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Assessing the Effectiveness of Web-Based Modules on Human Papillomavirus Among Dental and Dental Hygiene Students

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Abstract

Literature suggests that deficiencies among dental professional students in both knowledge and awareness of human papillomavirus (HPV) and its association with oropharyngeal cancers (OPC), as well as its risk factors implicating the prevalence of HPV, may be due to the lack of HPV-related education during professional schooling. The aim of this study was to assess the effectiveness of an online learning tool to educate dental and dental hygiene students about HPV and its association with OPC, rapidly evolving disease patterns, and dental professionals' role in HPV-associated OPC prevention efforts. A three-section online learning module was developed to improve dental professionals' comfort levels with, and knowledge of, HPV. The participants were recruited to participate in surveys before and after the intervention. Descriptive statistics and chi-square analysis were computed to study the effectiveness of the modules in improving the knowledge of students about this topic. Pre-intervention survey participants totaled 142, and 107 participants answered the post-intervention survey. The majority of the study participants had some baseline understanding of HPV prior to accessing the modules. After reviewing the modules, there was a statistically significant increase in the proportion of respondents who identified OPC ($p=0.01$), vaginal cancer (0.02), vulvar cancer (0.04), and penile cancer (0.01) as associated with HPV. A gap in the understanding of HPV vaccine-eligible groups was noted in almost half of the participants; while most participants could correctly identify that boys and girls aged 9–12 years were eligible to get the vaccine, the gap in knowledge in this regard was related to “25-year-old with an abnormal pap result.” Due to the evolving nature of this topic, there is a need to find new and effective methods of disseminating HPV-related information among the existing and future dental workforce.

Keywords Human papillomavirus (HPV) · Dental school curriculum · Dental students · Oropharyngeal cancers (OPC)

Introduction

Persistent, high-risk human papillomavirus (HPV) infections are associated with most oropharyngeal, cervical, and anal cancers in the USA. [1] Data obtained from cancer registries

of diagnosed patients between 1995 and 2005 show that approximately 72% of oropharyngeal cancers (OPC) are caused by HPV, [2, 3] and the rates of HPV-associated OPC have progressively surpassed those of cervical cancer in the USA. [3–5] Even though the incidence of HPV-associated OPC continues to increase and pose a significant threat to public health, most of these cancers are now preventable through HPV vaccination.

The HPV vaccine is a primary prevention tool which has been proven to be safe and effective in protecting against the most common HPV strains, including the high-risk types 16 and 18 that cause 80% of cancers. [6, 7] However, the US rates of HPV vaccine administration and coverage remain low. [8–10] According to National Immunization Surveys (NIS) data, only 61.4% of females and 56% of males aged 13–17 in the USA have received all of the recommended doses of the HPV vaccine as of 2020. [11] This continues to represent an unmet need and poses a public health threat.

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Both the American Dental Association (ADA) and the American Association for Pediatric Dentistry (AAPD) have issued policy statements that endorse dental professionals' role in the promotion of HPV vaccines to prevent OPC in dental care settings. [12, 13] Studies conducted in the past couple of years indicate that, post availing educational opportunities on this topic, several oral health care providers felt more comfortable educating their patients about HPV and HPV vaccinations [14–17] Because dental providers perform oral cancer screenings and routinely see their patients on a bi-annual/annual basis for preventive care, [18] point-of-care opportunities to educate about HPV can be effectively conducted in dental care settings. Beyond education, dental providers frequently administer local anesthetic injections for oral procedures, and several states now allow dentists to administer the COVID-19 and influenza vaccines. Such developments make the increased access of HPV vaccination in the dental setting seem closer to reality. [19–22] Increasing access to care by including dentists in HPV immunization practices may improve HPV completion rates while minimizing health disparities related to factors such as gender, racial and ethnic minority backgrounds, and geographic location. [23, 24]

Few studies have assessed the knowledge, awareness, and acceptance of vaccine administration and its implications with HPV-OPC among dental and dental hygiene students. [25–27] In addition, current deficiencies in both knowledge and awareness may be due to the lack of HPV-related education during school. [28–30] Recent evidence suggests that providing HPV-specific educational resources may improve both knowledge and likelihood of recommending HPV immunization in patient care. [31–33]

This study builds upon this very important and timely topic from existing literature. Due to the unprecedented challenges of uncertainty and adaptation of the COVID-19 pandemic, remote education has found its own niche, rendering online modules as a useful tool for distance learning especially when in-person settings are restricted. As such, with this study we aimed to assess the effectiveness of a novel web-based learning tool to educate dental and dental hygiene students about HPV and its association with OPC, as well as current preventative strategies for HPV-associated cancers that are both adaptable and pertinent to the evolving global environment and dental workforce.

Methods

Study Modules

We developed a three-section, web-based, learning module for dental and dental hygiene students focused on improving comfort levels with, and knowledge of, HPV.

The first section of the module consisted of flash cards that included information about HPV viral strains, HPV-related disease prevalence and epidemiological trends, HPV relationship to OPCs, and the current Advisory Committee on Immunization Practices (ACIP) recommendations for HPV vaccination. [34] The second section consisted of a pre-recorded presentations describing the role of oral health providers in HPV vaccine promotion and practical information on integrating HPV prevention into patient care. The last section of the module included patient-facing educational materials from professional organizations such as the ADA and AAPD for use in dental practices.

Descriptive 24-item pre-survey and 18-item post-survey questionnaires were used to assess the knowledge levels of the participants. The surveys were internally validated among the research investigators on the project, along with feedback from subject matter experts. These surveys included questions on HPV-associated cancer awareness, knowledge of risk factors for HPV-associated OPC, HPV vaccine recommendations, and student's attitude and comfort levels in discussing HPV with patients. The surveys were administered using Google forms and were connected to the modules' webpage. Details of the surveys can be found under Appendices I and II.

The Institutional Review Board at the Indiana University School of Dentistry approved this study as exempt (Protocol # 2,009,006,645).

Data Collection

Between November 2020 and July 2021, all modules were shared with the class listservs for dental and dental hygiene students at the Indiana University-Dental Public Health, dental residents at Harvard School of Dental Medicine, Boston University School of Dental Medicine, and University of California, San Francisco School of Dentistry. The survey and module links were shared first in November 2020 and reminder emails were sent out thrice to all participants (every 2 months). Participation was voluntary and all participants provided consent electronically. The participants who completed both pre- and post-surveys were provided with \$5 Amazon gift certificates.

Data Analysis

Descriptive statistics were used to summarize demographic information, including age, gender, and race/ethnicity. Frequency, percentage calculation, and the chi-square test were computed to compare the respondents' answers for pre- and post-intervention questionnaires. All *p* values were considered statistically significant at $p < 0.05$. We also used

descriptive statistics to synopsise the usefulness of the modules. SPSS version 22 for Windows was used.

Results

Participants' Distribution

The pre- and post-intervention surveys had a total of 142 and 107 respondents, respectively. Most respondents were dental students (68.3%; $n=97$); females (71.8%; $n=102$); and between 18 and 30 years of age (74.6%; $n=106$). Details on the demographic breakdown of the participants can be found in Table 1.

Baseline Understanding of HPV Infection (Pre-survey Responses)

Most of the study participants had some previous knowledge of HPV prior to accessing the modules, as shown in the pre-survey analysis (Table 2). 94.4% ($n=134$) of the respondents correctly identified HPV infections as not “rare” and 93.7% ($n=133$) noted HPV as a sexually transmitted infection. Although it was not statistically significant, the percentage of respondents who correctly answered the above questions increased after reviewing the modules. (The percentages of correct responses on the post-survey for the above questions were 98.1% ($n=105$) and 95.3% ($n=102$) respectively.)

Table 1 Demographic distribution of the respondents who completed the pre-survey

Demographics	Frequency, n (%)
Gender	
Male	40 (28.2)
Female	102 (71.8)
Age (years)	
18–30	106 (74.6)
31–40	29 (20.4)
41–> 60 *	7 (4.9)
Race	
White/Caucasian	69 (48.6)
Asian	47 (33.1)
Black/African American	6 (4.2)
Other**	9 (7.50)
Educational background	
Dental resident	28 (19.72)
Dental student	97 (68.31)
Dental hygiene student	17 (11.97)

* Ages 41 to 50; 51 to 60; and > 60 were combined into one category due to low cell frequencies. **Other is a combination of Pacific Islander, and Native Hawaiian/American and two or more races

Comparison of Pre- and Post-survey Responses

A statistically significant increase in correct responses was observed following the intervention for several questions, such as: “Do you think that an HPV infection would go away on its own without treatment?” ($p=0.002$); “Which of the following cancers may be caused by HPV” ($p=0.003$); “What percent of sexually active women and men are infected with HPV” ($p=0.001$); and “Which of these do you think the HPV vaccine can reduce or prevent” ($p=0.001$) (Table 2). When compared to the pre-educational intervention survey, a greater proportion of respondents could correctly identify that HPV infection was the main cause of genital warts during the post-survey, but it was not statistically significant (73.2% vs. 84.1%; $p=0.296$).

When asked about the type of cancers caused by HPV, 90.8% of the participants on the pre-survey and 95.3% on the post-survey correctly indicated cervical cancers (Table 3). There was a statistically significant improved knowledge post-intervention for other HPV-associated cancers: OPC ($p=0.01$), vaginal (0.02), vulvar (0.04), and penile (0.01). The number of participants who correctly identified diseases that could be prevented by HPV vaccine also increased post-intervention (32.4% vs. 54.2%; $p=0.001$). There was a statistically significant decrease in the number of students who incorrectly responded that chlamydia infections were caused by HPV ($p=0.05$). The percent of correct responses decreased for some (78.2% vs. 72.9%) for the question “if someone has HPV, they will develop cancer at some point,” but it was not statistically significant. The responses to the question on ACIP’s HPV vaccine recommendation were not statistically significant; almost half of the respondents ($N=65$; 45.8% vs. $N=50$; 46.7%) could not correctly identify a one vaccine-eligible group (previously unvaccinated 25-year-old women with abnormal pap smear). However, most respondents could correctly indicate other vaccine-eligible groups, such as “girls and boys 9–11 years of age” (girls aged 9–12 years: 85.2% vs. 85%, $p=0.97$; boys aged 9–12 years: 74.6% vs. 82.25, $p=0.15$). There was a statistically significant ($p=0.012$) increase in respondents who reported feeling a little (35.2% vs. 39.3%) or very comfortable (40.8% vs. 52.3%) in talking to their patient about HPV. There was a statistically significant increase in respondents who felt “a little comfortable” administering the HPV vaccine if they had adequate training and reimbursement (22.5% vs. 30.8%, $p=0.05$).

Usefulness of the Modules

More than 90% of study participants thought the information provided in the modules was valuable and 47% of the participants found the information to be new (Fig. 1). Importantly, 95% of study participants reported the information provided in the modules was easy to understand.

Table 2 Comparison of pre- and post-survey responses among study participants

Characteristic	Educational intervention		Total (N) Total number of responses	p value
	Pre-survey, N (%)	Post-survey, N (%)		
Do you think HPV infection is rare?				<i>p</i> =0.134
Yes	8 (5.6)	2 (1.9)	10	NS
No	134 (94.4)	105 (98.1)	239	
Do you think HPV a sexually transmitted infection (STI)?				<i>p</i> =0.572
Yes	133 (93.7)	102 (95.3)	235	NS
No	9 (6.3)	5 (4.7)	14	
Do you think that an HPV infection would go away on its own without treatment?				<i>p</i> =0.002
Yes	35 (24.6)	49 (45.8)	84	
No	91 (64.1)	52 (48.6)	143	
Don't know	16 (11.3)	6 (5.6)	22	
Do you think that an HPV infection can be prevented?				<i>p</i> =0.24
Yes	138 (97.2)	101 (96.3)	239	NS
No	4 (2.8)	4 (3.7)	8	
Do you think that HPV infections can cause genital warts?				<i>p</i> =0.296
Yes	126 (88.7)	101 (94.4)	227	NS
No	5 (3.5)	2 (1.9)	7	
Don't know	11 (7.7)	4 (3.7)	15	
If someone has HPV, they will develop cancer at some point				
Correct response ¹	111 (78.2)	78 (72.9)	189	<i>p</i> =0.336
Incorrect responses	31 (21.8)	29 (27.1)	60	NS
Which of the following cancers may be caused by HPV?				
Correct response ²	48 (33.8)	56 (52.3)	104	<i>p</i>=0.003
Incorrect responses	94 (66.2)	51 (47.7)	145	
What percent of sexually active women and men are infected with HPV?				
Correct response ³	50 (35.2)	73 (68.2)	123	<i>p</i> =0.001
Incorrect responses	93 (64.8)	34 (31.8)	126	
The HPV vaccine is recommended by the Advisory Committee on Immunization Practices for?				
Correct response ⁴	23 (16.2)	19 (17.8)	42	<i>p</i> =0.745
Incorrect responses	119 (83.8)	88 (82.2)	207	NS
Which of these do you think the HPV vaccine can reduce or prevent?				
Correct response ⁵	46 (32.4)	58 (54.2)	104	<i>p</i> =0.001
Incorrect responses	96 (67.6)	49 (45.8)	145	

Level of significance at $p \leq 0.05$; NS=not significant

¹It depends

²Cervical cancer + anal cancer + vulvar cancer + penile cancer + vaginal cancer + (OPC) cancer

³80%

⁴Previously unvaccinated 25-year-old women with abnormal PAP + 9–12-year-old boys + 9–12-year-old girls

⁵Cervical cancers + OPC + genital warts

Discussion

Our study assessed the effectiveness of web-based learning modules on HPV among dental students, dental residents, and dental hygiene students. Following the online

educational intervention, there was an increase in knowledge about topics such as prevalence of HPV infections, HPV-associated cancers, and diseases that could be prevented with the HPV vaccine. Most participants correctly identified that HPV is a common sexually transmitted infection

Table 3 Comparison of pre- and post-survey responses among study participants (questions that allowed more than one response)

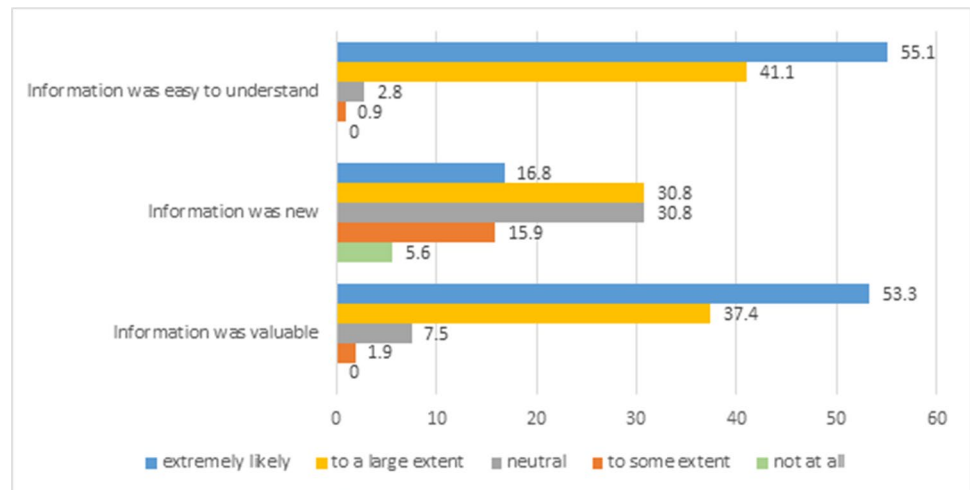
	Pre-survey N (%)	Post-survey N (%)	
Which of the following cancers may be caused by HPV?			
Cervical cancers	129 (90.8)	102 (95.3)	<i>p</i> =0.17
Anal cancers	101 (71.1)	84 (78.5)	<i>p</i> =0.18
Vaginal cancers	102 (71.8)	90 (84.1)	<i>p</i> =0.02
Vulvar cancers	92 (64.8)	82 (76.6)	<i>p</i> =0.04
Penile cancers	85 (59.9)	85 (76.6)	<i>p</i> =0.01
Breast cancer	28 (19.7)	16 (15)	<i>p</i> =0.32
Oropharyngeal cancers	96 (67.6)	93 (86.9)	<i>p</i> =0.01
The HPV vaccine is recommended by the Advisory Committee on Immunization Practices for?			
Girls of 9–12 years	121 (85.2)	91 (85)	<i>p</i> =0.97
Boys of 9–12 years	106 (74.6)	88 (82.2)	<i>p</i> =0.15
Previously unvaccinated 25-year-old women with abnormal pap smear	77 (54.2)	57 (53.3)	<i>p</i> =0.88
Previously unvaccinated 30-year-old women with cervical cancer	38 (26.8)	37 (34.6)	<i>p</i> =0.18
Which of these do you think the HPV vaccine can reduce or prevent?			
Cervical cancers	128 (90.1)	103 (96.3)	<i>p</i> =0.06
Genital warts	104 (73.2)	90 (84.1)	<i>p</i> =0.04
Oropharyngeal cancers	109 (76.8)	91 (85)	<i>p</i> =0.10
Chlamydia	34 (23.9)	15 (14)	<i>p</i> =0.05
HIV	29 (20.4)	16 (15)	<i>p</i> =0.26
If someone has HPV, they will develop cancer at some point			
It depends	111 (78.2)	78 (72.9)	<i>p</i> =0.18
False	24 (16.9)	17 (15.9)	
True	7 (4.9)	12 (11.2)	
How comfortable do you feel talking to patients about the HPV vaccine?			
Not at all comfortable	8 (5.6)	1 (0.9)	<i>p</i> =0.012
Not very comfortable	26 (18.3)	8 (7.5)	
A little comfortable	50 (35.2)	42 (39.3)	
Very comfortable	58 (40.8)	56 (52.3)	
If you had adequate training and reimbursement, would you feel comfortable administering the HPV vaccine?			
Not at all comfortable	5 (3.5)	6 (5.6)	<i>p</i> =0.005
Not very comfortable	8 (5.6)	17 (15.9)	
A little comfortable	32 (22.5)	33 (30.8)	
Very comfortable	97 (68.3)	51 (47.7)	

and is preventable. However, there were important HPV-related knowledge deficits among the students, which need to be addressed. Specifically, participants' responses to certain questions in the pre- and post-survey demonstrated that there are evident knowledge deficits regarding whether HPV infections can go away on their own without treatment. Moreover, the knowledge of HPV invariably leading to cancer development is inadequate. Because participants' knowledge of which subsets of cancers are prevented by the

HPV vaccine is limited, the participants' knowledge of HPV vaccine efficacy exists, but their knowledge of vaccine function does not suffice.

Several studies in the past have highlighted the importance of having an educational intervention on HPV for oral health providers to improve their knowledge and attitude toward HPV-associated cancer prevention and vaccination efforts. [28, 34–39] Yet, a recent study indicates dental hygiene programs, regardless of institutional setting, provide less than 2 h of HPV didactic content and clinical application

Fig. 1 Usefulness of the modules



[40]. Unlike other studies that reported an obvious lack in dental students' knowledge of both HPV pathogenesis and the HPV vaccine, [41] we found that most students had good, though basic, understanding of HPV and the cancers associated with it, even prior to accessing the modules.

Studies also suggest that HPV literacy among providers plays a vital role in improving patient education and OPC prevention. [26, 42, 43] Deficits in students' knowledge about this topic as observed in our study necessitate the importance of including and expanding on this topic in dental curriculums. Such curriculum content could have substantial impacts in OPC prevention, as our study's respondents reported a significant increase in comfort levels in talking to patient about HPV following the intervention.

The online educational intervention utilized in our study was designed to provide relevant and current information on HPV in a concise and accessible manner. It was found to be of value and was easily understood by most of the study participants. The limitation of this study included the cross-sectional study design with a relatively small and heterogeneous (dental students vs. dental residents) sample size, so the generalizability of the study results is limited. This could also explain why the knowledge of certain topics may be higher in our study participants as compared to other studies. It is important to note how variation by school location and level/type of education setting (e.g., students versus

residents, dental programs vs. dental hygiene programs) can potentially confound not only knowledge findings but also findings related to level of comfort in talking about the topic as well.

Sampling error is another potential limitation as the choice of participants to take part in the study might have been influenced by their previous knowledge on oral cancer and HPV and their interest in the topic. Moreover, not all participants completed both questionnaires, which limited the measurement of efficacy of the intervention.

There may be different ways to introduce HPV-related educational opportunities for the existing and future dental care workforce. One approach may be to include more specific information about HPV in relevant courses in dental school curricula, and continuing education courses for practicing dental professionals could be another. Because large-scale changes to dental curricula may not parallel the evolving role of dentists in vaccine administration, it is important to find other effective methods of disseminating HPV-related information, to prepare the existing and future dental workforce.

Appendix 1

HPV: Pre-intervention survey.

HPV: Pre-intervention survey

1. **What is your racial background?**
 - American Indian/Alaskan Native
 - Asian
 - Black/African American
 - Native Hawaiian/Pacific Islander
 - White/Caucasian
 - 2 (or more) races
 - Other:
2. **How old are you?**
 - 18 to 30
 - 31 to 40
 - 41 to 50
 - 51 to 60
 - >60
3. **How do you identify?**
 - Female
 - Male
 - Other
4. **Current Role**
 - Dental resident
 - Dental student
 - Dental Hygiene student
 -
5. **Have you previously participated on any educational activities on HPV prevention in the last 2 years?**
 - Yes
 - No
6. **Have you heard of human papillomavirus (HPV) before today?**
 - Yes
 - No
 - I don't know
7. **Is HPV infection rare?**
 - Yes
 - No
 - I don't know
8. **Is HPV a Sexually Transmitted Infection (STI)?**
 - Yes
 - No
 - I don't know
9. **Which of the following cancers may be caused by HPV? (check all that apply)**
 - Cervical Cancer
 - Anal Cancer
 - Vulvar Cancer
 - Breast Cancer

- Penile Cancer
 - Vaginal Cancer
 - Head and neck (oropharyngeal) cancer
- 10. What percent of sexually active women and men are infected with HPV?**
- 5%
 - 10%
 - 20%
 - 80%
- 11. The HPV vaccine is recommended by the Advisory Committee on Immunization Practices for _____. (Check all that apply)**
- Previously unvaccinated 30 y.o. woman with cervical cancer
 - Previously unvaccinated 25 y.o. woman with an abnormal pap
 - Girls 9-12 years
 - Boys 9-12 years
- 12. If someone has HPV, they will develop cancer at some point.**
- True
 - False
 - It depends
- 13. Do you think that an HPV infection would go away on its own without treatment?**
- Yes
 - No
 - I don't know
- 14. Do you think that an HPV infection can be prevented?**
- Yes
 - No
- 15. Do you think that HPV infections can cause genital warts?**
- Yes
 - No
 - I don't know
- 16. Which of these do you think the HPV vaccine can reduce or prevent? (check all that apply)**
- Cervical cancer
 - Head and neck cancers
 - Chlamydia
 - Genital warts
 - HIV
- 17. How comfortable do you feel talking to patients about the HPV vaccine?**
- Very comfortable
 - Not very comfortable
 - A little comfortable
 - Not at all comfortable
- 18. I currently discuss the connection between HPV and oropharyngeal cancer with my patients or their parents?**
- No, and I do not intend to start
 - No, but I have considered it
 - Yes, but only with some patients
 - Yes, with all or most (75% or more) of my patients
 - Other:-----

19. Why do you not currently discuss the connection between HPV and oropharyngeal cancer with your patients?

- I currently discuss the connection between HPV and oropharyngeal cancer with my patients
- I don't have enough information
- Practice setting is not sufficiently private
- Discomfort discussing sexual history with my patients
- I cannot provide an HPV vaccine to my patients
- Concern with safety of vaccine
- Not my role as oral health provider
- Appointments not long enough
- Liability Reasons
- No professional policies/guidelines
- Other:-----

20. If you had adequate training and reimbursement, would you feel comfortable administering the HPV vaccine?

- Not at all comfortable
- Not very comfortable
- A little comfortable
- Very comfortable

21. At your facility/organization, have you received education/training about HPV?

- Yes
- No
- I don't know

22. If training could be provided, what format of training would be most beneficial? Select all that apply.

- In person
- Webinar
- Online self-study
- Offline self-study
- Other:-----

23. Do you believe it would be easier for patients to complete their HPV vaccine schedule if they were to receive it from their dentists?

- Yes
- No
- I don't know

24. Do you have any other suggestions for how to improve HPV vaccination rates and the possible role of the oral health community in this?-----

Appendix 2

Post-intervention survey.

Post- Intervention Survey

1. **Do you think HPV infection is rare?**
 - Yes
 - No
 - I don't know

2. **Do you think HPV is a Sexually Transmitted Infection (STI)?**
 - Yes
 - No
 - I don't know

3. **Which of the following cancers may be caused by HPV? (Check all that apply)**
 - Cervical Cancer
 - Anal Cancer
 - Vulvar Cancer
 - Breast Cancer
 - Penile Cancer
 - Vaginal Cancer
 - Head and neck (oropharyngeal) cancer

4. **What percent of sexually active women and men are infected with HPV?**
 - 5%
 - 10%
 - 20%
 - 80%

5. **The HPV vaccine is recommended by the Advisory Committee on Immunization Practices for _____ . (check all that apply)**
 - Previously unvaccinated 30 y.o. woman with cervical cancer
 - Previously unvaccinated 25 y.o. woman with an abnormal pap
 - Girls 9-12 years
 - Boys 9-12 years

6. **If someone has HPV, they will develop cancer at some point.**
 - True
 - False
 - It depends

7. **Do you think that an HPV infection would go away on its own without treatment?**
 - Yes
 - No
 - I don't know

8. **Do you think that an HPV infection can be prevented?**
 - Yes
 - No

9. **Do you think that HPV infections can cause genital warts?**
 - Yes
 - No
 - I don't know

10. **Which of these do you think the HPV vaccine can reduce or prevent? (check all that apply)**
 - Cervical cancer
 - Head and neck cancers
 - Chlamydia
 - Genital warts
 - HIV

11. **How comfortable do you feel talking to patients about the HPV vaccine?**
 - Very comfortable
 - Not very comfortable
 - A little comfortable
 - Not at all comfortable

12. How likely are you to use the information in the modules in your clinic? (on a scale of 1-5)
Not at All likely (1) –Extremely Likely (5)
13. This learning tool improved my HPV Knowledge
- Strongly Agree
 - Somewhat Agree
 - Neutral
 - Somewhat Disagree
 - Strongly Disagree
14. Do you have any ideas/recommendations to improve HPV education/outreach in the community? —
15. The information presented in the modules was valuable to me. (on a scale of 1-5)
Not at All likely (1) –Extremely Likely (5)
16. The information presented in the modules was new to me. (on a scale of 1-5)
Not at All likely (1) –Extremely Likely (5)
17. The information presented in the modules was easy to understand. (on a scale of 1-5)
Not at All likely (1) –Extremely Likely (5)
18. Would you feel comfortable administering the HPV vaccine if you had adequate training and reimbursement, would you feel comfortable administering the HPV vaccine?
- Very comfortable
 - A little comfortable
 - Not very comfortable
 - Not at all comfortable

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Declarations

Ethics Approval The Institutional Review Board at the Indiana University School of Dentistry approved this study as exempt (Protocol # 2009006645).

Consent to Participate Participation in the study was voluntary and all participants provided consent electronically.

Conflict of Interest The authors declare no competing interests.

References

1. Zimet GD (2005) Improving adolescent health: focus on HPV vaccine acceptance. *J Adolesc Health* 37(6 Suppl):S17-23. <https://doi.org/10.1016/j.jadohealth.2005.09.010>
2. Gillison ML, Chaturvedi AK, Anderson WF, Fakhry C (2015) Epidemiology of human papillomavirus-positive head and neck squamous cell carcinoma. *J Clin Oncol* 33(29):3235–3242. <https://doi.org/10.1200/JCO.2015.61.6995>
3. Steinau M, Saraiya M, Goodman MT et al (2014) Human papillomavirus prevalence in oropharyngeal cancer before vaccine introduction United States. *Emerg Infect Dis* 20(5):822–828. <https://doi.org/10.3201/eid2005.131311>
4. Stein AP, Saha S, Kraninger JL et al (2015) Prevalence of human papillomavirus in oropharyngeal cancer: a systematic review. *Cancer J* 21(3):138–146. <https://doi.org/10.1097/PPO.0000000000000115>
5. Van Dyne EA, Henley SJ, Saraiya M, Thomas CC, Markowitz LE, Benard VB (2018) Trends in human papillomavirus-associated cancers - United States, 1999-2015. *MMWR Morb Mortal Wkly Rep* 67(33):918–924. <https://doi.org/10.15585/mmwr.mm6733a2> (Published 2018 Aug 24)
6. Arrossi S, Temin S, Garland S et al (2017) Primary prevention of cervical cancer: American Society of Clinical Oncology Resource-stratified guideline. *J Glob Oncol* 3(5):611–634. <https://doi.org/10.1200/JGO.2016.008151> (Published 2017 Mar 17)
7. Viens LJ, Henley SJ, Watson M et al (2016) Human papillomavirus-associated cancers - United States, 2008–2012. *MMWR Morb Mortal Wkly Rep* 65(26):661–666. <https://doi.org/10.15585/mmwr.mm6526a1> (Published 2016 Jul 8)
8. Oliver SE, Unger ER, Lewis R et al (2017) Prevalence of human papillomavirus among females after vaccine introduction-National Health and Nutrition Examination Survey, United States, 2003–2014. *J Infect Dis* 216(5):594–603. <https://doi.org/10.1093/infdis/jix244>
9. Berenson AB, Laz TH, Rahman M (2016) Reduction in vaccine-type human papillomavirus prevalence among women in the United States, 2009–2012. *J Infect Dis* 214(12):1961–1964. <https://doi.org/10.1093/infdis/jiw515>
10. Walker TY, Elam-Evans LD, Yankey D et al (2019) National, regional, state, and selected local area vaccination coverage among adolescents aged 13-17 years - United States 2018. *MMWR Morb Mortal Wkly Rep* 68(33):718–723. <https://doi.org/10.15585/mmwr.mm6833a2> (Published 2019 Aug 23)
11. Pingali C, Yankey D, Elam-Evans LD et al (2021) National, regional, state, and selected local area vaccination coverage among adolescents aged 13–17 years - United States 2020. *MMWR Morb Mortal Wkly Rep* 70(35):1183–1190. <https://doi.org/10.15585/mmwr.mm7035a1>
12. American Dental Association (2018) ADA adopts policy on HPV vaccination for the prevention of oral HPV infection. News Releases, Chicago
13. American Academy of Pediatric Dentistry (2017) Policy on human papilloma virus vaccinations. *Ref Man Pediatr dent* (40) 6:18-19 ed
14. Shukla A, Nyambose J, Vanucci R et al (2019) Evaluating the effectiveness of human papillomavirus educational intervention among oral health professionals. *J Cancer Educ* 34(5):890–896. <https://doi.org/10.1007/s13187-018-1391-z>
15. Pampena E, Vanucci R, Johnson LB et al (2020) Educational interventions on human papillomavirus for oral health providers. *J Cancer Educ* 35(4):689–695. <https://doi.org/10.1007/s13187-019-01512-7>

16. Salous MH, Bind MA, Granger L, Johnson LB, Welch K, Villa A (2020) An educational intervention on HPV knowledge and comfortability discussing vaccination among oral health care professionals of the American Indian and Alaskan Native population. *Hum Vaccin Immunother* 16(12):3131–3137. <https://doi.org/10.1080/21645515.2020.1752595>
17. COVID-19 Vaccine Regulations for Dentists Map. Accessed August 13, 2021. <https://success.ada.org/en/practice-management/patients/covid-19-vaccine-regulations-for-dentists-map>
18. Kline N, Vamos C, Thompson E et al (2018) Are dental providers the next line of HPV-related prevention? Providers' perceived role and needs. *Papillomavirus Res* 5:104–108. <https://doi.org/10.1016/j.pvr.2018.03.002>
19. Immunizations and Vaccinations. Accessed August 13, 2021. https://www.dhs.state.mn.us/main/idcplg?IdcService=GET_DYNAMIC_CONVERSION&RevisionSelectionMethod=LatestReleased&dDocName=dhs16_136660
20. Joint Committee on Administrative Rules. www.ilga.gov/commission/jcar/admincode/068/068012200d04030r.html. Accessed August 13, 2021. <https://www.ilga.gov/commission/jcar/admincode/068/068012200d04030r.html>
21. Indiana Dental Association | Indiana Dentists Approved to Administer Vaccines. Accessed August 13, 2021. <https://indental.org/indiana-dentists-approved-to-administer-vaccines/>
22. Oregon passes bill allowing dentists to administer vaccines. Accessed August 13, 2021. <https://www.ada.org/en/publications/ada-news/2019-archive/april/oregon-passes-bill-allowing-dentists-to-administer-vaccines20190426t142836>
23. Ryerson AB, Peters ES, Coughlin SS et al (2008) Burden of potentially human papillomavirus-associated cancers of the oropharynx and oral cavity in the US, 1998–2003. *Cancer* 113(10 Suppl):2901–2909. <https://doi.org/10.1002/cncr.23745>
24. HPV-Associated Cancer Rates by Race and Ethnicity | CDC. <https://www.cdc.gov/cancer/hpv/statistics/race.htm>. Accessed March 21, 2021.
25. Kepka D, Rutkoski H, Pappas L et al (2019) US oral health students' willingness to train and administer the HPV vaccine in dental practices. *Prev Med Rep* 15:100957. <https://doi.org/10.1016/j.pmedr.2019.100957> (Published 2019 Jul 17)
26. Vázquez-Otero C, Vamos CA, Thompson EL et al (2018) Assessing dentists' human papillomavirus-related health literacy for oropharyngeal cancer prevention. *J Am Dent Assoc* 149(1):9–17. <https://doi.org/10.1016/j.adaj.2017.08.021>
27. Daley E, DeBate R, Dodd V et al (2011) Exploring awareness, attitudes, and perceived role among oral health providers regarding HPV-related oral cancers. *J Public Health Dent* 71(2):136–142. <https://doi.org/10.1111/j.1752-7325.2011.00212.x>
28. Daley E, Dodd V, DeBate R et al (2014) Prevention of HPV-related oral cancer: assessing dentists' readiness. *Public Health* 128(3):231–238. <https://doi.org/10.1016/j.puhe.2013.12.002>
29. Rutkoski H, Fowler B, Mooney R, Pappas L, Dixon BL, Pinzon LM, Winkler J, Kepka D (2018) Pilot test of survey to assess dental and dental hygiene student human papillomavirus-related oropharyngeal cancer knowledge perceptions and clinical practices. *J Cancer Educ* 33:907–914 ([CrossRef] 18)
30. Daley EM, Thompson EL, Vamos CA et al (2018) HPV-related knowledge among dentists and dental hygienists. *J Cancer Educ* 33(4):901–906. <https://doi.org/10.1007/s13187-016-1156-5>
31. Mann SK, Kingsley K (2020) Human papillomavirus (HPV) vaccine knowledge, awareness and acceptance among dental students and post-graduate dental residents. *Dent J (Basel)* 8(2):45. <https://doi.org/10.3390/dj8020045> (Published 2020 May 9)
32. Dodd VJ, Daley EM, Logan HL (2011) Discussing the link between HPV and oral cancer: where do we begin? *Today's FDA* 23(1):58–61
33. Kepka D, Rutkoski H, Pappas L et al (2019) US oral health students' willingness to train and administer the HPV vaccine in dental practices. *Prev Med Rep* 15:100957. <https://doi.org/10.1016/j.pmedr.2019.100957> (Published 2019 Jul 17)
34. HPV Vaccine Recommendations | CDC. Accessed September 4, 2021. <https://www.cdc.gov/vaccines/vpd/hpv/hcp/recommendations.html>
35. Pampena E, Vanucci R, Johnson LB et al (2020) Educational interventions on human papillomavirus for oral health providers. *J Cancer Educ* 35(4):689–695. <https://doi.org/10.1007/s13187-019-01512-7>
36. Cleveland JL, Junger ML, Saraiya M, Markowitz LE, Dunne EF, Epstein JB (2011) The connection between human papillomavirus and oropharyngeal squamous cell carcinomas in the United States: implications for dentistry. *J Am Dental Assoc* 142(8):915–924. <https://doi.org/10.14219/jada.archive.2011.0298>
37. Lind E, Welch K, Perkins RB (2017) hpv related cancer prevention through coalition building. *Human Vaccines Immunotherapeutics* 13(10):2300–2306
38. Menegaz AM, Silva AER, Cascaes AM (2018) Educational interventions in health services and oral health systematic review. *Rev Saude Publica* 52:52
39. Hosking YP, Cappelli D, Donly K, Redding S (2017) HPV vaccination and the role of the pediatric dentist: survey of graduate program directors. *Pediatr Dent* 39(5):383–389
40. Trauger KA, Stull CL, Arnett MC, Blue CM, Flynn PM (2021) Human papillomavirus content inclusion in dental hygiene program curricula in the United States. *J Dent Hyg* 95(2):42–49
41. Lorenzo-Pouso AI, Gándara-Vila P, Banga C et al (2019) Human papillomavirus-related oral cancer: knowledge and awareness among Spanish dental students. *J Cancer Educ* 34(4):782–788. <https://doi.org/10.1007/s13187-018-1373-1>
42. Patel S, Koskan A, Spolarich A, Perry M, Flood T (2020) Dental professionals' knowledge, attitudes, and practice behaviors related to human papillomavirus vaccination. *J Public Health Dent* 80(1):61–69. <https://doi.org/10.1111/jphd.12350>
43. Patton LL, Villa A, Bedran-Russo AK et al (2020) An American Dental Association Clinical Evaluators Panel survey. *J Am Dent Assoc* 151(4):303–304.e2. <https://doi.org/10.1016/j.adaj.2020.01.027> ([published correction appears in *J Am Dent Assoc*. 2020 Jun;151(6):387])

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