication about HPV with providers by participant demographics. Females were much more likely to report HPV conversations with providers, as compared with males. This finding may reflect the misconception that HPV and resulting cancers primarily affect women. In reality, HPV affects both males and females, and can result in anal, cervical, oral, penile, vaginal, and vulvar dysplasia and cancers in both males and females. Furthermore, this finding suggests that providers have an opportunity to provide HPV education to males and providers should be informed of the importance of discussing HPV across all genders. Other demographic variables like marital status, race, and education also influenced the likelihood of provider patient communication about HPV, which indicates that education and awareness interventions should target a more diverse audience in order to overcome these health disparities. Additional research is needed to explore potential barriers (e.g., language, culture, etc.) that could improve health education efforts towards Hispanic populations, which are least likely to get the HPV vaccine.

HINTS is the only population-based survey that has measured respondents' report of providers' communication about and recommendation of the HPV vaccine. However, it is important to note that these self-reported data are only from the patients' perspective based on their recollection of their health care providers' behavior. Thus, the fact that we are unable to use the patients' medical records or audio-recorded clinic visit to validate these self-reported data is a limitation. Even among survey respondents who reported talking to their providers about the HPV vaccine, we cannot say with certainty if it was the patient or the provider who initiated the discussion since most of the survey respondents in our subsample were aware of HPV and the HPV vaccine. HINTS questions about HPV provider communication and vaccine recommendation do not specify provider type (doctor, nurse practitioner, physician assistant, nurse, etc.) and/or specialty (e.g., general practice, primary care, pediatric care, etc.) [19]. Therefore, we are unable to discern if the HPV providers' communication and recommendation (or lack thereof) was with the survey participants' own health care provider or their child's pediatrician, which is another limitation of our study. Further, HINTS does not assess how many HPV vaccine doses (if any) were received, which limits our ability to examine the potential impact of providers' behaviors on HPV vaccination rates among our study sample. Also, we are unable to determine the exact ages of minor household members. Nonetheless, only survey participants that had an HPV vaccine age-eligible immediate family member were asked the HINTS questions about provider communication and recommendation of the HPV vaccine. However, the fact that the immediate family member's relationship to the survey respondent was unknown is a potential study limitation because we do not know what role this person would have in vaccine decision making.

Conclusion

This study provides important insight into a unique population that are at risk for HPV related disease due to smoking. Our study indicates that there are no significant differences with respect to physician communication or recommendation for adolescents and young adults living in homes where they are likely to be exposed to SHS compared to those who live in non-smoker homes. This represents a missed clinical opportunity for providers to promote cancer prevention by combining smoking cessation and vaccination strategies for parents/caregivers. We did identify several key areas related to awareness and knowledge that were associated with HPV vaccine communication and recommendation. These areas should be further investigated in the context of a prospective study to examine whether strategies such as "patient priming" with education and information about vaccination may be an effective way to facilitate provider communication and recommendation of the HPV vaccine for adolescents and young adults.

Practice Implications

Health education programs aimed at increasing current/former smokers' HPV-related awareness/knowledge are warranted. The need for continued efforts to improve providers' HPV vaccine communication are further underscored.

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Highlights

- Smokers had less HPV-related awareness, knowledge, and beliefs than nonsmokers.
- HPV knowledge was positively associated with providers' HPV vaccine communication.
- HPV vaccine awareness was also positively associated with providers' communication.
- Smoking status did not affect providers' HPV vaccine communication.

Table 1. Sample Description, *N* = 725

Characteristics	Proportion (95% CI)
<i>Smoking Status</i>	
Current smoker	.0994625 (.0708411 .1280839)
Former smoker	.2503387 (.2054242 .2952533)
Nonsmoker	.6501988 (.604173 .6962245)
<i>HPV-Related Awareness, Knowledge, and Beliefs</i>	
Heard of HPV	.7466034 (.7076049 .7856019)
Heard of HPV vaccine	.7298294 (.6880787 .7715801)
HPV can cause anal cancer	.2126621 (.1712645 .2540597)
...cervical cancer	.6181161 (.5784755 .6577568)
...oral cancer	.2228615 (.1800518 .2656712)
...penile cancer	.2417906 (.1955254 .2880558)
HPV is a sexually transmitted disease	.5420335 (.4913498 .5927173)
HPV will usually go away on its own without treatment	.0483299 (.028842 .0677755)
HPV vaccine prevents cervical cancer	.378931 (.3328459 .4250162)
<i>Provider Communication</i>	
Provider ever talked about the HPV vaccine, past year	.273517 (.2275724 .3194617)
Provider recommended the HPV vaccine, past year	.2403853 (.1956667 .2851038)
<i>Sociodemographics</i>	
Age (<50), years	.7050448 (.6631448 .7469448)
Female	.5765067 (.5424664 .6105469)
Race/ethnicity	
Hispanic	.6207132 (.58986151 .6528113)
NH White	.099306 (.0807559 .1178562)
NH Black or African American	.1969007 (.1651607 .2286407)
NH American Indian or Alaska Native	.0616237 (.043759 .0794884)
NH Asian	.0214563 (.0097808 .0331318)
Born in the United States of America	.8249401 (.7905956 .8592847)
Marital Status	
Married/Partnered (or living as married)	.6618559 (.6215498 .7021621)
Divorced/Separated	.0930803 (.0662384 .1199222)
Widowed	.0215564 (.0072446 .0358683)
Single, never been married	.2235073 (.1815665 .2654481)
<i>Socioeconomic Status</i>	
Education	
Less than high school	.0835271 (.0469487 .1201055)
High school graduate	.2002747 (.1490457 .2515037)_
Some college	.3078539 (.2632474 .3524605)

Characteristics	Proportion (95% CI)
College graduate or more	.4083443 (.3696972 .4469914)
Annual Household Income	
Less than \$20,000	.1293913 (.0932868 .1654958)
\$20,000 to < \$35,000	.0959467 (.0653549 .1265386)
\$35,000 to < \$50,000	.1315244 (.0892891 .1737597)
\$50,000 to < \$75,000	.1821072 (.1408177 .2233966)
\$75,000 or higher	.4610304 (.4066116 .5154492)
<i>Health Care Access</i>	
Insured	.9165493 (.8793355 .9537632)
Non-emergency health visits, past year	
1 time	.2761831 (.2184677 .3338986)
2 times	.263674 (.2169558 .3103937)
3 times	.1485784 (.1212779 .1758789)
4 times	.0932533 (.0701613 .1163452)
5–9 times	.133271 (.0955558 .1709862)
10 or more times	.0850395 (.058032 .112047)

Abbreviations: CI (confidence interval); HPV (human papillomavirus), NH (non-Hispanic), SE (standard error).

Table 2. Chi-square tests by participants' smoking status, $N = 725$

Characteristics	Total	Current	Former	Nonsmoker	<i>P</i> -value ^a
		10.0	25.0	65.0	
<i>HPV-Related Awareness, Knowledge, and Beliefs</i>					
Heard of HPV	74.7	8.6	19.6	46.5	0.08
Heard of HPV vaccine	73.0	7.7	19.1	46.2	0.62
HPV can cause anal cancer	21.3	3.3	8.4	9.6	0.00
...cervical cancer	61.8	7.0	17.7	37.1	0.07
...oral cancer	22.3	2.9	7.3	12.1	0.08
...penile cancer	24.2	4.6	8.9	10.7	0.00
HPV is a sexually transmitted disease	54.2	6.2	15.4	32.6	0.12
HPV will usually go away on its own	4.8	0.5	1.5	2.8	0.78
HPV vaccine prevents cervical cancer	37.9	4.2	9.2	24.5	0.40
<i>Provider Communication</i>					
Provider ever talked about the HPV vaccine, past year	27.4	3.0	7.2	17.1	0.62
Provider recommended the HPV vaccine, past year	24.0	3.0	6.5	14.6	0.58
<i>Sociodemographics</i>					
Age (<50), years	70.5	7.3	15.3	47.9	0.09
Female	57.7	6.0	12.4	39.2	0.20
Race/ethnicity					0.00
Hispanic	62.1	7.6	19.9	34.6	
NH White	9.9	0.6	1.1	8.2	
NH Black or African American	19.7	1.1	2.6	16.0	
NH American Indian or Alaska Native	6.2	0.3	0.8	5.1	
NH Asian	2.2	0.4	0.6	1.2	
Born in the United States of America	82.5	9.3	22.9	50.3	0.00
Marital Status					0.05
Married/Living as married	66.2	6.4	19.6	40.2	
Divorced/Separated	9.3	2.0	1.7	5.6	
Widowed	2.2	0.04	0.8	1.3	
Single, never been married	22.4	1.5	2.9	17.9	
<i>Socioeconomic Status</i>					
Education					0.01
Less than high school	8.4	1.4	1.9	5.1	
High school graduate	20.03	2.4	4.8	12.8	
Some college	30.8	4.4	10.3	16.1	
College graduate or more	40.8	1.8	8.01	31.1	
Annual Household Income					0.13

Characteristics	Total	Current	Former	Nonsmoker	<i>P</i> -value ^a
Less than \$20,000	12.9	2.5	2.2	8.3	
\$20,000 to < \$35,000	9.6	2.1	2.4	5.2	
\$35,000 to < \$50,000	13.2	1.1	3.4	8.6	
\$50,000 to < \$75,000	18.2	2.0	5.0	11.3	
\$75,000 or higher	46.1	2.3	12.1	31.7	
<i>Health Care Access</i>					
Insured	91.7	8.7	24.5	58.5	0.01
Non-emergency health visits, past year					0.02
1 time	27.6	1.5	3.7	22.4	
2 times	26.4	2.6	6.5	17.4	
3 times	14.9	2.4	4.4	8.1	
4 times	9.3	1.01	2.3	6.0	
5–9 times	13.3	1.3	4.3	7.8	
10 or more times	8.5	1.3	3.9	3.3	

Note:

^aAdjusted Wald *F* statistic | Abbreviation: HPV (human papillomavirus), NH (non-Hispanic).

Table 3. Chi-square tests by participants' whose providers communicated with them about the HPV vaccine, $N = 725$

Characteristics	Total	Discussed	<i>P</i> -value ^a	Recommended	<i>P</i> -value ^a
<i>Smoking Status</i>			0.76		.44
Current smoker	9.95	3.0		2.99	
Former smoker	25.03	7.21		6.46	
Nonsmoker	65.02	17.14		14.59	
<i>HPV-Related Awareness, Knowledge, and Beliefs</i>					
Heard of HPV	74.66	25.2	0.00	22.34	0.00
Heard of HPV vaccine	72.98	25.8	0.00	22.6	0.00
HPV can cause anal cancer	21.27	8.03	0.04	7.69	0.01
...cervical cancer	61.81	22.02	0.00	19.85	0.00
...oral cancer	22.29	8.1	0.08	7.35	0.05
...penile cancer	24.18	10.47	0.00	9.38	0.00
HPV is a sexually transmitted disease	54.2	20.09	0.00	18.41	0.00
HPV will usually go away on its own	4.83	0.72	0.08	0.73	0.17
HPV vaccine prevents cervical cancer	37.89	14.85	0.01	13.46	0.00
<i>Sociodemographics</i>					
Age (<50), years	70.5	18.99	0.79	16.7	0.80
Female	57.65	18.57	0.01	16.52	0.01
Race/ethnicity	---	---	0.14		0.10
Hispanic	62.07	16.26	---	14.22	
NH White	9.93	3.85	---	3.53	
NH Black or African American	19.69	5.57	---	4.75	
NH American Indian or Alaska Native	6.16	0.96	---	0.82	
NH Asian	2.15	0.71	---	0.72	
Born in the United States of America	82.49	22.92	0.73	20.27	0.65
Marital Status	---	---	0.21		0.27
Married/Living as married	66.19	18.51	---	15.89	
Divorced/Separated	9.31	2.63	---	2.48	
Widowed	2.16	0.13	---	0.13	
Single, never been married	22.35	6.08	---	5.55	
<i>Socioeconomic Status</i>					
Education			0.00		0.00
Less than high school	8.35	0.52		0.29	
High school graduate	20.03	5.81		5.42	
Some college	30.79	7.92		7.43	
College graduate or more	40.83	13.1		10.89	
Annual Household Income			0.14		0.08

Characteristics	Total	Discussed	<i>P</i> -value ^a	Recommended	<i>P</i> -value ^a
Less than \$20,000	12.94	1.68		1.52	
\$20,000 to < \$35,000	9.59	3.09		2.84	
\$35,000 to < \$50,000	13.15	2.89		1.88	
\$50,000 to < \$75,000	18.21	5.32		5.02	
\$75,000 or higher	46.1	14.37		12.79	
<i>Health Care Access</i>					
Insured	91.65	25.47	0.66	22.0	0.97
Non-emergency health visits, past year			0.61		0.92
1 time	27.62	6.67		6.16	
2 times	26.37	8.22		6.68	
3 times	14.86	4.27		4.0	
4 times	9.33	2.37		1.96	
5–9 times	13.33	4.06		3.5	
10 or more times	8.5	1.77		1.73	

Note:

^aAdjusted Wald *F* statistic | Abbreviation: HPV (human papillomavirus), NH (non-Hispanic).

Table 4. Multivariable logistic regression analysis of participants whose providers discussed the HPV vaccine, $N = 725$

Characteristics	OR (95% CI)	aOR (95% CI)
<i>Smoking Status (Exposure)</i>		
Current smoker	1.21 (0.62 – 2.36)	1.01 (0.43 – 2.37)
Former smoker	1.13 (0.66 – 1.93)	1.08 (0.59 – 1.99)
Nonsmoker	Ref	Ref
<i>HPV-Related Awareness, Knowledge, and Beliefs</i>		
Heard of HPV (Ref=Unaware of HPV)	5.50 (1.42 – 21.3) *	1.61 (0.31 – 8.4)
Heard of HPV vaccine (Ref=Unaware of HPV vaccine)	9.0 (3.3 – 24.5) ***	6.28 (2.0 – 19.6) **
HPV can cause anal cancer (Ref=incorrect)	1.86 (1.05 – 3.31) *	0.59 (0.2 – 1.8)
...cervical cancer (Ref=incorrect)	3.41 (1.68 – 6.93) **	0.72 (0.24 – 2.2)
...oral cancer (Ref=incorrect)	1.73 (0.96 – 3.13)	0.68 (0.23 – 2.0)
...penile cancer (Ref=incorrect)	2.67 (1.54 – 4.62) **	3.11 (1.32 – 7.33) *
HPV is a sexually transmitted disease (Ref=incorrect)	3.13 (1.91 – 5.12) ***	2.1 (1.1 – 3.9) *
HPV will usually go away on its own (Ref=incorrect)	0.44 (0.15 – 1.3)	0.26 (0.08 – 0.89) *
HPV vaccine prevents cervical cancer (Ref=unsuccessful)	2.27 (0.06 – 89.4)	1.23 (0.01 – 104.5)
...don't know	0.89 (0.02 – 35.2)	0.81 (0.01 – 73.4)
<i>Sociodemographics</i>		
Age (<50), years (Ref=50+)	0.93 (0.54 – 1.60)	0.66 (0.32 – 1.36)
Female (Ref=Male)	1.82 (1.10 – 2.99) *	1.00 (0.55 – 1.83)
Race/ethnicity		
Hispanic	Ref	Ref
NH White	1.78 (1.00 – 3.18) *	2.33 (1.04 – 5.23) *
NH Black or African American	1.11 (0.59 – 2.10)	1.69 (0.8 – 3.59)
NH American Indian or Alaska Native	0.52 (0.16 – 1.74)	1.03 (0.25 – 4.18)
NH Asian	1.39 (0.31 – 6.23)	1.98 (0.43 – 9.23)
Born in the USA (Ref=foreign born)	0.88 (0.41 – 1.91)	---
Marital Status		
Married/Living as married	Ref	---
Divorced/Separated	1.02 (0.47 – 2.18)	---
Widowed	0.16 (0.06 – 0.42) ***	---
Single, never been married	0.96 (0.42 – 2.19)	---
<i>Socioeconomic Status</i>		
Education		
Less than high school	Ref	Ref
High school graduate	6.19 (1.21 – 31.7) *	3.96 (0.57 – 27.5)

Characteristics	OR (95% CI)	aOR (95% CI)
Some college	5.24 (1.09 – 25.1) *	2.52 (0.46 – 13.9)
College graduate or more	7.15 (1.59 – 32.0) *	2.97 (0.52 – 17.1)
Annual Household Income		
Less than \$20,000	Ref	---
\$20,000 to < \$35,000	0.33 (0.08 – 1.31)	---
\$35,000 to < \$50,000	1.05 (0.46 – 2.39)	---
\$50,000 to < \$75,000	0.62 (0.34 – 1.13)	---
\$75,000 or higher	0.91 (0.47 – 1.78)	---
<i>Health Care Access</i>		
Insured (Ref=uninsured)	0.76 (0.15 – 3.75)	---
Non-emergency health visits, past year		
1 time	Ref	---
2 times	1.42 (0.78 – 2.61)	---
3 times	1.27 (0.58 – 2.78)	---
4 times	1.07 (0.43 – 2.69)	---
5–9 times	1.38 (0.62 – 3.06)	---
10 or more times	0.82 (0.29 – 2.34)	---

Abbreviations: aOR (adjusted odds ratio), CI (confidence interval), HPV (human papillomavirus), NH (non-Hispanic), OR (odds ratio), USA (United States of America) |

*
p<0.05

**
p<0.01

***
p<0.001.

Table 5.

Multivariable logistic regression analysis of participants whose providers recommended the HPV vaccine, $N=725$

Characteristics	OR (95% CI)	aOR (95% CI)
<i>Smoking Status (Exposure)</i>		
Current smoker	1.49 (0.76 – 2.92)	1.34 (0.57 – 3.13)
Former smoker	1.20 (0.68 – 2.14)	1.11 (0.56 – 2.19)
Nonsmoker	Ref	Ref
<i>HPV-Related Awareness, Knowledge, and Beliefs</i>		
Heard of HPV (Ref=Unaware of HPV)	5.93 (0.99 – 35.5)	1.24 (0.16 – 9.80)
Heard of HPV vaccine (Ref=Unaware of HPV vaccine)	7.97 (2.54 – 25.0) **	4.89 (1.32 – 18.1) *
HPV can cause anal cancer (Ref=incorrect)	2.16 (1.24 – 3.77) **	0.96 (0.31 – 3.1)
...cervical cancer (Ref=incorrect)	3.85 (1.79 – 8.25) **	0.98 (0.33 – 2.93)
...oral cancer (Ref=incorrect)	1.8 (1.02 – 3.16) *	0.60 (0.20 – 1.76)
...penile cancer (Ref=incorrect)	2.64 (1.57 – 4.44) ***	2.01 (0.90 – 4.50)
HPV is a sexually transmitted disease (Ref=incorrect)	3.67 (2.12 – 6.36) ***	2.62 (1.32 – 5.23) **
HPV will usually go away on its own (Ref=incorrect)	0.55 (0.19 – 1.56)	0.34 (0.10 – 1.15)
HPV vaccine prevents cervical cancer (Ref=unsuccessful)	1.94 (0.05 – 76.5)	1.03 (0.01 – 93.6)
...don't know	0.72 (0.02 – 28.6)	0.62 (0.01 – 60.6)
<i>Sociodemographics</i>		
Age (<50), years (Ref=50+)	0.94 (0.56 – 1.57)	0.65 (0.32 – 1.35)
Female (Ref=Male)	1.86 (1.1 – 3.2) *	1.03 (0.55 – 1.94)
Race/ethnicity		
Hispanic	Ref	Ref
NH White	1.85 (0.99 – 3.46)	2.66 (1.08 – 6.55) *
NH Black or African American	1.07 (0.53 – 2.15)	1.75 (0.8 – 3.84)
NH American Indian or Alaska Native	0.52 (0.13 – 2.0)	1.13 (0.27 – 4.69)
NH Asian	1.7 (0.36 – 7.98)	2.75 (0.61 – 12.3)
Born in the USA (Ref=foreign born)	0.84 (0.37 – 1.93)	---
Marital Status		
Married/Living as married	Ref	---
Divorced/Separated	1.15 (0.52 – 2.52)	---
Widowed	0.2 (0.07 – 0.53) **	---
Single, never been married	1.04 (0.45 – 2.45)	---
<i>Socioeconomic Status</i>		
Education		
Less than high school	Ref	Ref

Characteristics	OR (95% CI)	aOR (95% CI)
High school graduate	10.2 (0.59 – 176.9)	6.58 (0.28 – 154.9)
Some college	8.8 (0.56 – 137.2)	4.2 (0.22 – 79.1)
College graduate or more	10.0 (0.64 – 157.2)	3.95 (0.2 – 77.2)
Annual Household Income		
Less than \$20,000	0.35 (0.07 – 1.63)	---
\$20,000 to < \$35,000	1.09 (0.47 – 2.54)	---
\$35,000 to < \$50,000	0.43 (0.21 – 0.9)	---
\$50,000 to < \$75,000	0.99 (0.50 – 1.95)	---
\$75,000 or higher	Ref	---
<i>Health Care Access</i>		
Insured (Ref=uninsured)	1.02 (0.24 – 4.44)	---
Non-emergency health visits, past year		
1 time	Ref	---
2 times	1.18 (0.65 – 2.17)	---
3 times	1.28 (0.6 – 2.74)	---
4 times	0.93 (0.36 – 2.43)	---
5–9 times	1.24 (0.57 – 2.72)	---
10 or more times	0.89 (0.31 – 2.56)	---

Abbreviations: aOR (adjusted odds ratio), CI (confidence interval), HPV (human papillomavirus), NH (non-Hispanic), OR (odds ratio), USA (United States of America) |

*
p<0.05

**
p<0.01

***
p<0.001.