



Barriers to human papillomavirus (HPV) vaccination among young adults, aged 18–35

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ABSTRACT

In the United States (US), an estimated 35,900 human papillomavirus (HPV)-related cancers are diagnosed annually. HPV vaccines are projected to eliminate ~90% of these cancers. Routine vaccination is recommended at age 11–12 with “catch-up” vaccination through age 26 and shared clinical decision making for ages 27–45. However, vaccine uptake has been slow with many young adults remaining unvaccinated. This study examined barriers to HPV vaccination among individuals aged 18–35 years and assessed likelihood of future HPV vaccination.

Age-eligible participants (n = 499) recruited through Facebook advertisements, Facebook posts, and clinics (6/2019–3/2020) completed an online survey. Descriptive statistics and bivariate analysis examined HPV vaccine barriers and intent. Logistic regression models examined predictors of HPV vaccine intent.

Most (57.1%) reported they were not at all likely to get vaccinated for HPV in the future. Lower intent was associated with belief that the vaccine is not necessary (aOR: 0.134, 95% CI: 0.073, 0.246) and not safe (aOR: 0.312, 95% CI: 0.126, 0.773). Intent was positively associated with the belief that health insurance would not cover vaccination (aOR: 2.226, 95% CI: 1.070, 4.631). Provider recommendation was not significantly associated with vaccine intention.

This study highlights challenges to HPV vaccine uptake for young adults. Though several successful interventions exist, most target adolescents and their parents or providers. Future steps should use this evidence to inform development of targeted interventions to increase HPV vaccine intention and uptake in adults, ultimately reducing the burden of HPV-related cancers.

1. Introduction

In the United States (US), human papillomavirus (HPV) is the most common sexually transmitted infection; lifetime risk of acquiring HPV is nearly 100% for sexually active adults.(Centers for Disease Control, 2020; Chesson et al., 2014; Viens et al., 2016) While 90% of HPV infections are cleared by the immune system, 10% of infections with high-risk HPV types persist and cause cell abnormalities that can progress to cancer.(Meites et al., 2021) High-risk HPV types are responsible for 91% of cervical cancers, 91% of anal cancers, 69% of vulvar cancers, 75% of vaginal cancers, 63% of penile cancers, and 70% of oropharyngeal cancers.(Meites et al., 2021)

An effective vaccine is available to protect against 9 high-risk HPV types (6, 11, 16, 18, 31, 33, 45, 52, 58).(Meites et al., 2016) Guidelines

recommend routine vaccination for children age 11–12 years with catch-up vaccination through age 26; for adults age 27–45 years, shared clinical decision-making is recommended.(Meites et al., 2019) The vaccine is given in 2 or 3 doses depending on age of initiation,(Meites et al., 2016) and is projected to prevent up to 90% of HPV-related cancers.(Senkomago et al., 2019)

Global studies report high effectiveness of HPV vaccines.(Drolet et al., 2019; Lehtinen et al., 2017; Lei et al., 2020; Patel et al., 2018) Ten years since the vaccine’s introduction in 2006, prevalence of HPV types 6, 11, 16, and 18 decreased by 86% among females age 14–19 years and 71% among females age 20–24 years.(Drolet et al., 2019) The HPV vaccine is associated with substantially lower risk of invasive cervical cancer,(Lei et al., 2020) and high-grade cervical disease(Lehtinen et al., 2017) with one population study showing declines in HPV infections and

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genital warts for both men and women.(Patel et al., 2018)

In the US, HPV vaccination has slowly increased since 2006 and much of the attention has focused on increasing vaccination of 11–12 year olds with few efforts to improve uptake for unvaccinated young adults. As a result, there are substantial differences in vaccination by birth cohort years. For example, in 2017 among 13–17 year olds, 48.6% completed the vaccine series.(Walker et al., 2018) In contrast, for 18–26 year olds in 2018, completion of the vaccine was much lower (21.5%).(Boersma, 2020) Additionally, due to changes in vaccine guidelines by sex (for boys provisional recommendations started in 2009 and routine vaccination in 2011), there are gender disparities in uptake among the older birth cohorts. Among 18–26 year olds in 2018, 26% of women versus 9% of men completed the vaccine series.(Boersma, 2020)

Few studies have examined determinants or correlates of HPV vaccine intention among unvaccinated young adults. Several studies have established provider recommendation as a key predictor of HPV vaccination for young adults, paralleling studies in adolescents.(Brewer and Fazekas, 2007; Krawczyk et al., 2012; Rambout et al., 2014) Other barriers to HPV vaccine uptake for young adults (age 18–26) include potential cost of the HPV vaccine series, perceptions of vaccine safety, and worry regarding anticipated side effects.(Alber et al., 2021; Gerend et al., 2019; Gerend et al., 2016; Gerend et al., 2013) Sociodemographic factors associated with lower HPV vaccine uptake include male gender, Hispanic ethnicity, Black/African American race, being married, higher educational attainment, and urban residence.(Adjei Boakye et al., 2018; Williams et al., 2016; Wilson et al., 2016) These data are mostly from studies that largely focused on women or male sexual minorities recruited on college campuses. Even fewer included newly vaccine-eligible – men and women age 27–45.(Thompson et al., 2021)

This study adds to the literature historically focused on college-enrolled populations and reports on barriers to HPV vaccine uptake among young adults recruited via social media channels and clinics. Evidence of vaccination barriers from a broader sample are critical to design effective interventions, and will aid the US government's new effort to promote young adult vaccination in geographic areas with historically low uptake.(Giroir and Fink, 2021)

2. Methods

2.1. Study design and population

We used an inclusive outreach strategy to recruit participants to this cross-sectional study about young adult HPV vaccination, using Facebook advertisements and outreach with clinics and organizations serving young adults. Facebook ads were only shown to US users aged 18–35 years from 06/18/2019 to 03/05/2020. In St. Louis, we asked the following clinics/organizations to distribute invitations via multiple channels (print and digital flyers, Facebook posts, patient referrals): Washington University Infectious Disease clinic, the SPOT (health/social services for 13–24 year olds), St. Louis County STD clinic, SLUCare Infectious Disease clinic, Saint Louis University's OB/GYN clinic, and St. Mary's Hospital. Eligible participants included those who were 1) aged 18–35 years, 2) unvaccinated for HPV, 3) HPV vaccine-eligible, 4) able to complete an online survey in English; and 5) living in the US. This age group includes adults who are or were eligible for the HPV vaccine from the time it was initially recommended in 2006. Interested individuals were directed to an online consent page with study information. After providing consent, participants completed self-reported screening questions. Those meeting eligibility criteria were offered the survey. Upon survey completion, participants could enter a raffle for a \$15 electronic Amazon gift card.

Because this paper examines vaccination barriers, we excluded from the analysis survey respondents who had never heard of the HPV vaccine ($n = 41$). This study was approved by Saint Louis University Institutional Review Board (IRB #29426).

2.2. Survey items

The main outcome was likelihood of getting the HPV vaccine in the next six months (not at all likely, a little likely, somewhat likely, very likely). The main independent variable of interest was barriers to HPV vaccination. Based on existing literature,(Gerend et al., 2016; Krawczyk et al., 2012; Rambout et al., 2014; Wilson et al., 2016; Zimet et al., 2010) participants were asked about 12 barriers (yes /no) and given the opportunity to list other barriers in an open text response. Other covariates included demographics, healthcare information, and provider recommendation of the HPV vaccine.

2.3. Data analysis

Overall frequencies were used to describe the sample. We dichotomized intention into negative (not at all likely) versus positive (a little likely/ somewhat likely/ very likely). We examined the association between each barrier and HPV vaccination intention in three ways. First, chi-square and independent samples t-tests determined the unadjusted relationship between each barrier and the likelihood of HPV vaccination. Second, a set of multivariate logistic regression models included a single barrier (as the main independent variable of interest) and adjusted for sociodemographic and healthcare utilization factors found significant in the bivariate analysis or in previous literature. Finally, we ran a multivariate model including all 12 barriers and adjusting for the above-mentioned covariates. We used basic text analysis to inductively code the open text response to the barriers question. All responses were double coded. We recoded barriers that mapped onto one of the 12 barriers in the survey, and also noted if multiple barriers were listed. Analyses were conducted with IBM SPSS v25.

3. Results

Of 598 recruited participants, 548 completed the survey (Facebook ads: 428, Facebook posts: 64, clinic flyers: 5). Forty-nine were excluded from analysis (41 never heard of HPV, 8 were unsure regarding past HPV vaccination), leaving 499 participants in the analytic sample.

The sample was skewed toward the >26 age group (68.0%); participants' average age was 28.5 years. Most were female (78.7%), and White (80.6%) (Table 1). Nearly all were non-Hispanic (92.2%), and more than half had completed college (52.7%). Exactly half of participants had an income of under \$50,000 per year and almost half (43.8%) were working full-time. Most had private health insurance (65.5%) and had visited a healthcare provider in the last 12 months (80.7%), though 60.7% reported not speaking with their healthcare provider about the HPV vaccine since turning 18.

Most (57.1%) said they were not at all likely to get the HPV vaccine in the next six months. Compared to those with positive HPV vaccine intention, a higher proportion of those with negative intention were older (29.0 vs. 27.9 years), female (86.6% vs. 68.2%), heterosexual (79.6% vs. 64.5%), non-Hispanic White (84.9% vs. 74.8%), and married or a member of an unmarried couple (66.2% vs. 48.1%). A higher proportion of those with a high school degree or GED had positive HPV vaccine intention.

The average number of barriers to HPV vaccination reported was 3.56 (Table 1; range: 0–12), with significantly more barriers among those who had negative HPV vaccine intention (3.75 vs. 3.32; $p=0.022$). The most common barrier reported was the belief that the vaccine is not necessary, with 54.7% endorsing this barrier. More than half (53.1%) also reported their doctor never recommended the HPV vaccine. Nearly half (43.2%) thought the HPV vaccine might cause health problems in the future. Almost one-third of participants did not think the vaccine was safe (32.7%) or that their health insurance would pay for it (32.3%). Compared to respondents who intended to vaccinate against HPV, those with negative intention more often reported the following barriers: not necessary (78.1% vs. 23.6%), future problems (60.6% vs. 19.9%), not

Table 1
Participant Demographics (N = 499).

Variable		Overall n (%)	HPV vaccine intention*		P value
			Negative	Positive	
			285 (57.1)	214 (42.9)	
Age, years (Mean (SD), range)		28.54 (5.08), 18-35	29.0 (4.9)	27.9 (5.3)	.024
Gender	Male	80 (16.1)	31 (10.9)	49 (22.9)	.000
	Female	392 (78.7)	246 (86.6)	146 (68.2)	
	Other	26 (5.2)	7 (2.5)	19 (8.9)	
Sexual Identity	Heterosexual	365 (73.1)	227 (79.6)	138 (64.5)	.001
	Lesbian	9 (1.8)	6 (2.1)	3 (1.4)	
	Gay	19 (3.8)	6 (2.1)	13 (6.1)	
	Bisexual	90 (18.0)	40 (14.0)	50 (23.4)	
	Other	16 (3.2)	6 (2.1)	10 (4.7)	
Race	White	426 (85.5)	252 (88.4)	175 (81.8)	.040
	Other	72 (14.4)	33 (11.6)	39 (18.2)	
Hispanic	No	456 (92.1)	268 (94.7)	189 (88.7)	.018
	Yes	39 (7.9)	15 (5.3)	24 (11.3)	
Race/Ethnicity	Non-Hispanic White	402(80.6)	242 (84.9)	160 (74.8)	.001
	Non-Hispanic Black	29 (5.8)	19 (6.7)	10 (4.7)	
	Hispanic	39 (7.8)	15 (5.3)	24 (11.2)	
	Other	29 (5.8)	9 (3.2)	20 (9.3)	
Marital Status	Married/member of an unmarried couple	291 (58.6)	188 (66.2)	103 (48.1)	.000
	Not married	206 (41.4)	96 (33.8)	111 (51.9)	
Highest Level of Education	≤ HS Grad/GED	89 (17.9)	42 (14.8)	47 (22.0)	.203
	Some college/tech school/Associate degree	146 (29.3)	87 (30.6)	59 (27.6)	
	College degree	178 (35.7)	107 (37.7)	71 (33.2)	
	Graduate degree	85 (17.0)	48 (16.9)	37 (17.3)	
Income	< \$50,000	246 (50.0)	131 (46.8)	115 (54.2)	.122
	≥ \$50,000	246 (50.0)	149 (53.2)	97 (45.8)	
Employment Status	Full-time	218 (43.8)	118 (41.4)	100 (46.7)	.012
	Part-time/ Self-employed/ Unemployed/ Disabled	125 (25.1)	78 (27.4)	48 (22.4)	
	Student	99 (19.9)	48 (16.8)	51 (23.8)	
	Other	56 (11.2)	41 (14.4)	15 (7.0)	
Health Insurance	None	44 (8.8)	27 (9.5)	17 (7.9)	.815
	Private Insurance	327 (65.5)	186 (65.3)	141 (65.9)	
	Public Insurance	117 (23.4)	67 (23.5)	50 (23.4)	
	Other	11 (2.2)	5 (1.8)	6 (2.8)	
Visited HCP in past 12 months	No	88 (19.3)	56 (21.1)	32 (16.7)	.279
	Yes	368 (80.7)	209 (78.9)	160 (83.3)	
Barriers					
Barrier 1: Expensive	The HPV vaccine is too expensive.	122 (24.7)	49 (17.4)	73 (34.4)	.000
Barrier 2: Not necessary	I don't think the HPV vaccine is necessary.	271 (54.7)	221 (78.1)	50 (23.6)	.000
Barrier 3: Health insurance	I don't think my health insurance will pay for the HPV vaccine.	160 (32.3)	65 (22.9)	95 (45.0)	.000
Barrier 4: Fever or pain	I'm afraid the HPV vaccine could cause fever or pain.	120 (24.2)	84 (29.7)	36 (17.0)	.001
Barrier 5: Future problems	I think the HPV vaccine might cause health problems in the future.	214 (43.2)	172 (60.6)	42 (19.9)	.000
Barrier 6: Provider recommendation	My doctor never recommended the HPV vaccine to me.	263 (53.1)	127 (44.9)	136 (64.2)	.000
Barrier 7: Location	I don't know where to get the HPV vaccine.	69 (13.9)	24 (8.5)	45 (21.3)	.000
Barrier 8: Not safe	I don't think the HPV vaccine is safe.	162 (32.7)	143 (50.4)	19 (9.0)	.000
Barrier 9: Other health issues	I have too many other health issues to worry about.	130 (26.2)	69 (24.3)	61 (28.8)	.302
Barrier 10: No time	I haven't had the time to get the HPV vaccine.	122 (24.6)	51 (18.0)	71 (33.6)	.000
Barrier 11: No transportation	I don't have transportation to the clinic to get the HPV vaccine.	31 (6.3)	12 (4.2)	19 (9.0)	.039
Barrier 12: Too sick	I feel too sick to get to the clinic where I can get the HPV vaccine.	19 (3.8)	8 (2.8)	11 (5.2)	.237
Other Barrier	Other barrier (specify)	92 (39.1)	42 (30.7)	50 (51.0)	.002
# of Barriers	Average number of barriers to HPV vaccination	3.56 (1.99), 0-12	3.75 (1.87)	3.32 (2.12)	.022

Bold-type indicates a significant result based on t-test or chi-square analysis.

* The HPV vaccine intention question was dichotomized into negative (not at all likely, 57%) vs. positive (a little likely [6%], somewhat likely [11%], very likely [26%]).

safe (50.4% vs. 9.0%), and fever or pain (29.7% vs. 17.0%). In contrast, more participants with positive intention (vs. negative) reported the following barriers: expensive (34.4% vs. 17.4%), health insurance (45.0% vs. 22.9%), provider recommendation (64.2% vs. 44.9%), location (21.3% vs. 8.5%), no time (33.6% vs. 18.0%), and no transportation (9.0% vs. 4.2%).

Ninety-two participants reported other barriers to vaccination via open text response. Using a basic text analysis, two major themes were found – participants believed they were not age-eligible to receive the vaccine or not at risk due to their marital status. Over a quarter (27.2%) of participants who provided an open text response reported that they were outside the age range of eligibility for the HPV vaccine (“When I asked about it, my doctor said I was too old for it to make a difference. I was 29 when I asked.”). Several participants also mentioned that the age

limits prevented their doctor from recommending the vaccine despite their desire to get the vaccine (“I have requested the vaccine and been denied because of my age repeatedly.”), as well as uncertainty regarding insurance coverage due to the changing guidelines (“Age limits where doctors won't do it or insurance won't cover it.”).

Nearly one-fifth (18.5%) of these participants cited their marital status as a barrier to HPV vaccination. These participants mentioned that their risk of acquiring HPV was low and so did not need the vaccine (“My husband and I were virgins when we got married and our risk for HPV is basically zero, no reason for me to get the vaccine because of that.”). Several participants mentioned that their doctor recommended against getting the vaccine based on their sexual history or marital status (“Doctor said I don't need it since I only have one sexual partner (husband).”).

Vaccine safety was also a concern for some – 12.0% of these

Table 2
Univariate and multivariate logistic regression modeling for HPV vaccine intent.

Barrier	Univariate OR (95% CI)	Multivariate 1: Single Barrier aOR * (95% CI)	Multivariate 2: All Barriers aOR** (95% CI)
The HPV vaccine is too expensive.	2.497 (1.643, 3.795)	2.507 (1.535, 4.096)	1.496 (0.696, 3.214)
I don't think the HPV vaccine is necessary	0.087 (0.057, 0.132)	0.071 (0.042, 0.120)	0.134 (0.073, 0.246)
I don't think my health insurance will pay for the HPV vaccine.	2.759 (1.873, 4.065)	2.970 (1.838, 4.799)	2.226 (1.070, 4.631)
I'm afraid the HPV vaccine could cause fever or pain.	0.485 (0.312, 0.752)	0.409 (0.238, 0.702)	0.633 (0.297, 1.352)
I think the HPV vaccine might cause health problems in the future.	0.162 (0.107, 0.245)	0.154 (0.094, 0.255)	0.593 (0.263, 1.339)
My doctor never recommended the HPV vaccine to me.	2.198 (1.525, 3.168)	2.272 (1.440, 3.585)	1.519 (0.843, 2.735)
I don't know where to get the HPV vaccine.	2.937 (1.725, 5.001)	2.042 (1.096, 3.805)	1.232 (0.544, 2.793)
I don't think the HPV vaccine is safe.	0.098 (0.058, 0.165)	0.096 (0.053, 0.176)	0.312 (0.126, 0.773)
I have too many other health issues to worry about.	1.259 (0.842, 1.882)	1.085 (0.671, 1.755)	1.355 (0.669, 2.744)
I haven't had the time to get the HPV vaccine.	2.317 (1.528, 3.513)	1.988 (1.177, 3.358)	1.508 (0.757, 3.005)
I don't have transportation to the clinic to get the HPV vaccine.	2.223 (1.054, 4.687)	2.215 (0.882, 5.562)	1.994 (0.576, 6.904)
I feel too sick to get to the clinic where I can get the HPV vaccine.	1.888 (0.746, 4.779)	1.092 (0.371, 3.210)	0.998 (0.226, 4.411)

* Single barrier models controlling for sociodemographic and healthcare utilization covariates (age, gender, sexual identity, race/ethnicity, marital status, employment status, educational attainment, income, health insurance, visited healthcare provider within last 12 months)

** With all barriers included and controlling for all sociodemographic and healthcare utilization covariates.

participants expressed their concerns regarding vaccine safety (“*HPV vaccine is most definitely unsafe.*”). Several free-text responses included concerns with anticipated side effects (“*It has way too many side effects on the vaccine insert.*”), citing knowledge of someone who suffered personally (“*I knew someone who got immediately sick after getting the vaccine in middle school.*”), or possible side effects that were yet unknown (“*It's a new vaccine and has unknown long term effects.*”).

In the adjusted multivariate model 1, which included each single barrier with covariates (Table 2, Column 2), participants who did not receive a provider recommendation for the HPV vaccine were 127% more likely report positive HPV vaccine intent. However, in the adjusted multivariate model 2, this association was no longer significant in the presence of the other barriers (Table 2, column 3). Barriers that did maintain significance in model 2 included the following. Participants who did not think the HPV vaccine was necessary were 87% less likely to report positive HPV vaccine intention (aOR: 0.134, 95% CI: 0.073, 0.246). Participants who did not think the HPV vaccine is safe were 69% less likely to report positive HPV vaccine intention (aOR: 0.312, 95% CI: 0.126, 0.773). Participants who did not think their health insurance would pay for the HPV vaccine were 122% more likely to get vaccinated in the next 6 months (aOR: 2.226, 95% CI: 1.070, 4.631).

4. Discussion

In this study population of HPV vaccine eligible young adults recruited through Facebook and St. Louis area clinics/organizations, 57.1% reported that they were not at all likely to get vaccinated. Factors associated with HPV vaccine intent were gender, education, ethnicity, and visiting a doctor in the last 12 months. Females and graduate degree holders were less likely to intend to get the HPV vaccine, contrary to other studies.(Adjei Boakye et al., 2018; Williams et al., 2016; Wilson et al., 2016) Participants who identified as Hispanic had a higher likelihood of HPV vaccination intention, as did those who had visited a doctor in the last 12 months.

Motivational barriers, such as lack of perceived need for the vaccine and concern about safety were negatively associated with HPV vaccine intent. While lack of necessity has been a reported barrier in other studies, those studies were either conducted among adolescents, those who had already initiated the HPV vaccine series, or females.(Grant et al., 2009; Jain et al., 2009; Rand et al., 2011) Some literature suggests that being married or in a monogamous relationship may be associated with the belief that the HPV vaccine is unnecessary.(Thompson et al., 2016) We found 61.7% of participants who were married or part of an unmarried couple endorsed this barrier, compared to 49.5% who were not married.

Vaccine safety was also a concern, with nearly a third (32.8%) of participants reporting this barrier. Consistent with previous studies, this barrier was still associated with negative HPV vaccine intention in the adjusted model.(Brewer and Fazekas, 2007; Cummings et al., 2015; Vadaparampil et al., 2013; Zimet et al., 2010) In the free-text response participants further expressed their concerns regarding vaccine safety, both immediate and long-term effects, with several free-text responses including concerns with anticipated side effects.

Structural barriers showed different (or no) association with HPV vaccine intent in this study. While some studies show cost as a barrier to vaccination for adults,(Cummings et al., 2015; Zimet et al., 2010) cost was not a significant barrier in this study. Other studies show that when cost is a factor in vaccine access, then it is the most common barrier.(Rambout et al., 2014) In our study, it is possible that cost concerns may be motivated by the perceived lack of value, rather than actual out of pocket cost, as most participants reported that the HPV vaccine is unnecessary.

Nearly a third (32.3%) did not think their health insurance will pay for the HPV vaccine and surprisingly, this barrier was associated with a positive HPV vaccination intention in our multivariate model. Generally, vaccines are considered preventive care and covered by most insurance plans. However, Food and Drug Administration (FDA) approvals and Centers for Disease Control (CDC) Advisory Committee on Immunization Practices (ACIP) recommendations of the HPV vaccine have evolved substantially for young adults between 2006 and 2019 when our survey was conducted. ACIP recommended vaccination only for females up to age 26 in 2006; vaccination of young adult males up to age 21 was added in 2011 then expanded to age 26 in 2019.(Meites et al., 2019) Thus, survey respondents may have wanted the vaccine in the past and were unable to receive it or be confused about insurance coverage because of changing recommendations for this vaccine. Though uncertainty regarding insurance coverage has been reported as a barrier to HPV vaccine uptake, Zimet (2010) did not find it associated with positive vaccine intent as it was in this study.(Zimet et al., 2010) With evolving guidelines and coverage updates by insurers, targeted messaging to young adults is warranted to prompt them to learn about their coverage and discuss the HPV vaccine with their providers.

Over half (58.6%) identified as married or a member of an unmarried couple. Though marital status was not significantly associated with intention in the adjusted models, several (18.5%) cited being married or in a monogamous/long-term relationship as a reason for not vaccinating. More married participants thought the HPV vaccine was unnecessary and were not likely to get the HPV vaccine, compared to those who were unmarried, paralleling other studies.(Rambout et al., 2014; Thompson et al., 2016) From an educational perspective, relationship

status may not be an adequate determination of risk of HPV exposure. Developing messaging to address this changing risk, potential future exposures to HPV, and to encourage vaccination, may be beneficial.

More than half of the study population (53.1%) reported that their doctor had never recommended the HPV vaccine to them. Several studies have demonstrated that provider recommendation is a strong predictor of HPV vaccine uptake; thus, it is concerning that so many never received this recommendation. (Brewer and Fazekas, 2007; Gilkey et al., 2016; Rambout et al., 2014) In the free-text responses, participants suggested that this was due to the previous age limits for eligibility or providers stating that the vaccine would not “make a difference” implying a lack of benefit. Due to the changing HPV vaccine recommendation guidelines and FDA approvals, there may be some confusion on who is currently eligible for HPV vaccination and when young adult patients and providers should be engaging in a shared decision-making discussion about the HPV vaccine.

Several interventions have been developed to improve HPV vaccine uptake, but many target parental decision-making for their children, not young adults. Policies and programs to overcome structural barriers, such as lack of insurance coverage, have been successful among adolescents. For example, Vaccines for Children is a federal program that covers the cost of the HPV vaccine for under- and uninsured children (through age 18). Adults age 19 to 34 have the highest uninsured rates of any age group in the United States (15.6%). (Conway, 2020) Some states have opted to cover HPV vaccination for young adults through Medicaid or family planning programs. The Merck Patient Assistant Program provides free HPV vaccines for uninsured adults age 19–45. States can also use the section 317 Immunization program to cover under-insured and uninsured adults (Centers for Disease Control, 2016); however, availability of these programs is not well communicated to the public. School-based vaccine requirements are also successful in increasing HPV vaccination, however these policies are only for elementary and secondary school students, not young adults. (Perkins et al., 2016) Currently, many universities do have requirements for other vaccines, such as the meningococcal vaccine.

Strategies to facilitate provider recommendation of the HPV vaccine have been developed including bundling vaccine recommendations, implementing clinic systems to minimize missed clinical opportunities for HPV vaccination, and providing resources that address parents’ specific concerns and questions about the HPV vaccine. Past research regarding the strength and content of a provider’s recommendation for adolescent HPV vaccination, has shown that a stronger recommendation focusing on cancer prevention has higher success in achieving HPV vaccine uptake. (Gilkey et al., 2016) To date, no studies have tested this strategy in young adults. This study did not find an association between vaccine intent and provider recommendation suggesting that a stronger recommendation and specific messaging content may be needed to encourage HPV vaccination. Moreover, as the recommendation for adults age 27–45 is to engage in shared clinical decision-making with their clinicians, strategies to encourage providers to discuss the HPV vaccine with their vaccine-eligible patients should be included in interventions for this age group.

Targeted programs and policies are needed to increase HPV vaccination among eligible adults, not just adolescents. Separate interventions may be needed to address vaccine hesitancy and motivational barriers, such as the belief that the HPV vaccine is unnecessary or unsafe. Unlike with adolescents, young adults make their own healthcare decisions, so messages that were effective with parents may not resonate with young adults and may need adaptation. This may include educational campaigns to highlight current HPV vaccine recommendations, expanded policy interventions to overcome structural barriers, as well as encouraging patient-provider discussions for young adults.

4.1. Limitations and strengths

While we deployed an inclusive recruitment strategy, the majority of our respondents came from Facebook ads and posts; thus, the sample may be biased and only be representative of young adults using that social media platform. In this sample, we recruited a high proportion of non-Hispanic Whites and females. Unfortunately, recruitment through local clinics/organizations was not sufficient to compare to the Facebook sample. While this may be due to recruitment methods, this could also be attributed to different response rates for different groups. Another limitation is the possibility of duplicate responses. We implemented the option to automatically disqualify participants who used duplicate IP addresses. We also used a raffle instead of an automatic incentive. Potential selection bias may limit external validity, as recruitment and data collection was all conducted online, thus limiting participation by those without internet access or lower digital literacy.

Changes to HPV vaccine guidelines are recent. Prior to June 2018, catch-up vaccination was recommended for all females age 13–26 years, and particular subgroups of males (e.g., 13–21 years, men who have sex with men, and immunocompromised men, such as those with HIV, through age 26 years). The recommendation encouraging shared-decision making about the HPV vaccine for adults aged 27–45 was only approved by the FDA in October 2019. With evolving guidelines for young adults, our study adds to the growing vaccine uptake and cancer prevention literature by assessing HPV vaccination for individuals aged 18–35. This evidence opens new avenues for future intervention development.

5. Conclusions

Recent changes in FDA approval and CDC ACIP guidelines for HPV vaccination affects both patients and providers, creating confusion regarding HPV vaccine eligibility and insurance coverage. Findings showed that structural barriers such as insurance is not a high-priority barrier, and may be less important than motivational barriers (necessity, safety) if this confusion is alleviated. Moreover, while provider recommendation is usually seen as the strongest predictor of HPV vaccine uptake, this study shows that in the presence of other barriers for this age group that may not hold true. Future steps should include using this evidence to inform the development of targeted interventions or adaptation of existing interventions to increase HPV vaccine intention and uptake in young adults, ultimately reducing the burden of HPV-related cancers.

CRediT authorship contribution statement

Meera Muthukrishnan: Conceptualization, Methodology, Investigation, Formal analysis, Writing – original draft, Writing – review & editing, Project administration. **Travis Loux:** Methodology, Formal analysis, Writing – review & editing. **Enbal Shacham:** Conceptualization, Methodology, Writing – review & editing. **Jasmin A. Tiro:** Writing – review & editing. **Lauren D. Arnold:** Conceptualization, Methodology, Writing – original draft, Writing – review & editing.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

The data that has been used is confidential.

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