RESEARCH PAPER

Provider perspectives on multilevel barriers to HPV vaccination

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ABSTRACT

Understanding physician recommendation practices for HPV vaccination is a crucial step to developing interventions that can increase high quality recommendations and improve vaccination acceptance. Florida physicians ($n = 340$) completed a survey assessing recommendation strategies, specifically strength, consistency, and presentation. Physicians were also asked to provide suggestions for improving HPV vaccination in Florida. Responses were dichotomized for each outcome: strength (i.e., strongly recommend vs. other), consistently recommend (i.e., always recommend vs. other), and recommendation presentation (i.e., presented in the same manner as mandatory vaccines for adolescents vs. other). Bivariate logistic regression was conducted to determine the association between physician/practice characteristics and each outcome. Variables significant ($p < .05$) in bivariate analyses were included in multivariable logistic regression analyses. Vaccines for Children (VFC) provider status (OR = 2.62, 95% CI = 1.23–5.59 [strong]; OR = 2.84, 95% CI = 1.26–6.39 [consistent]) and not limiting the number of vaccines during a visit (OR = .283, 95% CI = .111–.722 [strong]; OR = .210, 95% CI = .066–.673 [consistent]) were significantly associated with strong and consistent recommendation. Reminders from the healthcare team were associated with consistency (OR = 2.26, 95% CI = 1.23–4.16) and EMR-based reminders were associated with presentation (OR = 2.00, 95% CI = 1.11–3.61). Multinomial logistic regression analysis examined factors associated with level of engagement in recommendation strategies. Multinomial regression indicated VFC providers (OR = 12.61, 95% CI = 1.89–82.20), and those receiving EMR-based reminders (OR = 4.02, 95% CI = 1.28–12.63), among others, were more likely to engage in all 3 types of recommendation practices. Physician suggestions for improving HPV vaccination rates included improving parent/patient/provider education and reducing vaccine costs. Future interventions should emphasize key components of delivering effective HPV vaccine recommendations, include information about insurance coverage, and improve provider awareness of VFC benefits.

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Introduction

National human papillomavirus (HPV) vaccination rates from 2017 are relatively low, with 53.1% of females ages 13–17 and 44.3% of males ages 13–17 completing the recommended number of doses of the HPV vaccine series.¹ Vaccination rates in Florida are even lower, with only 42.3% of adolescents ages 13–17 completing the series.¹ Professional organizations such as the American College of Obstetricians and Gynecologists (ACOG), the Advisory Committee on Immunization Practices (ACIP), and the American Academy of Pediatrics (AAP), recommend routine HPV vaccination for adolescents ages 11–12^{2–4} however, rates among this age group are suboptimal.^{5–7} In Florida, five vaccines are mandated for school entry, such as Tdap and Hepatitis B, whereas HPV vaccine is not required.⁸ This may play a role in the strength, consistency, and presentation of HPV vaccine in clinical practice. The AAP recommends patients begin the vaccine series at 9–12 years old, at an age that providers feel is appropriate based on their perception of the likelihood of vaccine acceptance and completion.⁹ While HPV vaccination can begin at age 9, best practices support recommendation of HPV

vaccination in conjunction with Tdap and MCV4, which are generally administered at age 11.^{10,11} Thus, understanding physician behaviors and their communication with parents of 11–12 year olds is particularly important, as there are multiple barriers to HPV vaccination at the parent/patient-, provider-, and systems-levels.^{5,12–16}

Healthcare providers believe that parents of age-eligible adolescents demonstrate low knowledge about HPV vaccination and may hold negative attitudes about the vaccine due to misinformation.^{14,17} Similarly, providers may lack the necessary education about the vaccine and effective communication strategies.¹³ They may also be concerned that recommending HPV vaccination too strongly will damage the patient-provider relationship or anticipate that the patient or parent will express hesitancy and will decline the vaccine.¹⁴ Vaccine cost is an additional well-documented barrier at both the parent/patient- and the systems-level.^{18,19} Participation in the Vaccines for Children (VFC) program is often a determinant of whether or not specific financial barriers such as a lack of adequate reimbursement for HPV

vaccination and cost of purchasing the vaccine are experienced by providers. Specifically, VFC providers are less likely to experience these barriers.²⁰ These prior findings suggest that ultimately, participation in the VFC program may mitigate physicians' concerns about the cost of purchasing vaccine stock for their un/underinsured patients, therefore influencing their recommendation practices.²⁰

Physician recommendation has consistently emerged as the strongest predictor of HPV vaccination uptake and completion.²¹ Specifically, family medicine physicians and pediatricians have substantial influence on whether or not an adolescent will receive the HPV vaccine through vaccination education and a strong, consistent, urgent, and timely recommendation.^{15,16,22} Therefore, we examined overall physician engagement in, and factors associated with, recommendation practices. Additionally, given their vital role in vaccination uptake and experience discussing vaccination with adolescents and parents, physicians can provide key suggestions and important insight to increase HPV vaccination rates.^{14,21,23} Thus, we aimed to: 1) examine factors associated with physician engagement in recommendation practices, 2) examine factors associated with physicians' level of engagement in recommendation practices and 3) use qualitative methodology to examine provider-reported suggestions to improve HPV vaccine uptake.

Results

Physician sample

Our physician sample was comprised of pediatricians ($n = 146$, 44.8%) and family medicine physicians ($n = 160$, 49.1%), with a small portion describing a different primary clinical specialty (i.e., internal medicine) ($n = 5$, 1.5%). The average age of physicians was 52 years old ($SD = 8.14$). Males and females were nearly equally represented ($n = 178$, 52.4% & $n = 162$, 47.6%, respectively). Physicians commonly reported a daily load of 20–29 patients ($n = 159$, 46.9%), and the majority represented single specialty practices ($n = 238$, 70.4%). Half of our sample reported that they were a VFC provider and participated in the VFC program ($n = 177$, 51.3%), with the remainder indicating that they did not participate ($n = 145$, 42%) or they 'did not know' ($n = 23$, 6.7%). Table 1 provides a full description of sample characteristics.

Quantitative results

To determine the proportion of physicians that engage in the 3 recommendation practices (e.g., their level of engagement), descriptive statistics were conducted on the 3 recommendation practice variables: recommendation strength, recommendation consistency, and recommendation presentation. Recommendation *strength* is defined as how strongly physicians recommend HPV vaccine (i.e., strongly recommend to all patients ages 11–12, reflecting guidelines for universal vaccination of this age group at the time of the study²), recommendation *consistency* is defined as how consistently physicians recommend the vaccine (i.e., always/almost always:

Table 1. Demographic characteristics of family medicine physicians & pediatricians ($n = 340$).

	n(%) *age reported as mean and range
Age	52.2 (30–81)
Gender	
Male	178 (52.4)
Female	162
Primary clinical specialty	
Pediatrics	160 (47.9)
Family Medicine	148 (44.3)
Other	26 (7.5)
Practice type	
Single specialty	238 (70.4)
Multi-specialty	83 (24.6)
Other	17 (5.0)
Patient load (patients per day)	
Less than 15	29 (8.6)
15–19	74 (21.8)
20–29	159 (46.9)
30 or more	77 (22.7)
VFC provider	
Yes	177 (51.3)
No	145 (42.0)
I don't know	23 (6.7)
Provider race/ethnicity	
White/Caucasian	199 (63.0)
Asian	36 (11.4)
Black/African-American	23 (7.3)
Other	58 (18.4)
Limit # of vaccines (<i>'Do you limit the number of vaccinations for those that are due for multiple vaccinations at a single visit?'</i>)	
Yes	60 (20.3)
No	236 (79.7)
Use of vaccine state registry (<i>'Have you ever tried to use FL SHOTS to get data about HPV vaccination for patients?'</i>)	
Yes	192 (55.2)
No	149 (42.8)
Reminders from the healthcare team	
Yes	135 (38.8)
No	213 (61.2)
Use of EHR/EMR	
Yes	303 (88.3)
No	40 (11.7)
EMR-based reminders	
Yes	122 (35.1)
No	226 (64.9)
Completion of residency training in Florida	
Florida	105 (31.9)
All other regions	224 (68.1)

90–100%, etc.), and recommendation *presentation* is defined as how physicians present the HPV vaccine to patients and parents during the visit (i.e., present it as a routine vaccine along with other adolescent vaccines vs. present it as an optional vaccine, etc.). A third of physicians ($n = 85$, 33.3%) reported they do not engage in any of the three recommendation practices. In addition, a small portion reported engaging in just 1 type ($n = 45$, 17.6%), whereas the remainder of physicians reported engaging in either 2 types ($n = 61$, 23.9%) or all 3 types ($n = 64$, 25.1%) (Figure 1). Chi-square analyses indicated pediatricians reported significantly higher level of engagement in all 3 recommendation strategies as compared to family medicine physicians ($p = .0015$;

Figure 1. Physicians level of engagement in recommendation practices.

Engage in 0 types of recc.
Engage in 1 type of recc.
Engage in 2 types of recc.
Engage in 3 types of recc.

Table 2. Relationship between primary clinical specialty and level of engagement in recommendation practices.

Primary Clinical Specialty	Level of engagement in recommendation strategies			
	Engage in 0 recommendation strategies	Engage in 1 type of recommendation strategy	Engage in 2 types of recommendation strategies	Engage in 3 types of recommendation strategies
Pediatrics	34 (23%) $p = .0005^*$	26 (18%) $p = .9681$	38 (26%) $p = .6100$	48 (33%) $p = .0015^*$
Family Medicine	41 (45%) $p = .0005^*$	16 (18%) $p = .9681$	21 (23%) $p = .6100$	13 (14%) $p = .0015^*$
Total	75 (32%)	42 (18%)	59 (25%)	61 (26%)

*significant at Bonferroni corrected p -value of .006

Table 2), while family medicine physicians were more likely to not report engagement in any recommendation strategy ($p = .0005$, Table 2).

Recommendation strength

In bivariate regression analyses, several provider or practice variables were significantly associated with an increase in recommendation strength including VFC provider status (e.g., those that are VFC providers), primary clinical specialty (e.g., Pediatrics), vaccine characteristics/practices, clinic staff support, use of vaccine registry, and vaccine reminders (see Table 3). In multivariable analyses, VFC provider status (aOR = 2.62, 95% CI 1.23–5.59, $p = .013$) and not limiting the number of vaccines in one visit (aOR = .283, 95% CI .111–.722, $p = .008$) were significantly associated with recommendation strength (Table 3).

Recommendation presentation

Several practice/system and provider characteristics were significantly associated with an increase in presentation of the vaccine as routine in bivariate regression analyses, including VFC provider status, not limiting the number of vaccines during a visit, use of a vaccine state registry, receiving EMR-based reminders, and White provider race/ethnicity (vs. other race/ethnicity) (Table 3). In multivariable analyses, receiving EMR-based reminders was the only variable significantly associated with vaccine presentation (aOR = 2.00, 95% CI 1.11–3.61, $p = .020$) (Table 3).

Recommendation consistency

Six provider and practice/system characteristic variables were significantly associated with consistency of providers' recommendations in bivariate regression analyses: female gender, VFC provider status, not limiting the number of vaccines per visit, use of vaccine state registry, receiving reminders from the healthcare team, and primary clinical specialty (e.g., Pediatricians) were all associated with an increase in recommendation consistency (Table 3). In multivariable analyses, VFC provider status (aOR = 2.84, 95% CI 1.26–6.39, $p = .012$), not limiting the number of vaccines (aOR = .210, 95% CI .066–.673, $p = .009$), and receiving reminders from the health care team (aOR = 2.26, 95% CI: 1.23–4.16, $p = .009$) were all significantly associated with recommendation consistency. As was seen with recommendation strength, VFC providers and those who do not limit the number of vaccines administered during the visit were more likely to report consistently recommending HPV vaccination (Table 3).

Level of engagement in recommendation practices

Physician gender (aOR = 0.310, 95% CI: 0.10–0.95, $p = .040$; ref = male) was the only variable significantly associated with engagement in at least one recommendation practice in multinomial logistic regression. Engagement in at least two recommendation practices was significantly associated with VFC provider status (aOR = 4.11, 95% CI: 1.02–16.64, $p = .047$) and having a patient load of 20–24 patients per day (aOR = 4.79, 95%

Table 3. Factors associated with strong & consistent recommendation and presentation of HPV vaccine to 11–12 year old patients.

	Bivariate OR [95% CI]	Multivariable aOR [95% CI]
Outcome: Recommendation Strength		
VFC provider	4.99 [2.82–8.84]*	2.62 [1.23–5.59]*
Limit # of vaccines	.211 [.098–.457]*	.283 [.111–.722]*
Use of vaccine state registry	2.71 [1.61–4.56]*	1.67 [.861–3.22]
Reminders from the healthcare team	2.81 [1.71–4.63]*	1.59 [.868–2.93]
Primary clinical specialty	2.37 [1.41–3.98]*	.891 [.425–1.87]
Use of EHR/EMR	.966 [.473–1.97]	
EMR-based reminders	1.98 [1.19–3.29]*	1.80 [.953–3.38]
Daily patient load		
Less than 15 patients per day	.368 [.130–1.04]	
15–19 patients per day	.956 [.452–2.02]	
20–24 patients per day	.844 [.436–1.63]	
25–29 patients per day	.607 [.292–1.26]	
30 or more patients	ref	
Provider age		
Age 30–44	1.45 [.745–2.84]	
Age 45–54	1.46 [.842–2.52]	
Age 55+	ref	
Provider gender: Males	.705 [.434–1.14]	
<i>*Females used as reference category</i>		
Provider race/ethnicity		
White/Caucasian	1.56 [.793–3.08]	
Asian	1.08 [.428–2.72]	
Black/African-American	1.29 [.420–3.99]	
Other	ref	
Completion of residency training in Florida	1.25 [.741–2.12]	
Outcome: Recommendation Consistency		
VFC provider	6.85 [3.69–12.71]*	2.84 [1.26–6.39]*
Limit # of vaccines	.124 [.046–.332]*	.210 [.066–.673]*
Use of vaccine state registry	2.52 [1.49–4.27]*	1.09 [.535–2.20]
Reminders from the healthcare team	2.95 [1.79–4.86]*	2.26 [1.23–4.16]*
Primary clinical specialty	3.91 [2.27–6.74]*	1.49 [.707–3.15]
Use of EHR/EMR	.834 [.525–2.22]	
EMR-based reminders	1.50 [.909–2.47]	
Daily patient load		
Less than 15 patients per day	.465 [.172–1.26]	
15–19 patients per day	.611 [.291–1.28]	
20–24 patients per day	.756 [.392–1.46]	
25–29 patients per day	.574 [.278–1.18]	
30 or more patients	ref	
Provider age		
Age 30–44	1.31 [.674–2.54]	
Age 45–54	1.23 [.715–2.13]	
Age 55+	ref	
Provider gender: Males	450 [2.75–735]**	563 [.305–1.04]
<i>*Females used as reference category</i>		
Provider race/ethnicity		
White/Caucasian	1.09 [.550–2.15]	
Asian	.894 [.346–2.31]	
Black/African-American	1.57 [.503–4.91]	
Other	ref	
Completion of residency training in Florida	.847 [.501–1.43]	
Outcome: Presentation of Vaccine		
VFC provider	2.76 [1.52–5.00]*	1.90 [.882–4.07]
Limit # of vaccines	.434 [.196–.962]**	.801 [.305–2.11]
Use of vaccine state registry	2.12 [1.22–3.69]*	1.86 [.941–3.67]
Reminders from the healthcare team	1.54 [.938–2.52]	
Primary clinical specialty	1.47 [.863–2.49]	
Use of EHR/EMR	.743 [.359–1.54]	
EMR-based reminders	1.67 [1.01–2.77]*	2.00 [1.11–3.61]*

(Continued)

Table 3. (Continued).

	Bivariate OR [95% CI]	Multivariable aOR [95% CI]
Daily patient load		
Less than 15 patients per day	.862 [.318–2.34]	
15–19 patients per day	.821 [.384–1.76]	
20–24 patients per day	1.13 [.591–2.17]	
25–29 patients per day	.479 [.218–1.05]	
30 or more patients	ref	
Provider age		
Age 30–44	1.04 [.526–2.06]	
Age 45–54	.932 [.532–1.63]	
Age 55+	ref	
Provider gender: Males	.711 [.433–1.17]	
<i>*Females used as reference category</i>		
Provider race/ethnicity		
White/Caucasian	2.22 [1.05–4.69]*	1.77 [.760–4.14]
Asian	2.55 [.954–6.79]	1.60 [.536–4.76]
Black/African-American	2.40 [.725–7.97]	1.82 [.504–6.56]
Other	ref	ref
Completion of residency training in Florida	.734 [.427–1.26]	

*significant at $p < .05$

CI: 1.18–19.56, $p = .029$). Finally, engagement in all 3 of the practices was significantly associated with VFC provider status (aOR = 12.61, 95% CI: 1.89–82.20, $p = .009$), provider race (specifically identifying as Caucasian/White; aOR = 4.74, 95% CI: 1.05–21.43, $p = .043$; ref = other), and EMR-based reminders (aOR = 4.02, 95% CI: 1.28–12.63, $p = .017$) (Table 4).

Qualitative results

Physician responses to the question: “What are your top 3 suggestions for improving HPV vaccination rates in the United States?” fell into five broad categories: *education, systems-level factors, reminder systems, financial, and vaccine mandate*. 186 physicians (53% of the total sample) responded to the open-ended question prompt. For a full description of broad categories and sub-codes within these categories, see Table 5.

Education

Education was the most common suggestion provided by physicians in our study. Almost half of physicians who responded to this item ($n = 148$) provided suggestions related to education and indicated improvements in adolescent, parent, and provider-level education are necessary to increase adolescent vaccination rates. Of those who provided suggestions related to education, half of physicians ($n = 78$) provided suggestions related to adolescent/parent education. These physicians believed parent/adolescent education should be available as handouts in the waiting room and focus on several key components such as vaccine efficacy, benefits, and side effects. Physicians also felt that HPV-focused advertisements should be included on popular social media sites, television commercials, or magazines specifically targeted towards both parents and/or adolescents. They also emphasized the need for educational tools to be evidence-based.

Table 4. Multinomial factors associated with level of engagement in recommendation strategies.

Outcome: Engagement in all 3 types of recommendation practices (strength, consistency, & presentation of vaccine) <i>*engage in none of these 3 types used as ref. category for multinomial model</i>	Engages in at least 1 type of recommendation practice	Engages in at least 2 types of recommendation practices	Engages in all 3 types of recommendation practices
	Multinomial aOR [95% CI]	Multinomial aOR [95% CI]	Multinomial aOR [95% CI]
VFC Provider	.254 [.061–1.06]	4.11 [1.02–16.64]*	12.61 [1.89–82.20]*
Receiving reminders from the healthcare team to discuss vaccination	1.31 [.389–3.57]	2.66 [.958–7.39]	2.47 [.861–7.08]
Limit number of vaccinations administered during visit	.614 [.144–2.62]	.230 [.039–1.36]	.112 [.010–1.20]
EMR-based reminders for subsequent doses	2.06 [.627–6.79]	1.05 [.350–3.16]	4.02 [1.28–12.63]*
Use of state vaccine registry to obtain data on patient vaccination rates	2.10 [.662–6.63]	2.02 [.710–5.76]	1.97 [.627–6.20]
Primary Clinical Specialty	3.29 [.733–14.74]	.690 [.193–2.47]	1.25 [.292–5.38]
Completion of residency training in Florida	.428 [.130–1.41]	1.02 [.355–2.96]	.703 [.226–2.19]
Use of an EHR/EMR in clinical practice setting	.391 [.086–1.78]	.955 [.192–4.76]	.289 [.063–1.32]
Patient load: # of patients seen daily			
Less than 15 patients per day	3.20 [.364–28.14]	2.04 [.202–20.62]	.906 [.090–9.10]
15–19 patients per day	.514 [.069–3.85]	2.64 [.553–12.59]	.631 [.130–3.07]
20–24 patients per day	2.77 [.610–12.60]	4.79 [1.18–19.56]*	2.22 [.556–8.84]
25–29 patients per day	3.14 [.726–13.62]	2.17 [.518–9.08]	.544 [.122–2.42]
30 or more patients	ref	ref	ref
Provider Age			
Age 30–44	.612 [.131–2.87]	2.91 [.767–11.07]	1.34 [.316–5.65]
Age 45–54	1.02 [.319–3.25]	1.71 [.552–5.30]	1.97 [.636–6.07]
Age 55+	ref	ref	ref
Provider race/ethnicity			
White/Caucasian	1.35 [.330–5.52]	1.83 [.462–7.21]	4.74 [1.05–21.43]*
Asian	.763 [.124–4.69]	.309 [.049–1.96]	1.72 [.261–11.38]
Black/African-American	.414 [.026–6.64]	.260 [.031–2.22]	2.90 [.364–23.14]
Other	ref	ref	ref
Provider Gender: Males *females as ref category	.310 [1.02–.946]**	.393 [.139–1.11]	.511 [.178–1.46]

*significant at $p < .05$

Additionally, of those who provided suggestions related to education, nearly a quarter of physicians ($n = 28$) provided suggestions related to provider education. For provider-focused educational opportunities, participants felt educating the office staff in addition to the primary care provider would be important. They felt the most beneficial education would be through seminars and roundtables and would focus on differences between 4vHPV and 9vHPV, vaccine effectiveness, and communication strategies.

Systems-level practices

Some physicians ($n = 29$) cited system-level practices as ways to increase vaccination rates including vaccine availability, easily integrated reminder systems, and EMR integration with Florida's immunization registry (Florida Shots). Physicians felt the vaccine should be easier to stock and that a better supply of the vaccine should be provided through the VFC program, health departments, or the government. Overall, additional practice level factors mentioned by physicians consisted of: 1) making future appointments for subsequent vaccine doses when patients/parents checkout at the front desk after their appointment, 2) practices conducting a quality review of their immunization rates, and 3) inclusion of HPV as a line item in the EMR system.

Patient & provider reminders

A few physicians ($n = 16$) indicated several different reminder systems should be in place to increase HPV vaccination initiation and completion. Specifically, physicians mentioned provider-focused reminders could be delivered through their

EMR system electronically. Patient/parent reminder systems could be in the form of letters mailed to patients/parents, text message reminders, and/or phone calls to help ensure that patients/parents return for subsequent doses.

Financial aspect

Cost was a common theme identified in physician responses. Physicians ($n = 52$) consistently indicated that the vaccine needs to be less expensive for their practice to purchase and reimbursement needs to improve. Specifically, they expressed the desire for Medicaid to provide better vaccine payment arrangements that would limit the need for their practices to pay for the vaccine up-front. Insurance coverage for patients was mentioned by several physicians as something that needs to improve in order to increase vaccination rates. Overall, physicians mentioned that improvements need to be made with regard to: 1) coverage for 9vHPV vaccine, 2) VFC coverage for patients over 18 who are eligible for HPV vaccination, 3) automatic coverage so that it does not need to be verified, 4) overall insurance acceptance/coverage guarantee, and 5) legislation to compel insurance companies to provide adequate payment for preventive treatment during sick visits.

Vaccine mandate

Several physicians ($n = 39$) indicated it would be important to make HPV vaccine mandatory for school entry, specifically for middle or high school. A smaller number indicated that universities should require all college students to be vaccinated. Physicians noted that many parents only want mandatory shots for their children during visits.

Table 5. Qualitative themes and exemplar quotes.

Question: <i>What are your top 3 suggestions for improving HPV vaccination rates in the United States?</i>		
Most Common Themes	Sub-code & Definition	Exemplar Quotes
Education	Adolescent education	"Education for teens regarding vaccine benefits" "Patient handouts in waiting rooms" "Ads in magazines that parents and teens are reading"
	Parent education	"Improve or create online resources that present accurate information for families who are considering the vaccine." "Educate parents on [HPV vaccine] efficacy and side effects"
	Provider education	"Educate doctors on these 2 factors (I always tell my patients this): -HPV affects 80% of men & women by age 50. - The younger you give it, the more effective it is." "Better – educative seminars/roundtables about HPV4 & HPV9 similarities, differences, coverage, etc."
	Education source/location	"Endorsement of HPV vaccine by school system – even if it's not required for school entry, schools could consider recommending to students to receive it" "Middle school and high school education in health/wellness classes" "More scientific authorities speaking in favor of HPV vaccination on TV/internet"
System-level practices	Availability of the vaccine	"Office doesn't buy vaccine" "Better supply through VFC" "Improved cooperation with offices having vaccine on hand to administer"
	Integration of EMR with FL Shots records	"EMR integration with Florida SHOTS" "FL shots notifying when patient completes series"
Financial aspect	Cost	"Tell Medicaid not to make physicians pay for the shots, a better in arrangements" "Make it cost effective for a small practice." "Patients may or may not get vaccinated due to cost of vaccines is very high insurance reimbursement very low-we refer them to DOH to get or write script" "Decrease cost"
	Reimbursements for the vaccine	"Provide physicians with direct vaccine distribution and better prices (HPV vaccine is costly)" "Reimbursements for practice – low/poor payments for shots" "HPV is expensive – I can't afford to buy them – Also reimbursements are very poor – Also Medicaid doesn't pay us a fair amount."
	Insurance coverage	"Improving automatic coverage so it doesn't need to be verified" "Improved coverage for HPV9" "Expanding VFC coverage for patients over 18 who are eligible for HPV vaccination"
		"Improve insurance payment for preventative services, Legislature help in forcing insurance companies for adequate payment for preventative treatment rendered during sick visits. Why do I have to prove HPV vaccine is medically necessary in case patient is a teenage male?"
Patient & provider reminder systems	Patient/parent reminders	"Reminding via text/email to get complete HPV vaccinations" "Using text prompts to patients as reminders" "Reminder letters"
	Physician reminders	"EMR reminders" "Put in EHR even for sick visits"
Vaccine mandate	Mandate for school entry	"Consider making it mandatory for school entrance (many parents only want mandatory shots)" "Make mandatory for 9th grade and college admission" "Require for 7th grade"

Discussion

Physicians are a critical part of the HPV vaccination process and play a key role in patient and parental decisions about vaccination. In the current study, we aimed to understand physician recommendation practices and their level of engagement in these recommendation practices. We also sought to obtain physicians' suggestions for improving vaccination rates among adolescents in Florida. When examining level of engagement, quantitative results demonstrate that half of physicians in our study did not report engaging in high quality recommendation practices. Qualitative results suggested that physicians felt education related to HPV vaccination and communication for physicians was an important way to improve HPV vaccination rates in Florida. This indicates an important area for improvement because recent research shows engaging in these high quality recommendation practices significantly increases vaccination rates.¹⁶

Consistent with previous research,^{13,14,24,25} education for parents/adolescents and providers was often mentioned by our participants as a necessary step to increase vaccination rates among adolescents. Physicians believed that it would be

important to provide education for adolescents by the school system during health and wellness classes. Previous research has found support for a school-based intervention led by school nurses focused on improving perceived susceptibility and severity of HPV infection and related cancers, HPV vaccination intentions, and overall HPV vaccination uptake among high school students.²⁶ This suggests school system involvement could potentially help improve vaccination perceptions and overall rates. However, it is important to note that a recent review found that educational interventions alone are generally not effective.²⁷ Thus, educational interventions would likely be most effective in the context of multi-level interventions.²⁸

Results of this study found that physicians believe educational media campaigns targeting parents and physicians would help to counter the misinformation about vaccination on social media and would be an important facilitator of HPV vaccination and cancer prevention, which aligns with previous research conducted among a sample of physicians and parents.²⁵ Our participants also felt more educational media campaigns focusing on vaccine efficacy may positively influence parental perceptions and decrease the

amount of time physicians would need to spend during the visit discussing the vaccine and its importance. A common barrier reported by physicians was a lack of time to educate and discuss HPV vaccination with parents/adolescents, which may lead them to recommend HPV vaccine less strongly than other vaccines.^{14,23} While we did not assess physician recommendation practices for other adolescent vaccines in our study, previous research has found that providers believe it takes twice as long to discuss HPV vaccine as compared to other vaccines such as meningococcal and Tdap (tetanus, diphtheria, and acellular pertussis) vaccines. They report recommending these vaccines more often than HPV vaccine because of the time constraints they are faced with in the clinical setting.²³ Thus, media campaigns targeting parents/adolescents could serve to increase awareness, so that the clinical visit is not the first time that parents/adolescents are hearing about the efficacy of HPV vaccination.

Systems-level practices were a common theme that emerged from physicians' suggestions among methods to increase HPV vaccination rates among adolescents. Specifically, vaccine availability, EMR integration with the state vaccination registry, and reminder systems for patients/parents and physicians were consistently mentioned by physicians in our study. Interestingly, this is supported by quantitative results from our study demonstrating that physicians receiving EMR-based reminders were significantly more likely to report routine recommendations for HPV vaccination. Previous research has found support for a comprehensive EMR-linked clinical decision support tool directed at both physicians and patients/parents.²⁹ Specifically, this systems-level intervention included reminders targeted to the patient (e.g., phone calls) and providers (e.g., feedback about clinic rates). This intervention also improved provider recall of discussing and recommending HPV vaccine.²⁹

Financial aspects of HPV vaccination were commonly mentioned. Some physicians mentioned that high up-front cost of vaccine purchase resulted in them referring their patients to the Department of Health (DOH) to receive the vaccine, introducing additional time and barriers to vaccine uptake for the patient. Some also indicated that it is too expensive for their practices to purchase vaccine stock for their office and there is little to no reimbursement or incentives for their practices, which causes physicians to refrain from purchasing an adequate supply of the vaccine. The VFC program allows those physicians who participate to receive vaccine stock free of charge, as compared to non-VFC providers.²⁰ One of the factors consistently associated with each type of recommendation practice (strongly, consistently, recommend as routine) was VFC provider status. These findings align with previous research, which has found that non-VFC providers are more likely to perceive cost-related factors (lack of timely reimbursement for HPV vaccination and cost of stocking the vaccine) as barriers to vaccination uptake.²⁰ This suggests that increased participation in the VFC program may reduce the barrier of vaccine cost for practices, which may in-turn promote strong recommendation practices among physicians and increase vaccination rates.

Physicians indicated that insurance coverage for HPV vaccine should improve. However, there is a disconnect between perceived barriers related to insurance coverage indicated by participants and coverage that insurance companies are required to offer to patients.³⁰ According to the Centers for Disease Control and Prevention (CDC), all insurance marketplace plans and most private insurance plans are required to cover HPV vaccination for individuals ages 9–26.³¹ Additionally, the VFC program provides the vaccine for free to those individuals who: are not insured, have private insurance plans that may not cover the cost, or qualify for Medicaid.³² For those providers who are not VFC providers, they can refer their uninsured patients to the DOH or a federally qualified health center (FQHC) where the patient would be able to receive the vaccine for free.³² However, some physicians indicated that Medicaid will not pay for the vaccine, only a small portion indicated that they refer their patients to the DOH to receive the vaccine, and a large portion of physicians cited insurance coverage improvement as a way to improve HPV vaccine rates. Considering nearly half of our physicians identify as VFC providers and the VFC program provides free vaccines to Medicaid patients and others whose insurance plans may not cover the cost of the vaccine, it appears a possible area for future intervention would be educating providers on insurance coverage for HPV vaccination, VFC program benefits, and potential community resources for uninsured/underinsured individuals.

Vaccine mandate was another common theme identified in physician responses. Currently, Rhode Island, Virginia, and Washington DC are the only locations with vaccine mandates, each of these locations have HPV vaccine initiation rates that are higher than the national average (88.6%, 75.6%, and 91.9%, respectively).¹ There is evidence suggesting parents are supportive of an HPV vaccine mandate if they have positive perceptions of vaccine effectiveness, vaccine benefits, and believe that the vaccine is equally or more important than other recommended vaccines.³³ These findings further support the need for parent education regarding vaccine efficacy and consequences of HPV infection. Similarly, another study by our team focused on key Florida stakeholders (physicians, nurses, DOH professionals, and parents) found that stakeholders believe there is a perception among health care providers that HPV vaccination is less important because it is not a mandatory vaccine for school entry.¹³ Additional research has found parent and physician support for mandatory vaccination.^{34–36}

Our quantitative results indicate that physicians who did not limit the number of vaccines administered during the visit were more likely to recommend HPV vaccine strongly and consistently. This is similar to an approach described in previous research, where physicians deliver their recommendation for HPV vaccine in an “announcement” method and group HPV vaccine recommendation with other vaccines that are recommended for this age group (11–12) such as the Tdap and meningococcal vaccines.³⁷ Physicians in our study who do not limit vaccines administered during a visit are strongly and consistently recommending HPV vaccine and previous research suggests that grouping the HPV vaccine with other recommended vaccines does result in increases in

vaccination initiation among patients ages 11–12. While we did not assess vaccination coverage in our study, this still suggests that not restricting the amount of vaccines administered during a visit may result in increased vaccination acceptance, and ultimately initiation, as patients/parents may view HPV vaccine as a typical vaccination that they should get in addition to Tdap and meningococcal. Since HPV vaccine is approved for children as young as 9 years old,³ perhaps providers who restrict the number of vaccines could be encouraged to suggest the HPV vaccine at age 9 or age 10.

Strengths and limitations

Our study has several strengths, such as a large sample size and statewide representation from multiple both family medicine and pediatric providers, who play an important role in increasing HPV vaccination rates and are well-positioned to provide input on the necessary improvements to several systemic, intra and interpersonal factors. Our recruitment methods were also a strength, as we partnered with the Florida Chapter of the American Academy of Pediatrics (FCAAP) and the Florida Association of Family Medicine Physicians (FAFP) who assisted us with recruiting their member physicians and endorsed our study.³⁸ This, coupled with our repeat mailings, helped increase our response rate. Additionally, obtaining qualitative data on physicians suggestions for improving vaccination rates among adolescents helped us further explore barriers and facilitators of vaccination uptake, which we would not have uncovered otherwise.

While our study has several strengths, there are some limitations. Our sample was restricted to Florida, therefore limiting the generalizability of our findings to other states. Additionally, we only examined responses specifically in regard to the 11–12 year old age group, which may differ from physician recommendation practices for other age-eligible patients. Vaccine recommendation quality was also based on physician self-report, thus it is difficult to determine if recommendation strategies reported are truly being implemented in clinical practice. Moreover, these data are cross-sectional; thus, causal associations cannot be determined. Finally, qualitative data were limited to three bullet point responses regarding physician suggestions for improving HPV vaccination rates and suggestions may have been different if interviews were conducted in order to obtain more in-depth explanations for suggestions. Specifically, in-depth interviews would have allowed us to probe further when physicians provided suggestions for improving rates and would have increased the likelihood that more physicians would respond to this question, therefore allowing us to definitively make connections between physician characteristics (i.e., VFC provider status) and specific suggestions such as improvements to vaccine reimbursement. However, conducting interviews was not feasible given the large sample size for our study.

Conclusions & future directions

Only a quarter of physicians indicate they provide HPV vaccination recommendations that are strong, consistent,

and routine. Key factors associated with engagement in recommendation practices are EMR-based reminders for physicians and VFC provider status, with those providers who identify as VFC providers indicating that they strongly, consistently, and routinely recommend HPV vaccination more as compared to non-VFC providers. Qualitative results indicate that key ways to increase HPV vaccination rates center on: 1) physician and parent/patient education (e.g., media campaigns); 2) system-level practices (e.g., physician reminders); 3) reduced up front cost of vaccine purchase for physicians; 4) improvements to insurance coverage as well as providers' knowledge of insurance coverage of the vaccine; and 5) a school entry vaccine mandate.

Our results suggest that physician participation in vaccine assistance programs such as the VFC program could influence recommendation practices and also reduce physician concerns about the cost for purchasing vaccine stock for their practice. Due to the extensive administrative requirements to becoming a VFC provider, it is possible that the participants in our study who were VFC providers were more committed to vaccination and were therefore more likely to recommend the vaccine. Improvements to systems-level factors such as EMR reminders for physicians and parents/patients may also increase the likelihood that HPV vaccine is discussed and recommended during the visit. Physicians also noted that insurance coverage is inadequate and presents a barrier to administering the vaccine, thus it is important to further understand this disconnect between insurance-related barriers and coverage that insurance companies are actually offering patients. Our results also indicate that improving provider awareness of VFC benefits and insurance coverage and improving parent/patient perceptions about vaccination safety and efficacy may improve HPV vaccination rates. Future directions should include interviewing physicians in order to learn more about their perceptions of ways to improve HPV vaccination rates.

Methods

Detailed recruitment methods have been previously published.^{15,38} Briefly, in 2016, we mailed 770 surveys to Family Medicine physicians and Pediatricians in Florida; 367 surveys were completed and returned to study staff. After accounting for undeliverable ($n = 46$) and duplicate ($n = 16$) surveys, our overall response rate was 48.5% (351/724). Although a web link to our survey online was included in the materials sent to participants, all participants chose to complete the mailed survey. Participants who reported they did not provide care to male or female patients between the ages of 9 and 26 ($n = 8$), who indicated geriatrics as their primary specialty ($n = 2$), and returned the survey after the data collection period ($n = 1$) were excluded, resulting in a final analytic sample size of 340.

Survey items

The survey was adapted from our prior work¹⁵ and assessed physician, general practice, and vaccine-specific characteristics. Physician characteristics assessed included clinical specialty and demographics. General practice characteristics included questions about practice size, geographic location, and patient

population characteristics. Vaccine-specific characteristics consisted of items assessing whether they administered HPV vaccine to male and female patients, Vaccines for Children (VFC) provider status, whether they used reminder prompts for vaccines, and if they had a vaccine coordinator in their practice. Additionally, in order to evaluate recommendation practices, physicians were asked to respond to several survey items which assessed these constructs. Specifically, physicians were asked to indicate the strength of their HPV vaccine recommendation on a 5-point scale (*'strongly recommend,' to 'recommend against'*), consistency with which they recommend the HPV vaccine during the last 12 months on a 5-point scale (*'always recommend' to 'never recommend'*) and the manner in which they present the HPV vaccination (*'recommend as a routine vaccine,' 'present as optional'*) to 11–12 year old males and females. We also assessed physicians' suggestions to improve HPV vaccination rates for Florida adolescents through an open-ended item (e.g., *what are your top 3 suggestions for improving HPV vaccine rates among adolescents in Florida?*).

Data analysis

Quantitative

At the time of our study, the recommended target age group for beginning the HPV vaccine series was adolescents ages 11–12,² thus, analysis was restricted to examine recommendation practices for adolescents within this age group. Responses to recommendation practice items were dichotomized for each outcome: strongly recommend vs. other types of recommendations (i.e., recommend, but not strongly, recommend against), consistently recommend (always/almost always recommend) vs. other types (i.e., almost always, occasionally recommend), and routine presentation vs. other types of presentation (i.e., vaccine is optional). Descriptive statistics were used to compare physicians who engaged in zero, one, two, or three of these recommendation practices. A chi square test of independence was conducted to assess the relationship between primary clinical specialty and level of engagement in recommendation strategies.

Bivariate logistic regression analyses were conducted to determine the association between the demographic characteristics in Table 1 and each outcome of interest: recommendation strength, consistency, and vaccine presentation. A significance level of $p < .05$ was needed to be included in further analyses. Variables that were identified as significant factors in bivariate analyses were included in multivariable logistic regression analyses to further assess the association between physician characteristics and each recommendation strategy. We then conducted a multinomial regression analysis to examine factors associated with physician level of engagement in the three combined recommendation strategies. We defined physician level of engagement as engaging in zero, one, two, or three recommendation strategies.

Qualitative

Physician responses for the top 3 ways to improve adolescent HPV vaccination rates were explored using inductive content analysis. Two research team members (MK & PL) reviewed all physician responses independently, identified common themes, and then met to discuss responses, common themes uncovered, and areas

of disagreement. Through weekly meetings and discussions, a detailed codebook was developed based on emergent themes.

Disclosure of potential conflicts of interest

The authors (PWL, MLK, SMC, and STV) have no conflicts of interest to disclose.

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Abbreviations

HPV	Human papillomavirus
CDC	Centers for Disease Control and Prevention
VFC	Vaccines for Children
DOH	Department of Health
EMR	Electronic medical record
CI	confidence interval
OR	odds ratio
aOR	adjusted odds ratio

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