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Obstetrician/gynecologists' HPV vaccination recommendations among women and girls 26 and younger

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ABSTRACT

Background: Obstetrician/gynecologists (OB/GYNs) are well poised to vaccinate girls and young women against HPV, however little is known about if and how they recommend the HPV vaccine. This study aims to understand factors associated with strong and frequent HPV vaccine recommendations among OB/GYNs for patients 26 years and younger.

Methods: 224 practicing U.S. OB/GYNs were surveyed for how strongly and frequently they recommend the HPV vaccine to patients 26 and younger. Provider beliefs, knowledge, and preferences surrounding the vaccine, as well as clinic and patient-level variables were examined as covariates. We then examined the relationships using multivariable logistic regression analyses.

Results: Of the 224 respondents, 205 were included in the analysis, with 57% (n = 116) reporting strongly and frequently recommending the HPV vaccination to eligible patients 26 and younger. The regression showed two provider beliefs and two clinic-level attributes to be strongly associated with strong and frequent recommendations. Being a strong and frequent recommender was positively associated with believing other gynecologists frequently recommend the vaccine (aOR 24.33 95%CI[2.56–231.14]) and believing that 50% or more of their patients are interested in receiving the vaccine (aOR 2.77 95%CI[1.25–6.13]). The clinic-level attributes were having the vaccine stocked (aOR 2.66 95%CI[1.02–6.93]) and suburban (aOR 3.31 95%CI[1.07–10.19]) or urban (aOR 3.54 95%CI[1.07–11.76]) location versus rural.

Conclusions: These findings suggest that OB/GYN peer support and educating OB/GYN about patients' interest in HPV vaccination may improve HPV vaccination. This work can inform clinic-level interventions including stocking the vaccine and focusing improvement efforts on rural clinics.

1. Introduction

The United States (US) Centers for Disease Control and Prevention's (CDC) Advisory Committee on Immunization Practices (ACIP) and the American College of Obstetricians and Gynecologists (ACOG) recommend human papillomavirus (HPV) vaccination starting at age 9 to 12 years old and catch-up vaccination through age 26 for those who were not adequately vaccinated earlier (Brady et al., 2012; Meites et al., 2019; American College of Obstetricians and Gynecologists, 2020). The 9-valent HPV vaccine efficacy is almost 100% in children and 88% in mid-adults (Chatterjee, 2014; Schiller et al., 2012; U.S. Food and Drug Administration, 2018; World Health Organization, 2017), and has the potential to prevent >32,000 of the 35,000 annual HPV-caused cancers in the United States (Senkomago et al., 2019).

Despite this vaccine's effectiveness, it is currently underutilized. In 2020, only 58.6% of US adolescents 13–17 years old were up-to-date on the HPV vaccine series (Pingali et al., 2021). This falls far short of the Healthy People 2020 goal of 80% series completion for adolescents (U.S. Department of Health and Human Services, 2014), and leaves many vulnerable to HPV-related cancers and genital warts (Elam-Evans et al., 2020).

Unvaccinated adult women showed high HPV vaccine acceptability

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in previous work (Weiss et al., 2011; Black et al., 2009). Yet, of the vaccinated 19–26 year olds, only 13.0% received the vaccine as an adult, (Kasting et al., 2020) indicating more could be done to increase vaccination coverage among adults. This is especially important considering that new HPV infections occur into adulthood (Plotnick and Craig, 2017; Muñoz et al., 2004; Centers for Disease Control and Prevention, 2020a).

Provider recommendation has been shown to be the strongest predictor of uptake of preventive services for adults (Caskey et al., 2009; Finney Rutten et al., 2004; Boyd et al., 2018; Gamber et al., 2019). Adults who received this recommendation had over 35 times the odds of getting >1 dose of HPV vaccine, yet only 53% of adults 18–26 years old received a recommendation as compared to 77.5% of parents to adolescents (Gerend et al., 2016; Sturm et al., 2017; Centers for Disease Control and Prevention, 2019). The way that pediatricians recommend the HPV vaccine has been well studied, leading to many interventions for increasing vaccination recommendations in this specialty (Community Preventive Services Task Force, 2017).

Studying obstetrician and gynecologist (OB/GYN) HPV vaccine recommendation practices in a similar way could make them strategic partners to improve HPV vaccination rates. OB/GYNs see many patients during adolescence and the catch-up vaccination window for regular gynecologic exams. In fact, many healthy patients use a OB/GYN as their sole primary care provider (PCP) who may be their main link to the healthcare system. In a survey of 1,404 gynecology patients, 20% identified their OB/GYN as their PCP and another 28% did not identify a PCP (Mazzoni et al., 2017). OB/GYNs are also well-equipped to explain the benefits of the vaccine given that HPV causes many gynecologic cancers (Centers for Disease Control and Prevention, 2020b).

Research is needed to understand how OB/GYNs recommend the HPV vaccine, along with the barriers this group faces in vaccinating patients. By understanding OB/GYN beliefs, knowledge, and preferences for recommending the HPV vaccine, future interventions can be made effective and acceptable to this important group, and target providers who report recommending the HPV vaccine less frequently or strongly.

The objective of this study was to identify the factors that are most associated with an OB/GYN being a strong and frequent HPV vaccine recommender to girls and women 26 years of age or younger across four domains: provider characteristics; clinic characteristics; provider knowledge, attitudes, and beliefs; and provider perception of patient attitudes and beliefs.

2. Methods

2.1. Respondents and procedures

Detailed methodology has been previously published elsewhere (Kasting et al., 2021). In brief, an online survey was created in Qualtrics and distributed to OB/GYNs practicing in the U.S. by Dynata, a survey panel research company. The survey consisted of 73 questions and took approximately 20 min to complete, with data collected in October 2019. This study was approved by the Institutional Review Board at Purdue University and granted exempt status.

2.2. Measures

The medical encounter presents competing demands for health care providers, which may influence how they recommend and provide preventive services during patient encounters. Accordingly we used the Competing Demands Model for delivery of clinical preventive services to design five domains and using previously validated measures whenever possible (Jaén et al., 1994).

HPV Recommendation Practices. Our primary outcome variable was HPV vaccine recommendations to vaccine-eligible OB/GYN patients. We assessed both recommendation frequency and strength using questions sourced from previous research (Vadaparampil et al., 2016; Gilkey et al., 2015). We asked respondents to indicate how frequently and strongly they would recommend vaccination to age-eligible patients. We created a composite measure for the primary outcome measure by combining those who reported recommending the vaccine to eligible patients 9–26 years old both frequently (*always/almost always (>90% of the time)* and strongly (*I strongly recommend*). They were defined as *strong and frequent* recommenders. For the remaining analysis, we compared these *strong and frequent* recommenders to all *other* respondents who reported they did not recommend frequently, strongly, or either.

Provider characteristics. We measured respondent demographic information, clinical specialty, and years practicing.

Clinic characteristics. We collected basic information on the respondents' patient population and clinic characteristics. This included a measure of system-level barriers to vaccination based on responses to 5 yes/no questions (e.g. "Is the upfront cost of buying the vaccine a barrier for the clinic?"), and *yes* responses were summed to give each participant a score on a scale of 0–5. Other information included having the vaccine and educational materials stocked, federally qualified health center (FQHC) status, majority payment method of the patient population (e.g. private insurance, self-pay, etc.), geographic location (rural, urban, suburban), and whether the electronic medical record included reminder prompts.

Provider knowledge, attitudes, and beliefs. We assessed respondent knowledge attitudes, and beliefs about the role of the vaccine in clinical practice, as well as the methods by which they discuss the vaccine with their patients (Vadaparampil et al., 2016; O'Leary et al., 2018; Tan et al., 2010; Stanley et al., 2018; Daley et al., 2010; Tom et al., 2016). Respondents were asked about how frequently they believe other OB/GYNs recommend the vaccine to eligible patients. Only two respondents answered 'None/almost none (<10%)' so we added them to a combined category 'Some/None/Almost none (<39% of the time)'. We also asked participants which HPV-related cancers they mentioned when discussing the HPV vaccine with their patients, out of a total of six possible HPV-related cancers (cervical, vaginal, vulvar, anal, oropharyngeal, and penile). Because all participants indicated they mentioned cervical cancer in the discussion, we summed the number of the other five cancers, giving a scale of 0–5. We assessed the importance of patient medical and social history to respondent recommendation by averaging 4 Likert-type questions on a 5-point scale from 1 = not at all important to 5 = extremely important (Cronbach's α 0.780). Additionally, we created a knowledge score (range 0–7) by summing the number of correct responses to 7 *true/false/unsure* HPV-related questions, adapted from other surveys (range 0–7) (Vadaparampil et al., 2016; Kahn et al., 2003; Lataifeh et al., 2014). The final factor of this domain averaged two items about the respondent's own concerns over vaccine safety and efficacy being barriers to their patients' vaccination, to make *provider's beliefs about vaccine safety or efficacy as barriers to vaccination* (Cronbach's α = 0.880) for 19- to 26-year old patients. This information was not collected for patients 18-years or younger.

Provider perception of patient attitudes and beliefs. In addition to respondent attitudes and beliefs, we also assessed the respondent's perceptions of their patients' attitudes and beliefs regarding HPV vaccination (Vadaparampil et al., 2016; Stanley et al., 2018; Lataifeh et al., 2014; Esposito et al., 2007; Kempe et al., 2019). Given previous research on patient attitudes and beliefs in pediatric patient populations we focused on young adults 19- to 26- years of age (Staras et al., 2014; Bartlett and Peterson, 2011; Ogunbajo et al., 2016). We assessed the perceived benefits of HPV vaccination as an average of 4 items (e.g. *it prevents a sexually transmitted infection*) on a 5 point scale, with 1 = extremely important and 5 = not at all important (Cronbach's α 0.715). We assessed patient-level barriers as an average of 6 items (e.g. *patients are opposed to vaccines in general*) each on a 5-point scale, with 1 = strongly agree and 5 = strongly disagree (Cronbach's α = 0.723).

2.3. Analysis

We excluded any respondents who did not answer the questions for

Table 1
Respondent Demographics and Recommendations for HPV Vaccination.

Variable	Total sample (N=205)	Not strong or frequent recommenders (n=89)	Strong and frequent recommenders n=116)	P-value (2-sided)
	n (%) or mean (SD)	n (%) or mean (SD)	n (%) or mean (SD)	
Provider Characteristics				
Age	53.0 (10.5)	51.7 (11.4)	53.9 (9.8)	0.134
Sex				0.066
Male	106 (57.0)	50 (64.9)	56 (51.4)	
Female	80 (43.0)	27 (35.1)	53 (48.6)	
Years practicing medicine	23.2 (11.3)	21.4 (12.1)	24.4 (10.5)	0.054
Race/Ethnicity				0.216
Non-Hispanic White	132 (69.1)	53 (67.1)	79 (70.5)	
Non-Hispanic Black	3 (1.6)	2 (2.5)	1 (0.9)	
Non-Hispanic Asian	28 (14.7)	9 (11.4)	19 (17.0)	
Non-Hispanic Other / Prefer not to Answer	20 (10.5)	9 (11.4)	11 (9.8)	
Hispanic (of any race)	8 (4.2)	6 (7.6)	2 (1.8)	
Clinical Specialty				0.450
Obstetrician Gynecologist or Gynecologist	182 (96.3)	74 (94.9)	108 (97.3)	
Other gynecology related specialty[1]	7 (3.7)	4 (5.1)	3 (2.7)	
Clinic Characteristics				
Is the HPV vaccine stocked in your clinic				**0.001**
Yes	159 (77.9)	59 (67.0)	100 (86.2)	
No	45 (22.1)	29 (33.0)	16 (13.8)	
HPV education materials available in clinic				0.190
Yes	161 (87.5)	61 (83.6)	100 (90.1)	
No	23 (12.5)	12 (16.4)	11 (9.9)	
Majority patient payment method				0.508
Private insurance/HMO	134 (70.2)	51 (64.6)	83 (74.1)	
Medicaid	42 (22.0)	21 (26.6)	21 (18.8)	
Uninsured/Self-pay/Other	6 (3.1)	3 (3.8)	3 (2.7)	
Unsure/No definable payment majority	9 (4.7)	4 (5.1)	5 (4.5)	
FQHC[2]				0.646
Yes	17 (8.9)	8 (10.1)	9 (8.0)	
No	137 (71.7)	58 (73.4)	79 (70.5)	
Unsure	37 (19.4)	13 (16.5)	24 (21.4)	
Geographic location:				**0.025**
Rural	24 (12.6)	16 (20.3)	8 (7.2)	
Urban	59 (31.0)	24 (30.4)	35 (31.5)	
Suburban	107 (56.3)	39 (49.4)	68 (61.3)	
EMR reminder prompts for any vaccination[3]				0.428
Yes	80 (40.6)	29 (35.4)	51 (44.3)	
No	92 (46.7)	41 (50.0)	51 (44.3)	
Unsure	25 (12.7)	12 (14.6)	13 (11.3)	
EMR reminder prompts for HPV vaccination[3]				0.159
Yes	55 (27.9)	17 (20.7)	38 (33.0)	
No	115 (58.4)	52 (63.4)	63 (54.8)	
Unsure	27 (13.7)	13 (15.9)	14 (12.2)	
Systems-level barriers to HPV vaccination	1.6 (1.5)	1.9 (1.5)	1.3 (1.4)	**0.004**
Provider Knowledge, Attitudes, and Beliefs				
Believe HPV vaccine should be incorporated into regular clinic care for non-pregnant patients				**0.012**
Yes	181 (91.9)	71 (86.6)	110 (95.7)	
No	16 (8.1)	11 (13.4)	5 (4.3)	
Benefits of HPV vaccine to patients	4.5 (0.6)	4.3 (0.6)	4.6 (0.5)	**0.001**
Perception of other OB/GYN recommendation frequency				**<0.001**
All/almost all (>90% of the time)	23 (11.2)	1 (1.1)	22 (19.0)	
Most (60-90% of the time)	78 (38.0)	24 (27.0)	54 (46.6)	
About half (40-59% of the time)	72 (35.1)	43 (48.3)	29 (25.0)	
Some/None/Almost none (<39% of the time)	32 (15.6)	21 (23.6)	11 (9.5)	
Perceive other primary care providers adequately recommend vaccination				0.414
Yes	56 (28.7)	21 (25.6)	35 (31.0)	
No	139 (71.3)	61 (74.4)	78 (69.0)	
Discuss STI or genital warts prevention				0.491
Yes	171 (88.6)	69 (86.3)	102 (90.3)	
No	22 (11.4)	11 (13.8)	11 (9.7)	
Discuss cervical cancer prevention				0.722

(*continued on next page*)

Table 1 (*continued*)

Variable	Total sample (N=205)	Not strong or frequent recommenders (n=89)	Strong and frequent recommenders n=116)	P-value (2-sided)
	n (%) or mean (SD)	n (%) or mean (SD)	n (%) or mean (SD)	
Yes	190 (96.0)	79 (95.2)	111 (96.5)	
No	8 (4.0)	4 (4.8)	4 (3.5)	
Number of other HPV-related cancers mentioned	2.8 (2.0)	2.4 (2.0)	3.1 (1.9)	**0.009**
Importance of patient medical and social history	2.0 (0.6)	2.1 (0.6)	1.9 (0.6)	0.085
Knowledge score	5.2 (1.2)	4.9 (1.2)	5.4 (1.1)	**0.002**
Provider's beliefs about vaccine safety or efficacy as barriers to vaccination	4.2 (1.0)	3.9 (1.1)	4.3 (1.0)	**0.004**
Provider Perception of Patient Attitudes and Beliefs				
Patient-level barriers	2.5 (0.7)	2.5 (0.6)	2.6 (0.7)	0.466
Perception of patient interest in HPV vaccine				**<0.001**
Yes, at least 50% of patients	128 (66.3)	38 (46.9)	90 (80.4)	
Less than 50% of patients or don't know	65 (33.7)	43 (53.1)	22 (19.6)	
If you recommended HPV vaccination to patients:				**0.011**
Patients would accept	121 (63.0)	42 (51.8)	79 (69.9)	
Patients would not accept	71 (37.0)	38 (46.9)	33 (29.2)	

1. Includes trainees (n = 2) Obstetrician (n = 1) Gynecologic Oncologist (n = 1) and non-CGO Sub-specialist (n = 4).
2. FQHC is Federally Qualified Health Center.
3. EMR is Electronic Medical Record.

the primary outcome variable or indicated they did not see patients who were eligible for the HPV vaccine.

For each of the other factors we assessed means and standard deviations for continuous variables, or frequencies and percents of each answer choice for categorical variables. We then examined bivariate associations between each variable and our dichotomous recommendation outcome variable using 2-sided T-tests or Chi-squared tests, with 2-sided Fishers Exact Tests used for the categorical variables that did not fulfill the conditions of the Chi-squared test. We then included the statistically significant factors ($p < 0.05$) in a logistic regression analysis. Collinearity was acceptable with a variance inflation factor (VIF) of<1.8 for all factors. We first conducted bivariate logistic analysis with each factor and the recommendation outcome. We then created a multivariable logistic regression model combining all these variables. We used a backwards stepwise elimination approach based on a likelihood ratio selection method (significance level of stay = 0.1) to determine the best-fit model.

All analyses were performed in IBM SPSS Statistics 26 software package (IBM Corp., Armonk, N.Y., USA).

3. Results

Of the 224 physicians who responded, 205 saw vaccine eligible patients, responded to the recommendation strength and frequency questions, and were included in the final analytic sample. In total, for the primary outcome, 56.3% (n = 116) were categorized as *strong and frequent recommenders*, with the remaining 43.7% (n = 89) as *other recommenders*.

3.1. Demographics

Respondents were on average 53 years old (SD = 10.5) and had practiced medicine for 23.2 years (SD = 11.3). More than half were male (57%), and predominantly non-Hispanic white (69.1%). Most (96.3%) respondents were obstetrician gynecologists or gynecologists, with the remaining 3.7% in other gynecology-related specialties (see Table 1). Most clinics were suburban (56.3%), followed by urban (31.0%) and rural clinics (12.6%). Interestingly, male respondents were almost twice as likely to be in the not strong or frequent recommender group (65% vs 35%) however this variable did not reach statistical significance (0.066).

3.2. Factors associated with vaccine recommendation strength and frequency

In the χ^2 and *t*-test analyses, there were no statistically significant differences between the two recommendation groups in any respondent demographic characteristics. However, there was a higher percentage of strong and frequent recommenders practicing in a suburban area compared to other providers (61.3% vs. 49.4%, respectively; p = 0.025). Most strong and frequent recommenders worked in clinics where the HPV vaccine was stocked (86.2% vs 67%, p = 0.001) and reported fewer system-level barriers at their practice location (1.3/5 vs. 1.9/5; p = 0.004). When examining provider knowledge, attitudes, and beliefs, strong and frequent recommenders were more likely to believe that the HPV vaccine should be incorporated into regular clinical care (95.7% vs 86.6%, p = 0.012) and rated the benefits of vaccination as higher than other OB/GYNs (4.6/5 vs 4.3/5, p = 0.001). They were also more likely to believe that other OB/GYNs recommend the vaccine to eligible patients > 90% of the time (23.6% vs 9.5%, p < 0.001). When discussing vaccination with patients, they reported mentioning more cancers prevented by the HPV vaccine (3.1 vs 2.4p = 0.009). Finally, this group had a higher average knowledge score (5.4/7 vs. 4.9/7; p = 0.002) and was less likely to report their own concerns about the safety or efficacy of the vaccine as a barrier to their patients' vaccination (4.3/5 vs 3.9/5, p = 0.004). Strong and frequent recommenders were more likely to believe that *at least 50%* of their patients were interested in receiving the HPV vaccine (80.4% vs 46.9%, p < 0.001) and that patients would accept their recommendation to receive the vaccine (69.9% vs 51.8%, p = 0.011).

The multivariable model constructed from the statistically significant (p < 0.05) factors described above is shown in Table 2. Four factors emerged as statistically significant for being a strong and frequent HPV vaccine recommender in the reduced model. The variable with the largest odds ratio was respondents' perception of how other OB/GYNs recommend the HPV vaccine; respondents who perceived their peers to recommend the vaccine all or almost all of the time had higher odds of being strong and frequent recommenders (aOR 24.33 95% CI [2.56–231.14]). The distribution of responses for this variable are shown (Fig. 1). Next was believing that>50% of their patients would be interested in receiving the HPV vaccine was associated with increased odds of being a strong and frequent recommender (aOR 2.77 95% CI

[1.25–6.13]). The third factor was geographic location, with suburban and urban respondents having higher odds of being strong and frequent recommenders than rural respondents (aOR 3.31 95% CI [10.7–10.19]) (aOR 3.54 95% CI [1.07–11.76]). Having the vaccine stocked was the last statistically significant factor in the reduced model and was positively associated with being a strong and frequent recommender (aOR 2.66 95% CI [1.02–6.93]).

3.3. Barriers to vaccination

We conducted exploratory analyses examining each of the individual barriers and benefits in the survey, as well as their associations with recommendation quality. Strong and frequent recommenders were more likely than other recommenders to rate each of the four items for benefits of vaccination as important for their patients ($p < 0.05$). There were no significant differences in the individual items for patient-level barriers between strong and frequent recommenders and other recommenders (Fig. 2). However, there were significant differences for the two provider-level barriers, which were the respondent's own concerns about vaccine safety ($p < 0.05$) and efficacy ($p < 0.001$).

4. Discussion

OB/GYNs are in an ideal position to recommend the HPV vaccine to adolescent and young adult patients, yet little is known about what influences their vaccination practices. In our study, 57% of surveyed OB/GYNs reported recommending strongly and frequently for patients 26 years old or younger. Our survey collected information regarding respondents' demographic characteristics, patient population, as well as knowledge, attitudes, and beliefs, allowing us to compare those who recommended the HPV vaccine strongly and frequently to those who did not. Our reduced multivariable logistic regression model identified two provider beliefs and two clinic-level attributes as the factors most strongly associated with strong and frequent recommendation. The provider beliefs were that other OB/GYNs frequently recommend the vaccine and that patients are interested in receiving the vaccine. The clinic-level factors were having the vaccine stocked and being in a suburban or urban location, compared to a rural location.

The strongest association we found indicates that OB/GYNs' own recommendation practices are significantly associated with how they believe their OB/GYN peers recommend the vaccine. This variable is also important because a large proportion of our sample (about 50%) believed that their peers recommend the vaccine *about half* of the time or less (Fig. 1). Peer comparison is a valuable tool in improving clinical care. Specifically, recent research on the HPV vaccine found that providers with the strongest HPV vaccine recommendations were four times more likely to perceive their peers as strongly recommending the HPV vaccine than poor vaccine recommenders (Hopfer et al., 2019).

The finding that vaccine recommendation is associated with the perception of peers' recommendations presents an opportunity for future interventions to increase HPV vaccination rates. Using social norms to influence providers has shown promise in previous research. Specifically, a *meta*-review of social norms interventions on healthcare workers found that social comparison alone could cause improvements in desired behaviors, with large synergistic effects when combined with social rewards or prompts (Tang et al., 2021). The Community Preventive Services Task Force (CPSTF) has not considered interventions using social norms directly, however it did consider two similar interventions, standing orders for vaccination of eligible patients and assessment of vaccination rates for providers or clinics with feedback on how to improve, finding strong evidence for each (Community Preventive Services Task Force, 2017). The strong evidence for these similar interventions gives further weight to the notion that providers' recommendation practices could be influenced by their perception of the norms of their field and their peers' recommendation practices. Most of the studies above involve giving provider feedback before comparison to their peers. Our results indicate that giving the perception that their peers are strong and frequent recommenders may be effective even without the individual feedback, as providers who do not recommend strong and frequently believed the same was true of their peers.

Strong and frequent recommendations were also associated with the

Table 2
Logistic bivariate and multivariable modelling of factors influencing strength and frequency of HPV vaccine recommendations.

	Bivariate OR (95% CI)	Multivariable aOR (95% CI)	Backwards Stepwise aOR (95% CI)[1]
Provider Characteristics			
N/A			
Clinic Characteristics			
Geographic location:			
Rural	**ref**	ref	ref
Urban	**2.92 (1.08–7.89)**	3.03 (0.88–10.36)	**3.54 (1.07–11.76)**
Suburban	**3.49 (1.37–8.89)**	**3.38 (1.04–11.04)**	**3.31 (1.07–10.19)**
Is the HPV vaccine stocked in your clinic: Yes	**3.07 (1.54–6.13)***	2.62 (0.92–7.43)	**2.66 (1.02–6.93)**
Systems-level barriers to HPV vaccination	**0.75 (0.61–0.91)***	0.95 (0.82–1.09)	
Provider Knowledge, Attitudes, and Beliefs			
Believe HPV vaccine should be incorporated into regular clinic care for non-pregnant patients: Yes	**3.41 (1.14–10.22)**	1.62 (0.34–7.68)	
Benefits of HPV vaccine to patients	**2.53 (1.47–4.33)***	1.56 (0.78–3.11)	
perception of other OB/GYN recommendation frequency:			
Some or none/almost none (<39% of the time)	**ref***	**ref**	**ref***
About half (40–59% of the time)	1.29 (0.54–3.07)	1.15 (0.39–3.40)	1.01 (0.36–2.86)
Most (60–90% of the time)	**4.30 (1.79–10.29)***	2.47 (0.84–7.27) (0.84–7.27)	2.81 (0.98–8.07)
All/almost all (>90% of the time)	**42.00 (4.98–354.36)***	**28.74 (2.79–296.07)***	**24.33 (2.56–231.14)***
Number of HPV-related cancers mentioned	**1.22 (1.05–1.41)**	1.11 (0.91–1.34)	
Knowledge Score	**1.45 (1.12–1.87)***	1.21 (0.86–1.70)	1.35 (0.98–1.86)
Provider's beliefs about vaccine safety or efficacy as barriers to vaccination	**1.50 (1.13–1.98)***	1.26 (0.84–1.88)	
Provider Perception of Patient Attitudes and Beliefs			
Perception of patient interest in receiving HPV vaccine: 50% or more	**4.63 (2.45–8.77)***	**2.81 (1.02–7.73)**	**2.77 (1.25–6.13)**
If you recommended HPV vaccination to patients: Patients would accept	**2.17 (1.19–3.94)**	0.66 (0.24–1.61)	

1. The multivariable logistic regression model refined with a likelihood ratio-based backwards stepwise process using a factor elimination cutoff of $p < 0.1$. $N = 175$.
Odds ratios and adjusted odds ratios are statistically significant at $\alpha = 0.05$ (bold), or $\alpha = 0.01$ (*).

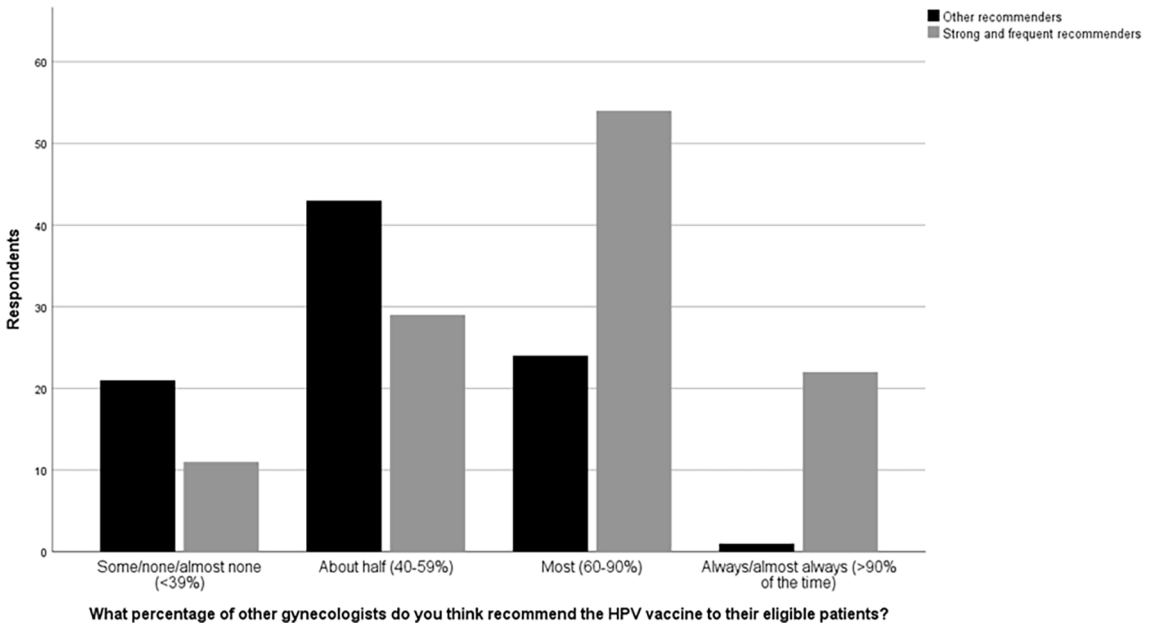

Fig. 1. Perception of other gynecologists' recommendation frequency.

belief that patients are interested in receiving the vaccine. This suggests that OB/GYNs may be discouraged from recommending the vaccine if they believe that their patient population is not interested in being vaccinated. Another study showed pediatricians dramatically underestimate their patients' interest in the HPV vaccine (Healy et al., 2014). A *meta*-review of provider communication about HPV vaccination reinforced this finding that providers give less frequent recommendations to patients that they perceive to be hesitant about the vaccine (Gilkey and McRee, 2016; Attia et al., 2018). The review also found that parents preferred unambiguous recommendations, a sentiment that may extend to adult patients. Given how profoundly pediatricians underestimate vaccine willingness in parents, OB/GYNs may share this misperception of their patients and fail to deliver strong recommendations. This emphasizes the importance of considering multilevel factors in the provision of HPV vaccine (e.g. patients, providers, and systems-level variables), as has been explored using an ecological perspective by examining the interaction between providers and patients in a variety of social contexts (Street, 2003). It also emphasizes the need for future research examining interventions to improve communication between patients and providers.

We found that many OB/GYNs have concerns over the safety and efficacy of the vaccine, with 11% and 15% respectively reporting that they agree or strongly agree that their own concerns are a barrier to their patients being vaccinated, and that these concerns were significantly negatively associated with strong and frequent recommendations. These concerns are unfounded given the vaccine's record of safety and efficacy (Schiller et al., 2012; World Health Organization, 2017) and more research is needed to understand why some physicians have this perception as well as how we can best work with physicians to counter this inaccurate belief.

Our results found the two clinic-level factors associated with strong and frequent recommendation were having the vaccine stocked in the clinic and being in a suburban or urban location. Rural respondents had significantly lower odds of being strong and frequent recommenders

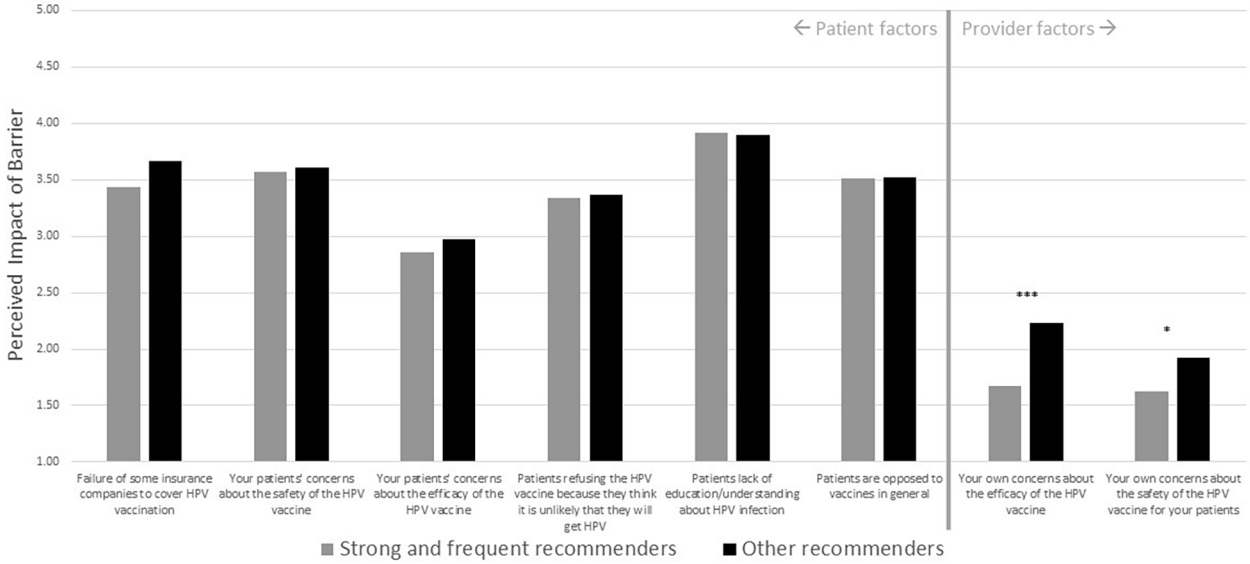

Fig. 2. Association between barriers to HPV vaccination and strength and frequency of vaccine recommendation. * denotes $p < 0.05$, *** denotes $p < 0.001$.

than those from suburban or urban clinics. This is consistent with other research that found HPV vaccination to be lower among adolescents at or above the poverty line who lived outside a metropolitan statistical area (Elam-Evans et al., 2020). Interventions targeting rural practices may be particularly important given the lower rates of strong HPV vaccine recommendations. Finally, almost a quarter of respondents (22.1%) did not have the vaccine stocked in clinic, eliminating the possibility of on-site same-day vaccination. Survey items regarding clinic-level barriers to vaccination may help elucidate these findings. Over one-third (37%) of respondents reported the upfront cost of buying the vaccine as a barrier, 22% reported that storing the vaccine was a burden, 12% reported that it was difficult for the clinic to obtain the vaccine, and 36% reported a lack of staffing dedicated to vaccination. Each of these was significantly associated with having the vaccine stocked in clinic. This set of findings is consistent with other studies that identify HPV vaccine cost and reimbursement as frequent barriers to stocking the vaccine(Luque et al., 2014), especially in gynecology clinics (Dempsey et al., 2020). Reducing these barriers to stocking the vaccine would facilitate on-site same-day vaccination of OB/GYN patients.

4.1. Strengths and limitations

This study is one of the first to examine OB/GYN recommendations for the HPV vaccine. OB/GYNs are an important group because they often serve as primary care providers (Mazzoni et al., 2017) for adolescents and young adults, and therefore may represent one of the only opportunities for patients in this age group to have the vaccine recommended to them. Other strengths include the examination of multilevel factors associated with vaccination and psychosocial variables including knowledge, attitudes, and beliefs that could influence provider recommendation frequency and strength.

Results of this study should be interpreted in light of some limitations. First, because these data are self-reported they are vulnerable to response, recall, and social desirability biases. We also do not know the response rate of the survey, making it difficult to assess the magnitude of these biases. However, given the anonymous nature of the survey the social desirability bias is minimized. Second, there is the chance for multiple interpretation of survey questions. For example, asking about the recommending practices of other OB/GYNs could be interpreted as 'peers in the entire profession' or 'peers at one's particular clinic' to different respondents. Third, the OB/GYNs surveyed may not be representative of OB/GYNs nationally. Specifically, our sample had more men (55.8% vs. 42.9% nation-wide) and more non-Hispanic White respondents (67.0% vs. 60% nationwide) than the AAMC Diversity in Medicine 2019 report (Association of American Medical Colleges, 2019). Fourth, the analysis focused on eligible patients under 26 years old, meaning that that recommendations for adults and adolescents could differ from the statistics we report. Further, as noted in the methods some factors were collected only for 19–26 year olds. Fifth, the study focuses on provider recommendation of vaccination, but we were not able to determine respondents' actual vaccination rates.

5. Conclusions and future directions

This study provides valuable information about how OB/GYNs recommend HPV vaccination for patients 26 years or younger and has implications for future research. For example, future studies could examine whether strong and frequent recommendations could be increased by informing providers of the vaccination behaviors of their peers, or by informing them of patient interest in the vaccine, especially after their recommendation.

These data add the perspective of OB/GYNs, important stakeholders in the vaccine campaign. Understanding their perspectives on HPV vaccination will be essential to forming robust vaccination programs. Our findings have highlighted their most salient considerations for this group.

CRediT authorship contribution statement

Luke P. Brennan: Conceptualization, Formal analysis, Writing – original draft. **Natalia M. Rodriguez:** Conceptualization, Writing – review & editing. **Katherine J. Head:** Conceptualization, Writing – review & editing. **Gregory D. Zimet:** Supervision, Writing – review & editing. **Monica L. Kasting:** Conceptualization, Investigation, Writing – review & editing, Funding acquisition, Data curation.

Declaration of Competing Interest

Outside of the present work Gregory Zimet has served as an external advisory board member for Merck and Moderna and as a consultant to Merck. In addition, Gregory Zimet, Katharine Head, and Monica Kasting have received investigator-initiated research funding from Merck administered through Indiana University and Purdue University.

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