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A Multi-State Evaluation of Oral Health Students' Knowledge of Human Papillomavirus Related Oropharyngeal Cancer and HPV Vaccination

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Abstract

Human papillomavirus related oropharyngeal cancers (HPV-OPCs) are on the rise, yet HPV knowledge among dental professionals remains low. The purpose of this multi-state study was to examine sociodemographic factors associated with final year dental hygiene (DH), third year dental (DS3), fourth year dental (DS4) students' knowledge regarding HPV, HPV-OPC, and HPV vaccination. Twenty dental programs in the United States were approached in the implementation phase to complete an online, 153-item, self-administered questionnaire that was developed and tested in a previous study. Descriptive statistics and chi square analyses were conducted in SAS version 9.4 to examine the relationship between sociodemographic variables with HPV, HPV-OPC, and HPV vaccination knowledge levels. This study included the participation of students from 15 dental programs (n=380) with an overall response rate of 28%. Although the results cannot be generalized to the entire population of dental students in the United States, most students had inadequate overall HPV knowledge (65%), HPV-OPC knowledge (80%), and HPV vaccination knowledge (55%). While all student groups displayed adequate general HPV knowledge levels (≥70% correct responses), gender, racial, religious, age, and regional differences were observed. Future dental professionals need to have adequate levels of HPV knowledge to aid in reducing the HPV-OPC burden. This study identified sociodemographic factors related to lower knowledge of HPV, HPV-OPC, and HPV vaccination, and highlights groups of students with greater needs for

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Disclosure of potential conflicts of interest None reported.

Research involving human participants and/or animals

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards

Informed consent

Informed consent was obtained from all individual participants included in the study.

HPV education. This study provides a foundation for future research and interventions to be developed. Dental institutions can use findings to strengthen curricula development.

Keywords

Dentistry; Oral Health; Oropharyngeal Cancer; Human Papillomavirus; Knowledge

Introduction

Cancer caused by human papillomavirus (HPV) is an emerging public health concern negatively impacting the field of dentistry due to its ability to cause oropharyngeal cancer (OPC). HPV is the world's most common sexually transmitted viral disease[1]-- HPV's burden is vast with an estimated 80 to 110 million infections total and 14 to 20 million new cases arising each year in the United State alone [2, 3]. The high prevalence and incidence is mostly due to HPV's ability to infect mucosal and cutaneous epithelium in a variety of ways including sexual interaction, skin to skin contact [2, 4], and possibly even fomites [1]. Roughly 90% of all HPV infections clear asymptomatically within two years [5]. Currently it is estimated that 7% of the population has oral HPV, and prolonged infection with oncogenic strains of HPV (HPV 16, 18) progress to OPC in in a minority of cases [4]. An estimated 16,500 people will be diagnosed with OPC each year, and 70% of those (11,550) will be attributed to HPV infections [6]. The incidence of HPV related OPC (HPV-OPC) continues to increase despite a decrease in tobacco and alcohol related OPCs [4, 7–9]. With these increasing rates, it is important for dental professionals to be competent in areas of cancer prevention, detection, diagnosis, treatment, and education.

Dental professionals such as dentists and dental hygienists play an important role in HPV-OPC prevention and early diagnosis; however, may lack knowledge about HPV [10, 11] and HPV-OPC [12]. This lack of knowledge may be a barrier to engaging dental professionals in talking about the HPV vaccine [11, 13]; which has been shown to be effective in reducing HPV-oral infections in the US [14].

Identifying factors associated with lower HPV-related knowledge may provide programs insight into the sub-populations of dental professionals that may benefit the most from comprehensive training about HPV. Thus, the aim of this study is to examine the associations between sociodemographic factors and oral health students' HPV-related knowledge. Few studies have examined sociodemographic factors related to oral health professionals' knowledge of HPV in the US-- to our knowledge only one study has found that female dental students and those with more advanced degrees have greater knowledge about HPV vaccination than male students and students with baccalaureate degrees [13]. In addition, a study conducted with Spanish students found that dental students with more senior class standing had greater awareness and knowledge of HPV-related topics [15]. However, HPV and the HPV vaccine are a controversial topic in the popular media, and coverage of this topic has been influenced by gendered and political lenses [16], which may affect its overall acceptance. Factors such as having a younger age and affiliating as a liberal has been associated with greater awareness of the HPV vaccine among the young adult

population [16], while being non-White and practicing an organized religion have been reported as factors of lower HPV knowledge and HPV vaccine awareness [17, 18]. Guided by the literature surrounding HPV vaccine awareness and HPV knowledge, we expected that: 1) HPV knowledge would be significantly different by gender, age, religion, student type, prior degree, race and region (conservative vs. liberal), and that among the subscales of HPV knowledge, oral health students will demonstrate greater knowledge in HPV-OPC knowledge compared to general HPV or HPV vaccine knowledge.

Materials and Methods

This study builds on previous work [19] to examine oral health students' HPV knowledge levels with a validated assessment tool. The tool included a total of 153 questions out of which 57 items assessed knowledge of HPV, HPV OPC, and the HPV vaccine (general HPV- 20 items, HPV-OPC- 14 items, and HPV vaccine- 23 items). The majority of the items were true/false, with the option for respondents to select "don't know".

All study procedures were approved by the University of Utah's Institutional Review Board. After IRB approval, this study was conducted between April to May 2016. To assess oral health student HPV knowledge, a partnership was formed with the 400+ member, 12-state, Huntsman Cancer Institute Intermountain West HPV Vaccination Coalition whose members had connections with various dental programs within the Mountain West region, California, Texas, and Tennessee. Through these members, twenty dental and dental hygiene programs in the United States were approached to distribute the assessment tool to either their final year dental hygiene (DH), third year dental (DS3), and fourth year dental (DS4). Out of the 20 dental programs contacted, 18 agreed to participate in this study; however, only 16 formally distributed the analysis tool to their students. One school subsequently withdrew their participation. Each program was provided standardized study documentation, training, and reminders to maintain deadlines. Programs emailed students study information and the questionnaire and consent forms were distributed to those who were interested. To ensure data anonymity, none of the study principal investigators (PIs), coordinators, or staff had access to any of the schools' email lists/class rosters. Each participant received a $15 gift card.

Upon completion of data collection, the data was cleaned and analyzed using SAS software, Version 9.4. To determine if students achieved adequate knowledge levels for each of the four scales, a 70% correctness threshold was applied. This threshold was applied since most dental programs require their students to obtain at least a 70% on their exams to pass. Individuals failing to correctly answer at least 70% of the questions were deemed to have inadequate levels of knowledge. Liberal and conservative regions were identified based on historical voting practices from where the dental program was located. In addition to this, descriptive statistics and chi square (χ^2) were utilized. A variable assessing HPV curriculum inclusion was initially added, but later dropped after mixed self-reported results from students were obtained regarding if HPV was taught. Dental HPV education is also not standardized, which made including this variable difficult. To compensate for this, the knowledge scales mentioned above were emphasized. Finally, the results were compiled, and the study hypotheses were evaluated. Significance was set at the $p<0.05$ level.

Results

From the remaining programs, a total of N = 1,365 oral health students were eligible to participate in this study (n = 120 DH, n = 673 DS3s, n = 572 DS4s). While the online survey was accessed 578 times, 163 records had to be excluded from analysis. Records isolated included duplicates (n = 13), students that attended schools that withdrew from the study (n = 12), a student outside of the study population, a student that identified a nonparticipating school as their primary institution, and those that failed to complete at least 50% of the questionnaire (n = 136). Data from N = 380 records were analyzed.

There was a total of 380 participants (n = 83 DH, n = 185 DS3s, n = 91 DS4s, and n = 21 unknown), with 68% being female, 77% aged 18 to 29 years old, 56% self-identifying as Caucasian, 58% identifying with the Christian faith, 74% who had at least bachelor's degree, and 22% who lived in California (see Table 1).

The study response rates were 28% overall (380/1365), 69% for DH (83/120), 27% for DS3s (185/673), and 16% for DS4s (91/572). From the 15 participating programs, the response rates varied from 9% to 100%. Since response rates fluctuated heavily and were low, results could not be generalized to the entire oral health student population.

Overall Knowledge

Overall knowledge items consisted of the 57 general HPV, HPV-OPC, and HPV vaccine knowledge items. Only 35% of students were found to have adequate overall knowledge (n = 133, 35.4%). The scores ranged from 21% to 87%, with an average of 65%, and a median of 67%. For the demographic variables measured, only racial background ($P = 0.01$) and religious ideology ($P = 0.03$) were significantly associated with knowledge levels. Race was categorized by the 3 largest racial groupings, "White", "Asian", and "Other", which included American Indian or Alaskan Native, Native Hawaiian or other Pacific Islander, Other, and those who indicated don't know. Lower proportions of Asian participants demonstrated adequate overall knowledge (n = 16, 80%) compared to White participants (n= 85, 40%). Additionally, those who indicated having a non-Christian faith (eg. Buddhist, Hindu, Jewish, or Muslim), had lower proportions of adequate overall knowledge (n = 6, 16%) compared with those who reported a Christian religion (n = 79, 36%; see Table 2. A complete list of all the knowledge questions asked is included in Table 3.

General HPV Knowledge

Students generally performed best in the general HPV knowledge subscale, with 70% displaying adequate knowledge (n = 265). The scores ranged from 20% to 100%, with an average score of 70% and a median score of 75%. For the demographics, student type ($P = 0.01$), sex ($P = 0.03$), religious ideology ($P < 0.01$), degree status ($P = 0.03$), state residency ($P = 0.03$), and region (conservative vs. liberal, $P < 0.01$) were associated with general HPV knowledge levels. Lower proportions of adequate knowledge were observed among dental hygiene students (n = 47, 57%), females (n = 171, 66%), non-Christians (n = 18, 49%), associate degree holders (n = 27, 56%), participants from programs in Utah (n = 25, 53%), or those from more conservative regions (n = 136, 65%; see Table 2).

Although the students had adequate general HPV knowledge, there were several questions students fared worse in. Nearly 67% did not know that most HPV infections resolve spontaneously within two years while over half failed to correctly identify which age range had the highest HPV prevalence. When asked what HPV infections cause, 43% said herpes, while 19% thought HIV/AIDS. Almost half were unsure if HPV related dysplasia was more common among smokers.

HPV-OPC Knowledge

Of the knowledge questions, students fared worst on the HPV-OPC knowledge subscale-- only 20% of the students had adequate knowledge (n = 76). The scores ranged 5% to 85%. The average score was 55%, and the median score was 60%. For the demographics, differences in racial background ($P < 0.01$) and state residence ($P = 0.01$) were statistically significant. Participants who indicated Asian race (n = 5, 6%, vs White, n=53, 25%, $P < 0.01$) had lower proportions of adequate knowledge, while participants from programs in Nevada and Tennessee had lower proportions of adequate knowledge (n = 2, 7%; n = 1, 5%) compared to other states.

Over half of participants could not distinguish between HPV types that cause cervical cancer vs. genital warts, and 77% did not know that tobacco related OPC is more deadly than HPV-OPC. Regarding how often patients should receive an oral, head, and neck cancer examination, one third answered yearly or every two years (instead of correctly identifying that oral cancer screening should be performed at every visit). When asked which groups have the highest OPC incidence rates, only 13% correctly identified Caucasians, under half correctly selected males, and only 9% correctly identified individuals aged 60 years old or older were at highest risk. Only around 12% correctly answered that 72% of all OPCs can be attributed to HPV. For oral sites most affected by HPV-OPC, only 39% correctly identified the posterior oropharynx as having the highest prevalence, while only 27% mentioned that this location should be biopsied when making a diagnosis. Finally, only 13% knew that there are no existing Food and Drug Administration (FDA) standards or approved screening tools for HPV-OPC.

HPV Vaccination Knowledge

Less than half of the students had adequate HPV vaccine knowledge (n = 169, 45%). The scores ranged from 4% to 96%, the average was 65%, and the median was 70%. HPV vaccination knowledge levels differed by sex ($P = 0.04$), age ($P = 0.02$), State ($P = 0.01$), and Region ($P = 0.01$). Male participants (n = 37, 36%), participants who were 30 years and older (n = 25, 33%), participants whose program was in Tennessee (n = 4, 20%), and participants whose program was in a conservative region (n = 82, 39%) had lower proportions of students with adequate HPV vaccination knowledge.

While a high proportion of students knew about HPV vaccines (89%), felt that HPV vaccines were safe (90%), and did not think that they caused any serious side effects (79%), 73% did not know about the financial costs associated with vaccination, and 47% did not know about insurance coverage for the HPV vaccine. Knowledge about the HPV vaccine was generally high in several areas-- nearly 88% answered correctly that the most effective

time to administer the vaccines was prior to any sexual activity, 76% answered correctly that they are recommended for both males and females, 79% indicated that the vaccines would not provide full protection against all HPV types, and 61% knew that there was more than one dose for the vaccines. Furthermore, attitudes toward vaccination were positive-- 86% felt that discussing HPV topics provided an opportunity to discuss a patient's sexual behaviors including past history and safe sex practices.

However, while knowledge about the types of cancer HPV vaccines prevent was highest for cervical cancer (93%), knowledge about HPV vaccines protection concerning OPC (76%) and anal cancer (55%) was lower. Only 21% and 34% of students identified the correct age range for males and females to receive the vaccines, respectively. Almost half (45%) of students agreed that getting the HPV vaccine does increase one's risk of engaging in riskier sexual behaviors, while 79% incorrectly identified that past sexual experience does not reduce the efficacy of the vaccines.

Discussion

This was one of the first multi-state studies to examine factors associated with HPV-related knowledge in a cohort of dental hygienist and dental students to identify groups of students that were most at risk for lower HPV, HPV-OPC, and HPV vaccine knowledge. This study specifically examined graduating oral health student knowledge regarding general HPV, HPV-OPC, and HPV vaccinations. With the increasing prevalence of HPV-OPC, it is important that new dental professionals are aware and knowledgeable about the issue to help alleviate this disease burden. We found that knowledge differed by demographic factors such as race, age and gender, sociocultural and regional factors such as religion, state, and region (conservative vs. liberal), and academic factors such as type of program and highest degree earned.

Demographic Factors

In this study, we found that female students had higher proportions of knowledge in HPV vaccination topics. In addition, younger students whom were between the ages of 18–29 had higher proportions of HPV vaccination knowledge. The HPV vaccine was offered first to females in 2006 [20]; then to males at 2011 [21], thus it is likely that females and younger participants were more likely to have received or been offered the HPV vaccine, which may contribute to increased HPV vaccine awareness and knowledge. These findings suggest that older and male oral health students may benefit from greater education about the HPV vaccine, and has implications for more targeted interventions for this group of individuals. It was also hypothesized that women would be more familiar with HPV since the virus is a well-known cause of cervical cancer, but this was not the case. Instead, we found that women participants in this had lower proportions of adequate knowledge in general HPV topics which covered basic etiology of HPV infections and associated cancers. This could be due to a disproportionate amount of males in this sample receiving higher levels of education than females, as majority of female participants were in dental hygiene programs, for which an associate's degree was often listed as their highest level of education prior to entering their oral health program.

We also found that Asians had the lowest proportion of HPV-OPC knowledge among students, which may have affected their overall HPV knowledge scores. While cultural differences should be further explored, other considerations may be that HPV-OPC is most prevalent in White males compared to other races [22], and the more well known risk factors for OPC in Asians have been the chewing of tobacco products and betel nut quid [23]. Thus this finding suggests a greater need for efforts to educate Asian students about the rising incidence and pathogenesis of HPV-OPC.

Sociocultural and regional factors

We also found that non-Christian students had lower overall and general knowledge about HPV than students who were Christian. In addition, students from regions that were classified as Conservative also had lower proportions of adequate general, HPV-OPC, and HPV vaccination knowledge. It is possible that the underlying driver of these findings lie within the traditional value system sometimes upheld by individuals of non-Christian religions such as the Eastern religions and non-Christian Abrahamic religions such as Islam and Judaism, as well as political cultural values such as Conservatism. Our findings showed that students from Utah had lowest proportions of students with adequate general HPV knowledge compared with the other states, which aligns with these other findings. A previous study conducted among young adult women in Utah found that young women whom who practiced an organized religion had lower knowledge about HPV and the HPV vaccine [18]. Further research is recommended to assess the effect of traditional value systems on HPV knowledge, as well as racial, ethnic, and state-specific policy factors related to HPV. Taken together, these findings highlight the need for cultural sensitivity in delivering HPV, HPV-OPC, and HPV vaccine education to traditional and conservative student groups, as well as to specific regions of the US.

Academic factors—Type of program and highest degree earned

In this study, we found that dental hygiene students, females, and associate degree holders had proportionally lower levels of adequate knowledge then their counterparts who were dental students, male, and those whose highest degree earned was more advanced than an associate degree. As the majority of the dental hygiene students were female and were associate degree holders, it is likely that these factors may be related to each other. While it is understandable that students in the dental program may receive more in-depth education about virology and oncogenic infections related to the oropharyngeal region compared to those in the dental hygiene programs, this finding is concerning as dental hygienists play an important role in the prevention of oral conditions, and may be particularly important in HPV patient education [11]. Thus, enhancing dental hygiene curriculum to include more in-depth education about HPV may be beneficial for training students to be better equipped to discuss HPV-related topics with patients.

Gaps in education about HPV, HPV-OPC, and the HPV vaccine

To reduce HPV's impact, all healthcare providers, including dentists and dental hygienists, will be required to confront this increasing issue. To do this, adequate vaccination knowledge must be attained; however, the majority of the students did not have this. We anticipated that oral health students would have greater knowledge of HPV-OPC compared

with the general HPV and HPV vaccine items. However, we found that oral health students lacked adequate HPV-OPC knowledge the most out of all the other sections. We assumed that study participants should have completed oral pathology, an oral cancer course, or both prior to taking the assessment. However, this section included several epidemiological type questions, for which there may be a gap in existing dental curriculum.

Specifically, students seemed to lack epidemiological knowledge on the virus, and incorrectly identified different outcomes of the disease like herpes and HIV/AIDS. In addition, many thought that being in a monogamous relationship would eliminate their risk of acquiring HPV, which highlights a lack of etiological understanding of the various HPV types. In addition, oral health students were not well informed about the recommended age ranges for males and females to receive the HPV vaccine, which is 9 to 12 years of age for both sexes. This training is also more important now than ever as states begin to permit dentists to vaccinate their patients. In 2019, the Oregon Legislative Assembly authorized trained and certified dentists to prescribe and administer vaccines, including the HPV vaccine [24].

Limitations

A few limitations should be noted. First, selection bias may have occurred as students participating in the study was voluntary. In addition response rates may have been affected due to the fact that the study administration clashed with the final examination period for some programs. Second, the nature of the online survey design allowed participants to take the study multiple times, although measures were taken to exclude repeat responses. Third, the length of the questionnaire was long and resulted in some students taking between 30 minutes to days to submit the survey. Fourth, since this was an online survey, there was no way of limiting participants from looking up the correct answers to the questions while taking the assessment, which may have affected the accuracy in assessing knowledge levels.

Conclusions

Few studies have examined oral health student HPV knowledge, and none have implemented a tool that was as comprehensive. An emphasis was specifically placed on students near graduation since they will soon be entering the dental profession workforce and to assess gaps in current dental curriculum. Although the results cannot be generalized to the entire oral health student population, the results displayed gaps in student knowledge about HPV, HPV-OPC, and the HPV vaccine. Overall, the majority of students had inadequate knowledge levels. The only area where adequate knowledge levels were displayed was for general HPV topics. Several demographic and cultural characteristics may contribute to lower knowledge levels. Knowledge deficiency areas were highlighted to identify where dental curriculums and/or continuing educations programs can improve.

Future studies should determine students' self-efficacy in recognizing patient risk factors, signs, and symptoms of HPV-OPC, another important role of the dental professional in preventing oral cancer. This knowledge will help new practitioners detect, diagnose, and treat OPC early and can lead to improved prognoses for patients. Knowing where knowledge deficiencies exist may help dental programs cater their curriculum to ensure that future

generations of dental professionals are adequately equipped to address the increasing trend of HPV-OPC. These improvements may increase graduating student/new professional knowledge, and lead to improved patient education, detection, diagnoses, treatments, and prognoses.

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Table 1.

Demographic characteristics of oral health student participants (N=380)

Variables	Total n (%)
Class Standing	
Dental hygiene	83 (22)
DS3	185 (49)
DS4	91 (24)
Sex	
Male	107 (28)
Female	258 (68)
Age	
18–29 years old	291 (77)
30+ years old	78 (21)
Ethnicity	
Hispanic/Latino(a), or Spanish	36 (9)
Race	
Asian	81 (21)
White	213 (56)
Other[a]	72 (19)
Religion	
Christian	221 (58)
Non-Christian Faiths	37 (10)
Unaffiliated	71 (19)
Other or Unknown	40 (11)
Education Level	
AS degree only	48 (13)
BS degree	260 (68)
Advanced degree (master's or doctorate)	33 (9)
State	
Arizona	73 (19)
California	85 (22)
Colorado	35 (9)
Idaho	9 (2)
Nevada	28 (7)
Tennessee	21 (6)
Texas	60 (16)
Utah	47 (12)
Region	
Conservative	210 (55)
Liberal	148 (39)

[a]Includes participants who responded "American Indian or Alaska Native", "Black or African American", "Native Hawaiian or Other Pacific Islander", "Other", or "Don't know".

Table 2.

Sociodemographic Differences in HPV-related Knowledge among Oral Health Students (N=380).

Demographic	Overall knowledge			General HPV knowledge			HPV-OPC knowledge			HPV Vaccination knowledge		
	≥70%[b] n (%)	<70%[b] n (%)	*P*[a]	≥70%[b] n (%)	<70%[b] n (%)	*P*[a]	≥70%[b] n (%)	<70%[b] n (%)	*P*[a]	≥70%[b] n (%)	<70%[b] n (%)	*P*[a]
Student type[C]			0.90			**0.01**			0.10			0.34
DH	28 (34)	55 (66)		47 (57)	36 (43)		24 (29)	59 (71)		38 (46)	45 (54)	
DS3	66 (36)	117 (64)		137 (74)	48 (26)		33 (18)	152 (82)		87 (48)	96 (52)	
DS4	33 (37)	56 (63)		70 (77)	21 (23)		17 (19)	74 (81)		34 (38)	55 (62)	
Sex[C]			0.42			**0.03**			0.69			**0.04**
Male	33 (32)	71 (68)		83 (78)	24 (22)		20 (19)	87 (81)		37 (36)	67 (64)	
Female	93 (36)	164 (64)		171 (66)	87 (34)		53 (21)	205 (79)		122 (47)	135 (53)	
Age[C]			0.86			0.458			0.32			**0.02**
18–29	102 (35)	187 (65)		200 (69)	91 (31)		56 (19)	235 (81)		137 (47)	152 (53)	
30+	26 (34)	50 (66)		57 (73)	21 (27)		19 (24)	59 (76)		25 (33)	51 (67)	
Race[C]			**0.01**			0.07			**<0.0**			0.10
Asian	16 (20)	64 (80)		48 (59)	33 (41)		5 (6)	76 (94)	**1**	29 (36)	51 (64)	
White	85 (40)	126 (60)		155 (73)	58 (27)		53 (25)	160 (75)		104 (49)	107 (51)	
Other	26 (37)	45 (63)		52 (72)	20 (28)		16 (22)	56 (78)		29 (41)	42 (59)	
Religion[C]			**0.03**			**<0.01**			0.93			0.25
Christian	79 (36)	138 (64)		151 (68)	70 (32)		46 (21)	175 (79)		95 (44)	122 (56)	
Non-Christian	6 (16)	31 (84)		18 (49)	19 (51)		6 (16)	31 (84)		15 (41)	22 (59)	
Unaffiliated	31 (44)	40 (56)		58 (82)	13 (18)		15 (21)	56 (79)		38 (54)	33 (46)	
Other or N/A	12 (30)	28 (70)		30 (75)	10 (25)		8 (20)	32 (80)		14 (35)	26 (65)	
Degree Status[C]			0.98			**0.03**			0.20			0.56
Associate	17 (35)	31 (65)		27 (56)	21 (44)		14 (29)	34 (71)		18 (38)	30 (63)	
Bachelor	93 (36)	164 (64)		188 (72)	72 (28)		49 (19)	211 (81)		118 (46)	139 (54)	
Advanced	12 (38)	20 (63)		27 (82)	6 (18)		5 (15)	28 (85)		14 (44)	18 (56)	
State[C]			0.12			**0.03**			**0.01**			**0.01**

Demographic	Overall knowledge			General HPV knowledge			HPV-OPC knowledge			HPV Vaccination knowledge		
	≥70%[b] n (%)	<70%[b] n (%)	P[a]	≥70%[b] n (%)	<70%[b] n (%)	P[a]	≥70%[b] n (%)	<70%[b] n (%)	P[a]	≥70%[b] n (%)	<70%[b] n (%)	P[a]
Arizona	26 (36)	47 (64)		53 (73)	20 (27)		20 (27)	53 (73)		29 (40)	44 (60)	
California	28 (33)	56 (67)		64 (75)	21 (25)		12 (14)	73 (86)		44 (52)	40 (48)	
Colorado	19 (54)	16 (46)		29 (83)	6 (17)		12 (34)	23 (66)		22 (63)	13 (37)	
Idaho	6 (67)	3 (33)		7 (78)	2 (22)		4 (44)	5 (56)		3 (33)	6 (67)	
Nevada	8 (31)	18 (69)		24 (86)	4 (14)		2 (7)	26 (93)		10 (38)	16 (62)	
Tennessee	5 (25)	15 (75)		13 (62)	8 (38)		1 (5)	20 (95)		4 (20)	16 (80)	
Texas	20 (33)	40 (67)		38 (63)	22 (37)		15 (25)	45 (75)		19 (32)	41 (68)	
Utah	14 (30)	33 (70)		25 (53)	22 (47)		8 (17)	39 (83)		27 (57)	20 (43)	
Region[c]			0.44			**<0.01**			0.22			**0.01**
Conservative	71 (34)	138 (66)		136 (65)	74 (35)		48 (23)	162 (77)		82 (39)	127 (61)	
Liberal	55 (38)	90 (62)		117 (79)	31 (21)		26 (18)	122 (82)		76 (52)	69 (48)	

[a] Results are considered significant at the p<0.05 level.

[b] Adequate knowledge (≥70% correct responses); Inadequate knowledge (<70% correct responses)

[c] Indicates missing values

Table 3:

Knowledge Items

General HPV Knowledge Questions:	
1	There are many types of Human Papillomavirus (HPV)
2	HPV is a bacterial infection
3	A person can have HPV without knowing it
4	Generally, most HPV infections resolve spontaneously within 2 years
5	HPV can be transmitted via sexual contact
6	A person can transmit HPV even if a genital wart is not present
7	HPV can cause herpes
8	HPV can cause HIV/AIDS
9	HPV can cause genital warts
10	HPV can cause cervical cancer
11	The rate of HPV is highest among women in their 30s
12	HPV related dysplasia occurs more commonly in smokers
13	HPV can cause an abnormal Pap smear/Pap test in women
14	Genital warts are caused by the same HPV type(s) that cause cervical cancer
15	Almost all cervical cancers are caused by HPV
16	Using a condom will decrease the chance of transmitting/acquiring HPV
17	Even after HPV vaccination, condoms continue to provide protection against future Sexually Transmitted Infections (STIs) and/or HPV infections
18	Antibiotics can cure HPV
19	Being in a monogamous relationship eliminates your risk of HPV infection
20	Which age group has the highest rate of HPV infections?
HPV-OPC knowledge questions:	
1	HPV can cause oropharyngeal cancer
2	Genital warts are caused by the same HPV type(s) that cause oropharyngeal cancer
3	Oropharyngeal cancer caused by smoking is more deadly than oropharyngeal cancer caused by HPV
4	Early stages of HPV related oropharyngeal cancer are often asymptomatic
5	In the dental office, how often should a patient receive an oral, head, and neck cancer examination?
6	Which age group(s) should an oral, head, and neck cancer examination be performed on?
7	Which ethnic/racial background has the highest rate of oropharyngeal cancer?
8	Which age group has the highest rate of oropharyngeal cancer?
9	Which sex/gender has the highest rate of oropharyngeal cancer?
10	What percentage of oropharyngeal cancer is attributed to HPV?
11	Over the last ten years, which of the following oral locations had the most increase in rate for HPV related oropharyngeal cancer?
12	Over the last ten years, which age group has shown the most increase in rate for HPV related oropharyngeal cancer?
13	Where is the most common location for a HPV related oropharyngeal cancer biopsy?
14	There are standards or routine screening tests for oropharyngeal cancer, specifically.
HPV vaccination knowledge questions:	
1	There are vaccines that provide immunity against certain types of HPV
2	The effectiveness of the HPV vaccine does not decrease over time.

3	HPV vaccines can protect women against HPV related cervical cancer
4	HPV vaccines can protect men and women against HPV related oropharyngeal cancer
5	HPV vaccines can protect men and women against HPV related anal cancer
6	HPV vaccines do not protect an individual from all types of HPV
7	Individuals who receive the HPV vaccines do not have to be concerned with practicing safe sex (e.g. using condoms)
8	HPV vaccination increases the likelihood of people engaging in risky sexual behaviors (e.g. multiple partners, unprotected sex, etc.)
9	Generally, HPV vaccines are safe
10	In general, HPV vaccines do not cause serious side effects
11	HPV vaccines are expensive for uninsured individuals
12	HPV vaccines are covered by most insurance providers
13	HPV vaccines are administered in one dose
14	HPV vaccines can protect men and women against HPV related genital warts
15	People who have already had genital warts cannot get the HPV vaccines
16	HPV vaccines are only effective for individuals who have never had sex
17	Women who have had an abnormal Pap smear/Pap test should not receive the HPV vaccines
18	The Centers for Disease Control and Prevention (CDC) recommends that the HPV vaccines should be administered to both males and females
19	Discussing the HPV vaccines provide an opportunity to have a conversation with your patients about their sexual behaviors (e.g. sexual history, practicing safe sex, etc.)
20	HPV vaccines are highly effective at preventing cervical cancer precursors
21	When is HPV vaccination ideally recommended?
22	What is the optimal age for HPV vaccination in females?
23	What is the optimal age for HPV vaccination in males?