

RESEARCH ARTICLE

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HPV Vaccination among College Students in the South: The Role of HPV Knowledge on Vaccine Initiation and Completion

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Abstract

Background: The purpose of this study was to examine factors related to HPV vaccination initiation and completion, especially the role of health knowledge, among college students in a southern state. **Methods:** College students ages 17-45 (n=1,708) were analyzed in this study. Primary outcomes were HPV vaccine series initiation and completion; binary logistic regressions were performed to identify associated factors. **Results:** Among total participants, students who were aware that HPV could be transmitted even without symptoms were less likely to initiate HPV vaccination. However, among students who have initiated the vaccine series, those who were aware that HPV could be transmitted without symptoms and that men should receive the HPV vaccine were more likely to complete the vaccine series. Other significant variables included age, gender, race, and international student status. **Conclusion:** Future studies are needed to investigate students' concerns regarding initiating HPV vaccination and how to effectively motivate students to initiate and complete the HPV vaccine series.

Keywords: HPV vaccination- HPV knowledge- college students- initiation- completion

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Introduction

Human papillomavirus (HPV) is the most common sexually transmitted infection in the United States (U.S.). Over 14 million new cases of HPV are estimated each year, and approximately 79 million HPV-infected individuals are currently living in the U.S. (American Cancer Society; Centers for Disease Control and Prevention; National Cancer Institute). Rates of HPV infection are highest among individuals in their late teens and early twenties, who are likely to initiate sexual activity and are more likely to engage in risky sexual behaviors (American College Health Association, 2009). However, there is a highly effective vaccine, Gardasil 9, to prevent primary infection of the nine most common strains of HPV (American Cancer Society). The Advisory Committee on Immunization Practices (ACIP) recommends routine vaccination of males and females ages 11-12 (Henry J Kaiser Family Foundation, 2018); however, youth can begin vaccination as young as nine years and complete the series up to age 26. ACIP recommends that youth between 11-14 years old receive two doses of HPV vaccine over six months, while teens and young adults between 15-26 receive three doses over six months (Henry

J Kaiser Family Foundation, 2018). Recently the FDA approved HPV vaccination for individuals up to age 45 (U.S. Food and Drug Administration, 2020). Despite this, HPV vaccination recommendation has not been made to adults above age 26 by the ACIP due to a case-by-case basis (Henry J Kaiser Family Foundation, 2018).

Despite widespread availability and healthcare provider recommendations for vaccination, national rates of HPV vaccination in the U.S. lag far behind the desired Healthy People 2030 objective of 80% coverage of males and females ages 13-15, with the 2019 National Immunization Survey-Teen (NIS-Teen) reporting 54.2% of adolescents aged 13-17 years being up to date with the HPV vaccination series (Elam-Evans et al., 2020; Office of Disease Prevention and Health Promotion). States in the southern region of the U.S. have some of the lowest HPV vaccination rates in the country and some of the highest rates of HPV-associated (HPVa) cancers (Centers for Disease Control and Prevention; Elam-Evans et al., 2020). According to the most recent NIS-Teen data, Alabama's HPV vaccination initiation rate was 65.6%, with an up-to-date percentage of 47.3%, ranking it 41st and 42nd, respectively, among the rest of the states (Office of Disease Prevention and Health Promotion). Regarding

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HPV cancers, Alabama has the 2nd highest rate of cervical cancer and the 4th highest rate of cervical cancer deaths. Alabama also has the 5th highest rate of oropharyngeal cancer and the 3rd highest rate of oropharyngeal cancer deaths (Centers for Disease Control and Prevention). Given these significant, negative HPV outcomes, the need for HPV prevention through vaccination is particularly crucial for states in the Deep South.

A heavy and appropriate emphasis has been placed on HPV vaccination at 11-12 years old, focusing most research and intervention efforts on this population, their parents, and their healthcare providers. However, college-aged individuals are an important target population for increasing HPV vaccination and series completion, as the majority of HPV infections occur during individuals' late teens and early twenties (Centers for Disease Control and Prevention). College students, in particular, are an ideal population on which to focus catch-up efforts for many additional reasons, including (1) they are cognitively and legally old enough to engage in their own healthcare decisions (such as vaccination), (2) they still fall within the ACIP recommended age range for HPV vaccination, and (3) they are at a stage of greater autonomy when they are taking more initiative for their health (TurnerHurley, 2014). Additionally, national data indicates that over 95% of college students have health insurance, removing cost barriers to HPV vaccination. College students typically also access campus health centers and resources, increasing convenience and opportunities (American College Health Association, 2019; Thompson et al., 2016).

Recent studies have found that HPV vaccination rates among college students are similar to rates reported by NIS-Teen for 13-17 years old. In a study performed at South Carolina college, 69.5% of students surveyed reported receiving the HPV vaccine, and 16.4% reported not having been vaccinated; notably, 13.7% were uncertain of their HPV vaccination status (Barrera et al., 2019). Another study at a small Midwestern university found that while 60% of participating students had initiated the HPV vaccine series, 51% of those students had not completed the series (Rohde et al., 2018). This low completion rate demonstrates a potential gap in communication regarding follow-up a commonly seen issue in studies of broader populations (Berenson et al., 2019). This may also indicate low knowledge and/or awareness concerning the number of vaccinations in the series that students need and/or have received. However, these issues could be resolved through education, better communication, and helping students take a stronger advocacy role in their healthcare. By increasing students' knowledge and awareness, they will be able to make informed health decisions, engage in preventive health action, and ultimately contribute to the decrease of HPV cancer morbidity and mortality and transmission overall. However, to develop such strategies, a better understanding of the factors associated with HPV vaccine initiation and series completion among college students is needed.

Materials and Methods

Data Collection and Sample

This study utilized a cross-sectional research design to investigate college students' HPV knowledge and vaccination. Electronic data were collected separately from two public universities in the south. Informed consent was provided to participants before beginning the questionnaire. For the first university, survey links created on Qualtrics were sent to undergraduates' university emails by departments' undergraduate program directors at the authors' universities and advertised at universities' newsletters. University emails were required for participating in the survey. The average time for completing the survey questionnaire was about 40 minutes, and 375 students from the first university finished the survey questionnaire. For the second university, survey was constructed using Research Electronic Data Capture software, and the survey link was distributed to all undergraduate students via university email. Responses without the university emails were excluded from the analysis. The average time to finish the questionnaire from the second university was approximately 10 minutes, and 1,922 students from the second university completed the survey. A total sample of 2,249 participants completed the respective surveys. Considering that the Food and Drug Administration (FDA) approved 9vHPV for use in women and men through age 45 years, participants aged under 45 years older were all included for analysis (n=2,202). Participants with missing values on our focal variable, HPV vaccination initiation, were excluded (n=494). Thus, a final sample of 1,708 participants was analyzed in this study. Attrition analysis showed no significant differences between participants who were excluded versus those included for analysis regarding race, citizenship, health insurance coverage, primary physician, and regular flu shot; however, those excluded from this study were nearly 1-year younger ($p < 0.01$, $t = -2.86$) and more likely to be male ($p < 0.001$, $\chi^2 = 101.68$). This study received approval from each university's respective Institutional Review Board.

Dependent Variables

This analysis included two dependent variables: HPV vaccine initiation and HPV vaccine completion. HPV vaccine initiation was defined as receiving at least one dose of the HPV vaccine. HPV vaccine completion was described as receiving all the recommended doses (either 2 or 3, depending on the participant's age of initiation) of the HPV vaccine series. The question measured HPV vaccine initiation is, "Have you ever had the HPV / Human Papilloma Virus Vaccine?" (1 = yes, 0 = no). If "yes," the participant was asked the follow-up question, "Have you completed all the shots?" to measure HPV vaccination completion (1 = yes, 0 = no).

Independent Variables

HPV literacy variables and healthcare service access variables were analyzed. Two questions measured HPV knowledge, "I can transmit HPV to my partner(s) even if I have no HPV symptoms" and "Young adult men

should receive HPV vaccine.” Correct answers were coded as “1,” and incorrect answers were coded as “0.” Healthcare service access variables included insurance coverage, self-report of having a primary physician, and self-reported receiving regular flu shots. A single question assessed insurance coverage, “Do you have any health insurance coverage?” Similar questions were used to assess having a primary physician and receiving regular flu shots. For all three of these questions, “yes” responses were coded as “1,” and “no” responses were coded as “0.”

Control Variables

Age, gender, race, and international student status were added as covariates. Age was measured as a continuous variable. Gender (male/ female), race (non-White/ White), and international student (no/ yes) were all measured dichotomously.

Data Analysis

Descriptive analysis was performed to illustrate participants’ demographic characteristics, HPV vaccination literacy, and HPV vaccine receipt. Bivariate analysis, Chi-Square test and t-test, were used to examine associations between demographic characteristics and receipt of HPV vaccination. Logistic regressions were conducted to investigate factors associated with HPV vaccination initiation and completion. The HPV vaccination initiation analysis was conducted among all the participants (N= 1,708); the vaccination completion model was only performed for participants who reported having received at least one dose of the HPV vaccine (N= 1,066). In this study, 95% statistical significance threshold is applied. All analyses were completed in

SPSS Version 25.

Results

Participants Characteristics

The final study sample included for analysis was 1,708 students. As shown in Table 1, the mean age of participants was 21.7 years (SD= 4.7); about three-fourths (76.7%) of participants were female and White (72.3%). Only 2.0% of participants were international students. For healthcare service access, 88.6% of participants had health insurance coverage, 65.7% had a primary physician, and 60.0% reported receiving regular flu shots. However, Chi-Square tests showed that the UA sample was younger ($p < 0.001$, $t = 4.98$), had higher percentage of international students ($p < 0.001$, $\chi^2 = 70.69$), and higher health insurance coverage ($p < 0.001$, $\chi^2 = 19.37$).

HPV Vaccination Receipt and Knowledge

Table 2 illustrates the descriptive statistics regarding participants’ HPV vaccination literacy and receipt. Among the 1,708 participants, more than half (62.4%) reported initiating HPV vaccination, but less than one-third (28.8%) completed the full series. Of participants who initiated the HPV vaccine series, less than half (45.1%) reported completion.

Concerning the first HPV knowledge question, HPV can be transmitted even without symptoms, 78.2% of all participants answered correctly, 75.7% of participants who had initiated HPV vaccination ($n = 1,066$) responded correctly, and about 81.3% of participants who completed the vaccine series ($n = 481$). Similar results were found for the second HPV literacy question. Young adult men

Table 1. Descriptive Characteristics

Variables	N=1,708	%	USA=1,386	UA=322	χ^2/t
Age	21.7 (M)	4.65 (SD)	21.94 (M)	20.52 (M)	4.976***
Gender					1.66
Male	382	22.4	23.20	19.90	
Female	1310	76.7	76.80	80.10	
Race					1.276
Non-white	473	27.7	28.30	25.20	
White	1235	72.3	71.70	74.80	
International					70.693***
No	1655	96.9	99.30	91.90	
Yes	35	2.0	0.70	8.10	
Health insurance					19.373***
No	144	8.4	10.20	2.50	
Yes	1514	88.6	89.80	97.50	
Primary physician					0.744
No	579	33.9	34.50	32.00	
Yes	1122	65.7	65.50	68.00	
Regular flu shot					2.951
No	660	38.6	40.00	34.80	
Yes	1033	60.5	60.00	65.20	

M, mean; SD, standard deviation; *** $p < 0.001$

Table 2. Descriptive analysis for HPV Vaccination Receipts and Literacy

	Sample1 (N=1,708)		Sample2 (N=1,066)		Sample3 (N=481)	
	N (Yes)	%	N (Yes)	%	N (Yes)	%
HPV vaccination receipt						
1. Have you ever had HPV / Human Papilloma Virus Vaccine?	1,066	62.4				
2. Have you ever completed all the shots?	492	28.8	481	45.1		
HPV vaccination literacy						
1. I can transmit HPV to my partner(s) even if I have no HPV symptoms.	1,336	78.2	807	75.7	391	81.3
2. Young adult men should receive HPV vaccine.	1,399	81.9	853	80	401	83.4

Sample 1: All participants, N=1,708; Sample 2: All participants who ever had HPV vaccination, N=1,066; Sample 3: All participants who had completed 3 HPV shots, N=481.

should receive the HPV vaccine among the three groups of participants. Within the total sample (n=1,708), 81.9% of participants answered correctly; 80.0% of participants in the HPV vaccine initiation group (n=1,066) gave a correct answer; however, among those who completed the series (n=481), the correct response rate was substantially higher at 83.4%.

Bivariate Analysis

As shown in Table 3, participants who had not initiated HPV vaccination were older ($p < 0.001$, $t = -10.97$); females had a significantly higher initiation rate than males ($p < 0.001$, $\chi^2 = 46.70$); and the international student initiation rate was significantly lower than students from the U.S. ($p < 0.001$, $\chi^2 = 17.39$). Among participants who had initiated HPV vaccination, those who completed the full series were younger than those who did not finish the

series ($p < 0.01$, $t = 2.97$); female ($p < 0.001$, $\chi^2 = 22.76$), White participants ($p < .001$, $\chi^2 = 27.46$), and international students ($p < 0.01$, $\chi^2 = 8.04$) had higher completion rates.

Logistic Regression of HPV Vaccination Initiation and Completion

Logistic regression analyses of HPV vaccination initiation and completion are summarized in Tables 4 and 5. As shown in Table 4, the first HPV literacy question, that HPV can be transmitted even without any HPV symptoms, was significant (OR=0.63, CI [0.47, 0.84]). Compared with those who answered this question incorrectly, participants who correctly answered that HPV could be transmitted even without symptoms were 0.6 times less likely to have HPV vaccination initiation. No healthcare service access variables were significant predictors for HPV vaccination initiation. Several demographic

Table 3. Bivariate Analysis of Demographic and Healthcare Variables and Vaccination Outcomes

Variables	HPV initiation (N1=1,708)		HPV completion (N2=1,066)	
	Yes (%)	χ^2/t	Yes (%)	χ^2/t
Age	-2.47(MD)	-10.97***	0.55(MD)	2.97**
Gender		46.703***		22.757***
Male	47.4		29.4	
Female	66.6		48.9	
Race		0.963		27.464***
Non-white	64.3		32.7	
White	61.7		50.5	
International		17.392***		8.040**
No	63.1		45.1	
Yes	28.6		90	
Health insurance		0.963		0.12
No	66		44.2	
Yes	61.8		46.1	
Primary physician		1.647		0.842
No	60.3		47.6	
Yes	63.5		44.6	
Regular flu shot		0.477		0.349
No	63.3		46.6	
Yes	61.7		44.8	

** $p < 0.01$, *** $p < 0.001$; N 1, All participants; N 2, All participants who ever had HPV vaccination; MD, mean difference (yes group - no group).

Table 4. Logistic Regression Analysis on HPV Vaccination Initiation (N=1,708)

	OR	SE	Lower CI	Upper CI
Demographic				
Age (17-45)	0.879***	0.014	0.855	0.903
Gender (ref=male)	2.570***	0.131	1.989	3.321
Race (ref=non-white)	0.854	0.13	0.662	1.101
International (ref=no)	0.319**	0.409	0.143	0.711
Healthcare Service Access				
Insurance (ref=no)	0.809	0.21	0.536	1.221
Having primary physician (ref=no)	1.076	0.124	0.845	1.371
Having regular flu shot (ref=no)	1.018	0.116	0.812	1.277
HPV Literacy				
No symptom can transmit (ref=no)	0.625**	0.148	0.468	0.836
Men should have vaccine (ref=no)	0.846	0.161	0.616	1.16

** p<0.01; *** p<0.001

characteristics demonstrated significance including age (OR=0.88, CI [0.85, 0.90]), gender (OR=2.57, CI [1.99, 3.32]), and international student (OR=0.32, CI [0.14, 0.71]).

As shown in Table 5, the two literacy questions: (1) HPV can be transmitted even without any HPV symptoms (OR= 1.56, CI [1.12, 2.18]), and (2) Young adult men should receive the HPV vaccine (OR= 1.44, CI [0.996, 2.08], p=.053) were significant or marginally significant predictors of HPV vaccination completion. Compared with those who answered incorrectly, participants knowing that HPV could be transmitted even without symptoms were 1.6 times more likely to complete HPV vaccination, and those knowing that men should receive the HPV vaccine were 1.4 times more likely to have completed the full series. Demographic characteristics-age (OR= 1.06, CI [1.01, 1.11]), gender (OR=2.08, CI [1.43, 3.03]), race (OR=2.16, CI [1.58, 2.94]), and international student (OR=16.37, CI [1.97, 136.12]) were significant predictors of vaccine series completion. However, contrary to the associations with vaccine initiation, all these demographic variables demonstrated positive associations with the outcome of interest for series completion.

Discussion

The current study, designed to evaluate rates of HPV vaccination and potentially associated factors among undergraduate students, presents one of the largest sample sizes to date, examining HPV vaccine initiation, completion, and associated factors among college students in the Deep South. Over half of the participants (62.4%) reported receiving at least one HPV vaccination, comparable to rates from previous studies. In a study in Midwestern, 60% of students reported having initiated the HPV vaccine series (Rohde et al., 2018). Similarly, in a study of South Carolina college students, 69.5% of participants surveyed reported being vaccinated against HPV (Barrera et al., 2019). The vaccine series completion rate of the current sample, at 28.8%, is also comparable to other college studies indicating a completion rate of approximately 29% (Rohde et al., 2018) and 19.9% (D'Errico et al., 2020).

Unsurprisingly, younger individuals were more likely to initiate HPV vaccination, while among those who had initiated, older individuals were more likely to complete the vaccination series. This is likely attributable

Table 5. Logistic Regression Analysis on HPV Vaccination Series Completion (N=1,006)

	OR	SE	Lower CI	Upper CI
Demographic				
Age (17-45)	1.062*	0.024	1.013	1.113
Gender (ref=male)	2.083***	0.192	1.429	3.034
Race (ref=non-white)	2.155***	0.159	1.578	2.943
International (ref=no)	16.370**	1.081	1.969	136.118
Healthcare Service Access				
Insurance (ref=no)	1.091	0.245	0.675	1.763
Having primary physician (ref=no)	1.003	0.153	0.743	1.353
Having regular flu shot (ref=no)	0.911	0.14	0.692	1.199
HPV Literacy				
No symptom transit (ref=no)	1.560**	0.17	1.119	2.175
Men should have vaccine (ref=no)	1.440+	0.188	0.996	2.083

+ p=0.053; * p<.05; *** p<.001

to the increasing awareness of the importance of HPV vaccination as well as continued gains in the social acceptance of the vaccine. Particularly with promotional campaigns, the HPV vaccine is emphasized as a vaccine for cancer prevention rather than something associated with sexual activities, which has been a long-held stigma related to the vaccine (Cartmell et al., 2019; Fuller et al., 2018; Widman et al., 2018). Large professional organizations have initiated many educational efforts to promote HPV vaccination at ages 11-12 before most young people engage in sexual activity and are exposed to HPV (American Cancer Society; Centers for Disease Control and Prevention; Department of Health & Human Services). These campaigns may also contribute to the age association observed here.

Previous studies have indicated that HPV knowledge tends to be greater among women than men, with women demonstrating greater awareness of HPV transmission, HPV health risks for women, signs and symptoms of infection, and the existence of a vaccine than men (Barnard et al., 2017). Higher initiation and completion rates among females were expected and supported previous findings. This is likely, in part, because when introduced to the market in 2006, the HPV vaccination was initially licensed only for females (Markowitz et al., 2018). The U.S. did not adopt a gender-neutral routine HPV immunization policy until 2011 (Markowitz et al., 2018; Walker et al., 2019). Some people still do not realize that males also need and are recommended to receive the HPV vaccination. This is depicted in the current study by nearly 20% of respondents incorrectly disagreeing with the prompt, “young adult men should get the HPV vaccine.” And previous studies have found that as many as 54% of adolescent males believed that HPV infection only occurred in females (Dibble et al., 2019). HPV infection is frequently considered a women’s health issue because of its strong association with cervical cancer. However, 9.4 men per 100,000 U.S. men are diagnosed with HPV-associated oropharyngeal cancer annually (Centers for Disease Control and Prevention). FDA’s recent expansion of the HPV vaccine’s indications to include the prevention of oropharyngeal and head and neck cancers should assist in efforts focused on increasing awareness and knowledge among males (American Dental Association).

Despite the apparent lack of HPV knowledge among respondents, 78% correctly answered the question, “I can transmit HPV to my partner even if I have no HPV symptoms.” Similar to previous studies, although most participants were aware of the HPV vaccine, they had little knowledge about the infection, especially regarding the link between sexual behavior and HPV-related cancers (D’Errico et al., 2020; Kops et al., 2019). Consistent with prior research, we found that higher levels of HPV and HPV vaccination knowledge were positively associated with higher odds of HPV vaccine initiation and completion (Lee et al., 2017). Knowledge level has also been associated with positive attitudes toward the HPV vaccine (D’Errico et al., 2020; PrestonDarrow, 2019). The incomplete HPV vaccination series and lack of HPV vaccination knowledge demonstrated in this study,

combined with prior findings, indicate the importance of HPV education in the college population. These outreach efforts to increase HPV knowledge are pivotal in increasing vaccination rates.

Among total participants, those who correctly answered that HPV could be transmitted to partners without symptoms were less likely to initiate HPV vaccination; among those who have already initiated HPV vaccination, those who correctly answered that question were more likely to complete the vaccination. Knowledge can be regarded as a prerequisite for informed decision-making. If participants have a foundation of HPV knowledge, they are more likely to take ownership and initiative in ensuring full vaccination. Those without knowledge of HPV or the vaccine’s cancer prevention are less likely to follow up with their provider to complete the series. In our study, race was not a predictor of HPV vaccination initiation but completion. White students were more than twice as likely to complete vaccination after they initiated it compared to other races. This finding is not novel, with previous work attributing the disparity between initiation and completion to gaps in follow-up communication and lack of knowledge about the vaccine (Schluter et al., 2011). This may imply that participants initiate the vaccine because they are more likely to follow physician recommendations without questioning or refuting them due to limited HPV knowledge. At the same time, they are less likely to return for follow-up because of poor communication and lack of knowledge. As discussed above, gender was also a predictor of vaccination, with women being more likely to complete the vaccine series than men. As discussed above, this is likely due to the long-time emphasis on HPV vaccination as a women’s health initiative (Markowitz et al., 2018).

International students were less likely to initiate the series but had high completion rates. Barriers to initiation for this population are likely to include the type of insurance, language barrier, convenience, transportation, and difficulty navigating the U.S. healthcare system. HPV vaccination initiation and completion rates are higher internationally. International students may have already completed the series abroad before enrolling for their undergraduate education. HPV vaccination completion rates vary widely per country: the UK-Scotland achieved the highest uptake, at 91.4%, followed by Taiwan (89%), Prince Edward Island in Canada (81.4%), Australia (70%), and Denmark (62%), Japan (48.2%), and Germany (41%), France (range 23.7%-33.3%), and the United States (range 0.7%-27.7%) (Loke et al., 2017). Depending on the country of origin, international undergraduate students are likely to have either previously completed or never initiated the series.

Study Limitations

This study has several limitations. First, due to the cross-sectional design, the examination of causal associations is impossible in this study. Future longitudinal studies must investigate the causal associations between HPV knowledge and HPV vaccination receipt. Second, the outcomes were measured by self-report data from two universities, and two different questionnaires were adopted

in these two universities. Despite many similarities, the two samples differ in the mean age and gender proportion and questions. Also, compared with those excluded from this analysis, the remaining participants were older and had a higher percentage of females. Third, due to the limitations of the original questionnaires, only two HPV knowledge questions were analyzed in this study. Future studies need to include more HPV knowledge questions.

Implications for Health Practice and Policy

Despite its limitations, this study revealed surprising findings that college students with higher HPV literacy were still less likely to initiate HPV vaccination; among those who initiated vaccination, having higher HPV literacy is relevant to the high completion rate. This finding indicates that even though college students know the importance of HPV vaccination to their health, other factors may stop them from initiating HPV vaccination. Researchers need to identify student concerns, educate, and motivate them to initiate HPV vaccination. Furthermore, the higher completion rates among participants with higher HPV literacy indicate the importance of HPV literacy. Health policymakers and practitioners need to design and conduct more HPV literacy education programs to promote college students' HPV literacy.

Author Contribution Statement

All authors contributed equally in this study.

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Declaration of Interest Statement

None.

References

- American Cancer Society (2020). HPV and Cancer. Retrieved Aug. 20th from <https://www.cancer.org/cancer/cancer-causes/infectious-agents/hpv/hpv-and-cancer-info.html>.
- American Cancer Society (2020). HPV Vaccines. Retrieved Aug. 20th from <https://www.cancer.org/cancer/cancer-causes/infectious-agents/hpv/hpv-vaccines.html>.
- American College Health Association (2009). American College Health Association-National College Health Assessment Spring 2008 Reference Group Data Report (abridged): the American College Health Association. *J Am Coll Health*, **57**, 477-88.
- American College Health Association (2019). ACHA-NCHA IIc (Fall 2015-Spring 2019). Retrieved Aug. 20th from https://www.acha.org/NCHA/ACHA-NCHA_Data/Publications_and_Reports/NCHA/Data/Reports_ACHA-NCHAIIC.aspx.
- American Dental Association. FDA adds oropharyngeal cancer prevention as indication for HPV vaccine. Retrieved Oct. 11th from <https://www.ada.org/en/publications/ada-news/2020-archive/june/fda-adds-oropharyngeal-cancer-prevention-as-indication-for-hpv-vaccine>.
- Barnard M, George P, Perryman ML, Wolff LA (2017). Human papillomavirus (HPV) vaccine knowledge, attitudes, and uptake in college students: Implications from the Precaution Adoption Process Model. *PLoS One*, **12**, e0182266.
- Barrera J, Greene S, Petyak E, et al (2019). Reported rationales for HPV vaccination vs. Non-vaccination among undergraduate and medical students in South Carolina. *J Am Coll Health*, **2019**, 1-5.
- Berenson AB, Rupp R, Dinehart EE, et al (2019). Achieving high HPV vaccine completion rates in a pediatric clinic population. *Hum Vaccines Immunother*, **15**, 1562-9.
- Cartmell KB, Mzik CR, Sundstrom BL, et al (2019). HPV Vaccination Communication Messages, Messengers, and Messaging Strategies. *J Cancer Educ*, **34**, 1014-23.
- Centers for Disease Control and Prevention (2018). Cancers Associated with Human Papillomavirus by State—2010–2014. Retrieved Aug. 20th from <https://www.cdc.gov/cancer/uscs/about/data-briefs/no2-hpv-assoc-cancers-by-state-2010-2014.htm>.
- Centers for Disease Control and Prevention (2017). Genital HPV Infection- Fact Sheet. Retrieved Aug. 20th from <https://www.cdc.gov/std/hpv/hpv-Fs-July-2017.pdf>.
- Centers for Disease Control and Prevention. HPV and Oropharyngeal Cancer. Retrieved Oct. 10th from https://www.cdc.gov/cancer/hpv/basic_info/hpv_oropharyngeal.htm.
- Centers for Disease Control and Prevention (2019). HPV vaccine schedule and dosing. Retrieved Aug. 22nd from <https://www.cdc.gov/hpv/hcp/schedules-recommendations.html>.
- Centers for Disease Control and Prevention. Human Papillomavirus (HPV) Infection. Retrieved Aug. 19th from <https://www.cdc.gov/std/tg2015/hpv.htm>.
- Centers for Disease Control and Prevention (2019). United States Cancer Statistics: Data Visualizations. Retrieved Aug. 21st from <https://gis.cdc.gov/Cancer/USCS/DataViz.html>.
- Department of Health & Human Services (2019). Featured Priority: HPV Vaccination. Retrieved Aug. 25th from <https://www.hhs.gov/vaccines/featured-priorities/hpv-vaccination/index.html>.
- D'Errico MP, Tung WC, Lu M, D'Errico R (2020). Knowledge, attitudes, and practices related to human papillomavirus vaccination among college students in a state university: Implications for nurse practitioners. *J Am Assoc Nurse Pract*, **2020**.
- Dibble KE, Maksut JL, Siembida EJ, Hutchison M, Bellizzi KM (2019). A Systematic Literature Review of HPV Vaccination Barriers Among Adolescent and Young Adult Males. *J Adolesc Young Adult Oncol*, **8**, 495-511.
- Elam-Evans LD, Yankey D, Singleton JA, et al (2020). National, Regional, State, and Selected Local Area Vaccination Coverage Among Adolescents Aged 13-17 Years - United States, 2019. *MMWR Morb Mortal Wkly Rep*, **69**, 1109-16.
- Fuller C, Hudgins E, Finelt N (2018). Human-papillomavirus-related disease in pediatrics. *Curr Opin Pediatr*, **30**.
- Henry J Kaiser Family Foundation (2018). The HPV vaccine: Access and use in the U.S. Retrieved Aug. 19th from.
- Kops NL, Hohenberger GF, Bessel M, et al (2019). Knowledge about HPV and vaccination among young adult men and women: Results of a national survey. *Papillomavirus Res*, **7**, 123-8.
- Lee HY, Lee J, Henning-Smith C, Choi J (2017). HPV literacy and its link to initiation and completion of HPV vaccine among young adults in Minnesota. *Public Health*, **152**, 172-8.
- Loke AY, Kwan ML, Wong YT, Wong AKY (2017). The Uptake of Human Papillomavirus Vaccination and Its Associated Factors Among Adolescents: A Systematic Review. *J Prim Care Community Health*, **8**, 349-62.
- Markowitz LE, Gee J, Chesson H, Stokley S (2018). Ten Years

- of Human Papillomavirus Vaccination in the United States. *Acad Pediatr*, **18**, 3-10.
- National Cancer Institute. HPV and Cancer. Retrieved Aug. 20th from <https://www.cancer.gov/about-cancer/causes-prevention/risk/infectious-agents/hpv-and-cancer>.
- Office of Disease Prevention and Health Promotion. Immunization and Infectious Diseases. Retrieved from <https://www.healthypeople.gov/2020/topics-objectives/topic/immunization-and-infectious-diseases/objectives>.
- Preston SM, Darrow WW (2019). Improving Human Papillomavirus-Related Knowledge and Attitudes Among Ethnically Diverse Young Adults. *Health Equity*, **3**, 254-63.
- Rohde RL, Adjei Boakye E, Christopher KM, et al (2018). Assessing university students' sexual risk behaviors as predictors of human papillomavirus (HPV) vaccine uptake behavior. *Vaccine*, **36**, 3629-34.
- Schluterman NH, Terplan M, Lydecker AD, Tracy JK (2011). Human papillomavirus (HPV) vaccine uptake and completion at an urban hospital. *Vaccine*, **29**, 3767-72.
- Thompson EL, Vamos CA, Vázquez-Otero C, et al (2016). Trends and predictors of HPV vaccination among U.S. College women and men. *Prev Med*, **86**, 92-8.
- Turner HS, Hurley JL (2014). The history and practice of college health. University Press of Kentucky.
- U.S. Food and Drug Administration. (2020). Gardasil 9. Retrieved Aug. 22nd from <https://www.fda.gov/vaccines-blood-biologics/vaccines/gardasil-9>.
- 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**, 718-23.
- Widman CA, Rodriguez EM, Saad-Harfouche F, et al (2018). Clinician and Parent Perspectives on Educational Needs for Increasing Adolescent HPV Vaccination. *J Cancer Educ*, **33**, 332-9.



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