



US oral health students' willingness to train and administer the HPV vaccine in dental practices

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ABSTRACT

HPV oropharyngeal cancers have now surpassed cervical cancer rates in the US. Dental providers' engagement in HPV education and vaccination efforts may help reduce the burden of HPV oropharyngeal cancers. We examined factors associated with oral health students' willingness to train and administer the human papillomavirus (HPV) vaccine in dental settings. US students in 15 oral health programs participated in an online survey in 2016. Unadjusted and adjusted multivariable logistic regression were conducted and odds ratios (OR) and 95% confidence intervals (CI) were reported. Analyses were conducted in SAS Version 9.4. Data from a total of $N = 306$ students were analyzed to examine sociodemographic, educational, practice, and attitudinal factors associated with willingness to train and administer the HPV vaccine. Majority of the participants were female (70.3%), non-Hispanic/Latino (90.8%), and White (62.1%). Perceiving that HPV vaccination recommendation (OR = 1.95, 95% CI = 1.14–3.35) and administration (OR = 3.79, 95% CI = 1.63–8.81) was in the dental professional's scope was positively associated with outcome measures when other factors were held constant. Students with greater patient contact time (OR = 4.47, 95% CI = 1.14–17.58) and lower role conflict (agreed that HPV vaccine administration was in the dental professional's scope) had higher odds of willingness to administer the HPV vaccine when other factors were held constant (OR = 5.9, 95% CI = 2.27–15.3). The major barrier to engaging oral health students in HPV vaccination efforts was role conflict. Professional organizations and oral health programs should strongly support the role of oral health professionals in HPV oropharyngeal prevention.

1. Introduction

While smoking and drinking have traditionally been associated with the occurrence of oropharyngeal cancer (OPC), currently between 70 and 90% of OPCs are now caused by oncogenic human papillomavirus (HPV) infections in the United States (US) (Young et al., 2015). Between 1988 and 2004, the prevalence of HPV-OPC has risen by 225%, with approximately 7% of the population having an active oropharyngeal HPV infection at any given time (Chaturvedi et al., 2011; Gillison et al., 2012). In the US, HPV-OPC cases have already outnumbered cases of cervical cancer (Centers for Disease Control and Prevention, 2017).

HPV-OPC is more aggressive than non-HPV-OPC, and tends to occur in younger, male patients, with the median age of HPV-OPC patients at

58 years (Chaturvedi et al., 2011; Deschler et al., 2014). Treatment for OPC often includes radiation and chemotherapy, which may be painful, expensive, and debilitating (Wissinger et al., 2014). Reconstructive surgery and maxillofacial prosthetics are sometimes needed to help patients recover function, reduce disfigurement, and improve quality of life (Wissinger et al., 2014). Side effects and complications of treatments are common and are associated with physical and economic burdens (Wissinger et al., 2014). Patients with advanced disease experience greater costs and burdens of disease and treatment (Wissinger et al., 2014). For these reasons, primary prevention of HPV-OPC is an important public health priority.

Given that secondary prevention is complicated, primary prevention of HPV-OPC, completing the HPV vaccine series in a timely manner, is critical. Currently, there is no FDA approved test available to detect

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HPV infections in the oropharynx (Centers for Disease Control and Prevention, 2017), making early detection difficult. Visually detecting tumors in the deeper structures of the oropharynx is complicated (Huang et al., 2018). HPV vaccination in adolescence is the most effective primary prevention strategy to reduce the prevalence of HPV-OPC as the HPV vaccine offers protection against HPV 16 which account for the majority of HPV-OPC (Chaturvedi et al., 2011). Since 2011, the Advisory Committee on Immunization Practices (ACIP) has recommended that adolescents of both sexes receive the HPV vaccine series at ages 11 or 12 (Centers for Disease Control and Prevention, 2011). Yet as of 2016, only 49.5% of adolescent females and 37.5% of adolescent males were up-to-date on HPV vaccinations in the US (Walker et al., 2017), far below the HealthyPeople 2020 goal of 80% (HealthyPeople.gov., 2018). Promoting and administering the HPV vaccine in non-traditional locations such as dental offices may increase HPV vaccine uptake and completion. Recognizing the increasing trends of HPV-OPC in the population, the American Dental Association has strongly advocated for dental professionals to be educated about the relationship between HPV and OPC, pass that knowledge onto their patients, and encourage HPV vaccination to improve the prevention and screening of HPV-OPC in the dental setting (American Dental Association, 2012; American Dental Association, 2018). Indeed, the National HPV Vaccination Roundtable has recently developed a guide for dental providers to engage in HPV prevention in efforts provide dental providers with the needed resources to address this healthcare priority (National HPV Vaccination Roundtable, n.d.), despite the fact that the FDA has not yet approved the HPV vaccine for the prevention of OPC.

As a large majority of OPC is first detected in the oral cavity (Dahlstrom et al., 2013), dental providers already play an important role in the early detection of OPC when they perform routine oral cancer screenings. Adolescent patients see their dental providers around the same frequency as they see their medical providers (National Research Council and Institute of Medicine Committee on Adolescent Health Care Services and Models of Care for Treatment Prevention and Healthy Development, 2009), which presents a promising and untapped opportunity for dental providers to educate about and administer the HPV vaccine. However, the body of research examining dental providers' willingness to recommend and administer the HPV vaccine is scant.

Oral health professionals including dentists and dental hygienists, and dental students have reported a lack of knowledge or awareness of HPV, the HPV vaccine, and the link between HPV and OPC (Arora et al., 2018; Vázquez-Otero et al., 2018; Daley et al., 2011). Knowledge levels about HPV and HPV-OPC prevention have been positively associated with communication with patients about HPV and sexually transmitted infections (STIs) among dental hygienists (Daley et al., 2018), and has been studied among dentists as well (Vázquez-Otero et al., 2018). Comfort in communicating to patients about HPV may be associated with educational level and gender in the dentist and dental hygienist professions (Vázquez-Otero et al., 2018; Poelman et al., 2018; Clarke et al., 2018). However, increased knowledge about HPV topics could address communication deficits and self-efficacy (Daley et al., 2011). Daley et al. found that dentists and dental hygienists who received information about the HPV vaccine from professional journals, continuing education, and oral health colleagues demonstrated greater readiness to discuss HPV (Daley et al., 2018; Daley et al., 2014). In addition to HPV knowledge, dental professionals' willingness to discuss HPV may depend on patient and practice factors. Patient factors include discomfort talking about HPV with younger patients, and perceived susceptibility or lack of susceptibility of patient to HPV (Vázquez-Otero et al., 2018; Daley et al., 2011). Practice factors that have served as barriers to discussing HPV in the dental setting include liability issues, the lack of professional guidelines, limited time, concerns about confidentiality, role conflict with dental professionals becoming engaged in STI prevention, and discomfort discussing sexual history/topics (Daley et al., 2011; Daley et al., 2014). Furthermore, environmental

considerations regarding the inability to offer greater privacy to patients to have sensitive discussions about HPV, and the lack of clinical procedures to collect vaccination or sexual history was also perceived as barriers to discussing the HPV vaccine (Vázquez-Otero et al., 2018).

Including HPV vaccination and education within the scope and role of oral health professionals will require a large shift in the professional culture of dentistry from early detection and treatment to also include primary prevention of HPV-OPC. Oral health students represent the next generation of dental professionals. Assessing their perspectives on the role of dental professionals in engaging in HPV-OPC prevention through HPV vaccination education with patients and HPV vaccination delivery will help guide future interventions for HPV education and HPV-cancer prevention in U.S. dental practices. The purpose of this study is to examine the factors associated with willingness of dental and dental hygiene students to 1) be trained to administer the HPV vaccine, and 2) to administer the HPV vaccine after receiving training.

2. Methods

After obtaining Institutional Review Board approval, dental and dental hygiene programs in the US were approached via a convenience sampling approach in 2016. Out of 20 programs, 15 programs located in 8 states (Arizona, California, Colorado, Idaho, Nevada, Tennessee, Texas, and Utah) participated in this cross-sectional, quantitative study. Participating dental programs emailed their third and fourth year dental students or senior dental hygiene students about the study, and included a link to a 153-item, self-administered online survey in REDCap. The survey was administered the senior oral health students as it was assumed that they would have completed oral pathology coursework at the later years of the oral health program. Programs were also asked to twice remind students to complete the study at designated intervals. Questionnaires were anonymously completed, and collated through the REDCap platform. The median amount of time for students to complete the entire survey was 85 min. After submitting the survey, regardless of completion of all items, participants were reimbursed with a \$15 gift card as token of appreciation for their time.

2.1. Outcome variables

Willingness to train to administer the HPV vaccine was measured by a question asking participants, "How willing would you be to participate in a training to administer the HPV vaccines in your dental practice". Willingness to administer the HPV vaccine was measured by a question asking participants, "If trained, how willing would you be to administer the HPV vaccines in your dental office" Responses were measured on a 4-point Likert scale where 0 = not at all willing, and 3 = very willing. Response was then dichotomized to "Less willing" ("not at all willing" and "somewhat willing") and "more willing" ("willing" and "very willing").

2.2. Independent variables

We reviewed the extant literature surrounding HPV vaccination and dental professions, and together with our previous research associated with HPV vaccination in non-oral health professional populations, compiled a priori independent variables to examine in this analysis.

2.2.1. Sociodemographics

Sociodemographic variables we examined included gender, age, ethnicity, race, and state of program; educational characteristics included prior degree and type of oral health program; and current clinical exposure with patients was assessed by number of patients that students worked within a week.

2.2.2. Sources of HPV vaccine information

Questions pertaining to sources of HPV vaccination information

Table 1
Characteristics of participants (N = 306).

Variable	n (%)
Sociodemographics	
Gender	
Female	215 (70.3)
Age	
18–29 years old	245 (80.1)
Ethnicity	
Non-Hispanic/Latino	278 (90.8)
Race	
White	190 (62.1)
Type of oral health program	
Dental hygiene	73 (23.9)
Dental-3rd year	155 (68.0)
Dental-4th year	78 (25.5)
Prior degree earned	
Associate or bachelor's degree	254 (83.0)
Number of patient visits per week	
0–10	259 (84.6)
State of program	
Arizona	64 (20.9)
California	71 (23.2)
Colorado	33 (10.8)
Idaho	9 (2.9)
Nevada	27 (8.8)
Tennessee	15 (4.9)
Texas	49 (16.0)
Utah	38 (12.4)
Top sources of HPV information	
Dental curriculum	216 (70.6)
Internet	104 (34.0)
Non-oral health colleague (e.g., medical doctor, nurse practitioner)	63 (20.6)
Family/friend	62 (20.3)
Professional journal/publication (e.g., oral health journal)	54 (17.6)
HPV vaccine knowledge (correct responses)	
Overall HPV vaccine knowledge	Median = 69.6%, IQR = 60.9%–78.3%
HPV can cause oropharyngeal cancer	286 (93.5)
HPV vaccines can protect men and women against HPV related oropharyngeal cancer	236 (77.1)
Barriers to discussing HPV (those who agreed)	
I do not have enough information about the HPV vaccines	191 (62.4)
I am concerned with the safety of the HPV vaccines	39 (12.7)
Liability reasons	102 (33.3)
I do not believe it is my role as an oral health professional to recommend the HPV vaccines to my patients	76 (24.8)
There are no established professional policies/guidelines pertaining to recommendation of the HPV vaccines	125 (40.8)
There is not enough time to discuss this during appointments	126 (41.2)
I am not comfortable discussing sexual history/topics with patients	158 (51.6)
Politics play a role in discussing HPV and the HPV vaccines in the dental office	113 (36.9)
Social and cultural norms play a role in discussing HPV and the HPV vaccines in the dental office	229 (74.8)
A patient's religious ideology plays a role in discussing HPV and the HPV vaccines in the dental office	201 (65.7)
Communication about HPV	
Do not discuss HPV in the clinic setting and/or have no plans to start	57 (18.6)
Scope of practice	
Discussing the link between HPV and oropharyngeal cancer falls within the scope and role of a dental professional	256 (83.7)
Recommending HPV vaccination falls within the scope and role of a dental professional	177 (57.8)
Administering the HPV vaccines inside the dental office falls within the scope and role of a dental professional	54 (17.6)

were adapted from Daley et al.'s study on dentists' readiness for discussing HPV vaccination with patients (Daley et al., 2014). Participants were allowed to select as many sources of HPV vaccine information that they were exposed to from a list that included 1) dental curriculum, 2) family/friend, 3) internet, 4) magazines, newspapers, other printed materials, 4) non-oral health colleague (e.g., medical doctor, nurse practitioner), 5) oral health colleague, 6) patient(s), 7) professional journal/publication (e.g., oral health journal), 8) radio, 9) television or commercials, or 10) other sources (open ended). The frequencies of each of these dichotomous variables were calculated. The top 5 most frequently reported sources of HPV vaccination were then included for analyses in unadjusted and adjusted multivariable logistic regression analyses.

2.2.3. HPV and HPV vaccine knowledge

Overall HPV vaccine knowledge was assessed using a scale developed by Rutkoski et al. (Rutkoski et al., 2018). In addition, specific items of HPV and HPV vaccine knowledge related to oropharyngeal cancer were isolated for analysis.

2.2.4. Attitudes to engaging with patients about HPV and HPV vaccine

To assess participants' attitudes toward HPV and HPV vaccine education in the dental setting, we looked at barriers related to discussing HPV vaccine, current communication practices related to HPV vaccine, and participants' perceived scope of practice related to educating about, recommending, and administering the HPV vaccine to patients. These items were adapted from Daley et al.'s study (Daley et al., 2014) which were adapted and refined in a pilot stage of this

research (Rutkoski et al., 2018). Barriers and professional scope of practice questions were based on a 5-point Likert scale ranging from “strongly disagree” to “strongly agree”; responses were then dichotomized for analysis to “did not agree” and “agree”. Current communication practices were assessed with the question, “Which statement best describes how you communicate with patients about the HPV vaccine?” Possible responses were measured on a 5-item response scale to measure stages of readiness (Daley et al., 2014) and included: “I do not discuss it with my patients and have no plans to start”, “I do not discuss it with my patients but have thought about it”, “I sometimes discuss it with my patients”, “I often discuss it with my patients”, and “I always discuss it with my patients”.

2.3. Statistical analyses

Descriptive statistics and unadjusted and adjusted multivariable logistic regression models were used to describe the sample and to assess factors associated with oral health students' willingness to train to administer the HPV vaccine and to administer the HPV vaccine once trained. The median HPV knowledge score and interquartile ranges for those who were more willing and less willing to train, as well as those who were more willing and less willing to administer the HPV vaccine was produced. Logistic regression models were stratified by individual school to account for the sampling design. The sampling design was to invite several schools to participate. All independent variables from the univariate analyses were reanalyzed with unadjusted logistic regressions adjusting for the school cluster design of the study. Since education would be most similar within these schools (and potentially attitudes), each school was considered a strata in the analysis for the unadjusted logistic regression models. Significant findings in the unadjusted logistic regressions were retained for the adjusted multivariable models for each respective outcome. Odds ratios (OR) and 95% confidence intervals (CI) were produced. All analyses were conducted in SAS Version 9.4. Findings were considered statistically significant at the $p < 0.05$ level.

3. Results

After removing incomplete, duplicate, ineligible entries, and participants who did not identify their type of oral health program, records from a total of $N = 306$ participants were included for the analyses ($n = 155$, 68.0% third year dental students; $n = 78$, 25.5% fourth year dental students, $n = 73$, 23.9% dental hygiene students). Table 1 reports the descriptive statistics of the sample. The majority of the survey respondents were female ($n = 215$, 70.3%), between the ages of 18–29 years of age ($n = 245$, 80.1%), and non-Hispanic/Latino ($n = 278$, 90.8%). The majority were White ($n = 190$, 62.1%), and held at least an associate's degree or bachelor's degree prior to commencing their oral health program ($n = 254$, 83%). The majority had between 0 and 10 h of clinical time with patients weekly ($n = 259$, 84.6%). Most students came from programs in Arizona, California, and Texas (Arizona: $n = 64$, 20.9%; California: $n = 71$, 23.2%; Texas: $n = 49$, 16.0%; Table 1). The median overall HPV vaccine knowledge score was 69.6%, and the interquartile range was 60.9% to 78.3%.

3.1. Unadjusted and adjusted multivariable logistic regressions

Tables 2 and 3 report the results for the unadjusted and adjusted multivariable logistic regressions ($N = 306$). Table 2 reports the analyses for the first outcome measure, willingness to train to administer the HPV vaccine, while Table 3 reports the analyses for the second outcome measure, willingness to administer the HPV vaccine once trained.

3.1.1. Willingness to train

The barriers of 1) not believing that is was the role of the oral health

professional to recommend the HPV vaccine to patients, 2) perceiving a lack of time, and 3) discomfort talking to patients about the HPV vaccine, clinical communication practices (not discussing HPV in the clinic setting), and perceptions of scope of practice (recommending the HPV vaccine and administer the HPV vaccine falls within the dental scope of practice) were significantly associated with oral hygiene students' willingness to train to administer the HPV vaccine in the unadjusted models.

Accounting for the other variables in the model, participants who agreed that recommending HPV vaccination was within the scope and role of a dental professional had almost twice the odds of being willing to train to administer the HPV vaccine compared to those who disagreed (OR = 1.95, 95% CI = 1.14–3.35). Participants who agreed that administering the HPV vaccine in the dental office fell within the scope and role of a dental professional had 3.79 times the odds (95% CI = 1.63–8.81) of being willing to train to administer the HPV vaccine compared to those who disagreed.

3.1.2. Willingness to administer

In unadjusted models, the items: 1) number of patients seen per week, 2) I do not have enough information about the HPV vaccines, 3) I do not believe it is my role as an oral health professional to recommend the HPV vaccines to my patients, 4) there is not enough time to discuss this during appointments, 5) I am not comfortable discussing sexual history/topics with patients, 6) have not discussed HPV with patients/no plans to start, 7) recommending HPV vaccination falls within the scope and role of a dental professional, and 8) administering the HPV vaccines inside the dental offices falls within the scope and role of a dental professional were significantly associated with being willing to administer the HPV vaccine once trained. These variables were included in the final adjusted multivariable models.

Accounting for these variables, participants who saw 21 or more patients a week had 4.47 times the odds (95% CI = 1.14–17.58) of being willing to administer the HPV vaccine compared to those who saw 0–10 patients a week. Participants who perceived that administering the HPV vaccines was within the scope and role of a dental professional had almost 6 times the odds (95% CI = 2.27–15.3) to be willing to administer the HPV vaccine compared to those who disagreed in the adjusted model.

4. Discussion

While knowledge about HPV and its relationship with OPC has been the focus of studies among dental professionals and students (Rowan et al., 2015) our findings suggest that knowledge alone may not be the deciding factor in dental professionals' willingness to train or administer the HPV vaccine. The other perceived barriers for dental practices being involved in HPV vaccination, such as being able to accommodate increased time in patient-provider communication, and increasing providers' comfort level in talking about STIs in relation to OPC exist. While improving dental professional training with regards to HPV-OPC, and the development of clinical practices to accommodate the HPV discussions may be helpful efforts to engage providers in HPV vaccination, system-level barriers may pose a greater obstacle to dental professionals in engaging in HPV cancer prevention.

We found that the main barrier among dental students was role conflict – in particular, students did not perceive that it was the role and scope of an oral health professional to recommend or administer the HPV vaccine, which affected the likelihood of participants willing to train, and administer the HPV vaccine. Currently, administering the HPV vaccine is not in standard practice in dental settings; as such, there is a lack of similar studies examining these outcomes. However, studies that examined willingness to educate and recommend the HPV vaccine have been conducted in the United States. A recent mixed-method focus group study by Kline et al. found that oral health professionals may be open to engage in HPV cancer prevention related activities that are

Table 2
Factors Associated with US Oral Health Students' Willingness to Train to Administer the HPV Vaccine in 2016– Unadjusted and Adjusted Multivariable Logistic Regression Models (N = 306).^{a,b}

Variable	Unadjusted		Adjusted	
	Odds ratio	95% CI	Odds ratio	95% CI
Sociodemographics				
Gender				
Male	Reference			
Female	0.74	(0.43–1.28)		
Age				
18–29 years old	Reference			
30 years and above	0.89	(0.50–1.61)		
Ethnicity				
Non-Hispanic/Latino	Reference			
Hispanic/Latino	1.36	(0.59–3.15)		
Race				
White	Reference			
Other Race	0.86	(0.49–1.50)		
Type of oral health program				
Dental-3rd year	Reference			
Dental hygiene	0.88	(0.50–1.54)		
Dental-4th year	1.04	(0.60–1.81)		
Prior degree earned				
No prior degree	Reference			
Associate or bachelor's degree	1.19	(0.43–3.27)		
Master's degree or doctorate degree	2.14	(0.47–0.54)		
Number of patient visits per week				
0–10	Reference			
11–20	0.99	(0.42–2.32)		
21 +	3.07	(0.93–0.18)		
State of program				
Arizona	Reference			
California	0.62	(0.31–1.26)		
Colorado	0.62	(0.26–1.47)		
Idaho	0.37	(0.09–1.50)		
Nevada	0.37	(0.15–0.92)		
Tennessee	1.82	(0.46–7.14)		
Texas	0.61	(0.28–1.32)		
Utah	0.51	(0.22–1.16)		
Top 5 sources of HPV vaccine information reported				
Dental curriculum				
Yes	Reference			
No	0.89	(0.53–1.49)		
Internet				
Yes	Reference			
No	0.65	(0.39–1.07)		
Non-oral health colleague (e.g., medical doctor, nurse practitioner)				
Yes	Reference			
No	0.63	(0.35–1.14)		
Family/friend				
Yes	Reference			
No	1.01	(0.57–1.78)		
Professional journal/publication (e.g., oral health journal)				
Yes	Reference			
No	0.68	(0.34–1.34)		
HPV vaccine knowledge				
HPV vaccine knowledge				
Below median	Reference			
Above median	1.04	(0.98–1.10)		
HPV can cause oropharyngeal cancer				
True	Reference			
False/Don't know/Missing	0.76	(0.29–1.98)		
HPV vaccines can protect men and women against HPV related oropharyngeal cancer				
True	Reference			
False/Don't know/Missing	0.97	(0.56–1.68)		
Barriers to discussing HPV				
I do not have enough information about the HPV vaccines				
Did not agree	Reference			
Agreed	0.79	(0.49–1.28)		
I am concerned with the safety of the HPV vaccines				
Did not agree	Reference			
Agreed	0.59	(0.29–1.18)		
Liability reasons				
Did not agree	Reference			
Agreed	0.84	(0.51–1.36)		

(continued on next page)

Table 2 (continued)

Variable	Unadjusted		Adjusted	
	Odds ratio	95% CI	Odds ratio	95% CI
I do not believe it is my role as an oral health professional to recommend the HPV vaccines to my patients				
Did not agree	Reference		Reference	
Agreed	0.41	(0.24–0.71)	0.73	(0.37–1.44)
There are no established professional policies/guidelines pertaining to recommendation of the HPV vaccines				
Did not agree	Reference			
Agreed	0.95	(0.60–1.53)		
There is not enough time to discuss this during appointments				
Did not agree	Reference		Reference	
Agreed	0.60	(0.37–0.98)	0.63	(0.37–1.09)
I am not comfortable discussing sexual history/topics with patients				
Did not agree	Reference		Reference	
Agreed	0.55	(0.34–0.89)	0.81	(0.37–1.09)
Politics play a role in discussing HPV and the HPV vaccines in the dental office				
Did not agree	Reference			
Agreed	1.14	(0.71–1.85)		
Social and cultural norms play a role in discussing HPV and the HPV vaccines in the dental office				
Did not agree	Reference			
Agreed	0.89	(0.52–1.54)		
A patient's religious ideology plays a role in discussing HPV and the HPV vaccines in the dental office				
Did not agree	Reference			
Agreed	1.29	(0.80–2.10)		
Communication about HPV				
Do not discuss HPV in the clinic setting and/or have no plans to start				
Have discussed	Reference		Reference	
Have not discussed/No plans to start	0.44	(0.24–0.8)	0.72	(0.36–1.45)
Scope of practice				
Discussing the link between HPV and oropharyngeal cancer falls within the scope and role of a dental professional				
Did not agree	Reference			
Agreed	1.17	(0.63–2.19)		
Recommending HPV vaccination falls within the scope and role of a dental professional				
Did not agree	Reference		Reference	
Agreed	2.93	(1.81–4.75)	1.95	(1.14–3.35)
Administering the HPV vaccines inside the dental office falls within the scope and role of a dental professional				
Did not agree	Reference		Reference	
Agreed	4.87	(2.19–10.83)	3.79	(1.63–8.81)

^a Significance was set at the $p < 0.05$ level.

^b Significant variables identified in the unadjusted models were entered into the multivariable models.

synergistic with their existing roles; for example, the study reported dental hygienists perceived comfort in primary prevention efforts with the HPV vaccine as it was in line with their perceived roles of being specialists in preventive care (Kline et al., 2018). As administering the HPV vaccine is not in current practice, to improve the willingness of dental professionals for vaccine-related activities would require a strong statement of support by professional organizations for HPV vaccine administration in the dental setting. This finding is in alignment with other studies that emphasize oral health professionals' need for strong support from professional dental associations in encouraging and facilitating dental professionals in HPV patient education (Young et al., 2015; Daley et al., 2011).

We found that participants who had higher amounts of clinical exposure were more willing to administer the HPV vaccine in the dental setting. While potential reasons are not clear, it could be possible that participants who saw greater number of patients are also seeing greater numbers of pediatric patients in the vaccine eligible age range. Future research should examine the differences in willingness to administer the HPV vaccine among subspecialties of dentistry and explore the feasibility of engaging pediatric dentists in HPV cancer prevention. Another aspect of HPV vaccine administration in the dental setting that was not explored within the scope of this study was parental acceptability of children receiving the HPV vaccine at their dentists. A national survey of parents found that parents had lower confidence in their children receiving the HPV vaccine from their dentists but expressed greater acceptability of receiving HPV vaccine education in the dental setting (Lazalde et al., 2018). Future research should explore the willingness of

oral health professionals and students to engage in other roles related to HPV vaccination, such as education, recommending, and collaborating with primary care providers to improve HPV vaccination rates within communities, particularly those that have high volumes of patients.

Oral health students represent the next generation of dental professionals. Including HPV vaccination as the scope and role of the dental professional will require a large shift in the culture of dentistry to include primary prevention of HPV-OPC. Creating strategies to emphasize oral health professionals' role in cancer prevention and addressing the barriers to training and administration of the HPV vaccine will be important to reduce the prevalence of HPV-OPCs in the population. Academic institutions not only have a large responsibility to prepare the dental workforce to address the challenges of HPV-OPC in the population, but to strongly advocate and support the role of the dental professional in preventing HPV-OPCs as well. However, steps toward this role change may require restructuring of current dental programs. A study of associate and graduate pediatric dentistry program directors found that while 77% of the participants supported dental professionals discussing the HPV vaccine with their patients, only a quarter of programs had discussed HPV and the HPV vaccine in their curriculum (Hosking et al., 2017).

4.1. Limitations

The purposive sampling approach was a limitation of this study, which was addressed by stratifying analyses by school. Furthermore, the larger confidence levels in some of the findings may limit

Table 3
 Factors Associated with US Oral Health Students' Willingness to Administer the HPV Vaccine in 2016– Unadjusted and Adjusted Multivariable Logistic Regression Models (N = 306).^{a,b}

Variable	Unadjusted		Adjusted	
	Odds ratio	(95% CI)	Odds ratio	(95% CI)
Sociodemographics				
Gender				
Male	Reference			
Female	1.22	(0.70–2.13)		
Age				
18–29 years old	Reference			
30 years and above	1.32	(0.71–2.43)		
Ethnicity				
Non-Hispanic/Latino	Reference			
Hispanic/Latino	1.16	(0.50–2.69)		
Race				
White	Reference			
Other race	0.78	(0.44–1.36)		
Type of oral health program				
Dental-3rd year	Reference			
Dental-4th year	1.44	(0.82–2.55)		
Dental hygiene	1.39	(0.78–2.47)		
Prior degree earned				
No prior degree	Reference			
Associate or bachelor's degree	0.99	(0.34–2.88)		
Master's degree or doctorate degree	2.54	(0.57–11.30)		
Number of patient visits per week				
0–10	Reference		Reference	
11–20	1.21	(0.52–2.84)	1.09	(0.44–2.71)
21 +	4.40	(1.16–16.75)	4.47	(1.14–17.58)
State of program				
Arizona	Reference			
California	0.79	(0.39–1.61)		
Colorado	0.62	(0.26–1.47)		
Idaho	0.37	(0.09–1.50)		
Nevada	0.49	(0.20–1.23)		
Tennessee	2.95	(0.61–14.28)		
Texas	0.56	(0.26–1.21)		
Utah	0.78	(0.34–1.81)		
Top 5 sources of HPV vaccine information reported				
Dental curriculum				
Yes	Reference			
No	0.96	(0.57–1.62)		
Internet				
Yes	Reference			
No	0.86	(0.52–1.43)		
Non-oral health colleague (e.g., medical doctor, nurse practitioner)				
Yes	Reference			
No	0.64	(0.35–1.18)		
Family/friend				
Yes	Reference			
No	1.05	(0.59–1.87)		
Professional journal/publication (e.g., oral health journal)				
Yes	Reference			
No	0.53	(0.26–1.10)		
HPV vaccine knowledge				
HPV vaccine knowledge				
Below median	Reference			
Above median	1.03	(0.97–1.09)		
HPV can cause oropharyngeal cancer				
True	Reference			
False/Don't know/Missing	0.89	(0.33–2.35)		
HPV vaccines can protect men and women against HPV related oropharyngeal cancer				
True	Reference			
False/Don't know/Missing	1.13	(0.65–1.97)		
Barriers to discussing HPV				
I do not have enough information about the HPV vaccines				
Did not agree	Reference		Reference	
Agree	0.54	(0.33–0.90)	0.69	(0.39–1.25)
I am concerned with the safety of the HPV vaccines				
Did not agree	Reference			
Agree	0.54	(0.26–1.10)		
Liability reasons				
Did not agree	Reference			
Agree	0.67	(0.41–1.09)		

(continued on next page)

Table 3 (continued)

Variable	Unadjusted		Adjusted	
	Odds ratio	(95% CI)	Odds ratio	(95% CI)
I do not believe it is my role as an oral health professional to recommend the HPV vaccines to my patients				
Did not agree	Reference		Reference	
Agree	0.46	(0.27–0.79)	1.04	(0.51–2.11)
There are no established professional policies/guidelines pertaining to recommendation of the HPV vaccines				
Did not agree	Reference			
Agree	0.93	(0.58–1.50)		
There is not enough time to discuss this during appointments				
Did not agree	Reference		Reference	
Agree	0.51	(0.31–0.85)	0.58	(0.33–1.02)
I am not comfortable discussing sexual history/topics with patients				
Did not agree	Reference		Reference	
Agree	0.45	(0.28–0.74)	0.66	(0.35–1.22)
Politics play a role in discussing HPV and the HPV vaccines in the dental office				
Did not agree	Reference			
Agree	1.04	(0.64–1.70)		
Social and cultural norms play a role in discussing HPV and the HPV vaccines in the dental office				
Did not agree	Reference			
Agree	0.80	(0.46–1.40)		
A patient's religious ideology plays a role in discussing HPV and the HPV vaccines in the dental office				
Did not agree	Reference			
Agree	1.07	(0.65–1.76)		
Communication about HPV				
Do not discuss HPV in the clinic setting and/or have no plans to start				
Have discussed	Reference		Reference	
Have not discussed/No plans to start	0.38	(0.21–0.70)	0.55	(0.27–1.13)
Scope of practice				
Discussing the link between HPV and oropharyngeal cancer falls within the scope and role of a dental professional.				
Did not agree	Reference			
Agreed	1.00	(0.53–1.89)		
Recommending HPV vaccination falls within the scope and role of a dental professional.				
Did not agree	Reference		Reference	
Agreed	2.14	(1.32–3.46)	1.39	(0.79–2.44)
Administering the HPV vaccines inside the dental office falls within the scope and role of a dental professional.				
Did not agree	Reference		Reference	
Agreed	6.02	(2.47–14.71)	5.9	(2.27–15.3)

^a Significance was set at the $p < 0.05$ level.

^b Significant variables identified in the unadjusted models were entered into the multivariable models.

generalizations for some results. Additionally, the analyses were conducted with only participants who provided complete data. Thus, there is a potential for the results to be biased because of missing data. Nevertheless, the inclusion of multiple sites across the US and the adjustment for confounders in the analyses are a strength of this study.

5. Conclusions

This is the first multi-state study to examine the willingness of oral health students to train to administer and administer the HPV vaccine once they are trained, in the dental setting. Our findings indicate that overall, a majority of oral health students may be open to receiving training to administer the HPV vaccine and to administer the HPV vaccine once they are trained. A recent position statement from the Society of Behavioral Medicine calls for an increased and coordinated effort to develop and improve clinical practices and HPV vaccination to address the rising trend of OPCs (Peterson et al., 2019). It is imperative that dental education emphasize the importance of HPV vaccination within the curriculum to prepare new generations of oral health professionals as part of these efforts.

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Declaration of Competing Interest

None of the authors have a conflict of interest.

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