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Clinician Knowledge, Clinician Barriers, and Perceived Parental Barriers Regarding Human Papillomavirus Vaccination: Association with Initiation and Completion Rates

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CONFLICT OF INTEREST STATEMENT

No conflicts to report.

DISCLOSURES

All authors have approved the final article.

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Abstract

Purpose—We tested the hypothesis that clinician knowledge, clinician barriers, and perceived parental barriers relevant to the human papillomavirus (HPV) vaccination account for the variation in vaccine delivery at the practice-site level.

Methods—We conducted a survey from October 2015 through January 2016 among primary care clinicians (n=280) in a 27-county geographic region to assess clinician knowledge, clinician barriers, and perceived parental barriers regarding HPV vaccination. Primary care clinicians included family medicine physicians, general pediatricians, and family and pediatric nurse-practitioners. We also used the Rochester Epidemiology Project to measure the HPV vaccination delivery. Specifically we used administrative data to measure receipt of at least one valid HPV vaccine dose (initiation) and receipt of three valid HPV vaccine doses (completion) among 9 to 18 year old patients residing in the same 27-county geographic region. We assessed associations of clinician survey data with variation in vaccine delivery at the clinical site using administrative data on patients aged 9 to 18 years (n=68,272).

Results—Consistent with our hypothesis, we found that greater knowledge of HPV and the HPV vaccination was associated with higher rates of HPV vaccination initiation (Incidence rate ratio [IRR]=1.05) and completion of three doses (IRR=1.28). We also found support for the hypothesis that greater perceived parental barriers to the HPV vaccination was associated with lower rates of initiation (IRR=0.94) and completion (IRR=0.90). These IRRs were statistically significant even after adjustment for site-level characteristics including percent white, percent female, percent ages 9–13, and percent with government insurance or self-pay at each site.

Conclusions—Clinician knowledge and their report of the frequency of experiencing parental barriers is associated with HPV vaccine delivery rates—initiation and completion. Higher measures of knowledge correlated with higher rates. Fewer perceived occurrences of parental barriers correlated with lower rates. These data can guide efforts to improve HPV vaccine delivery in clinical settings.

Keywords

Clinician Barriers to Vaccination; HPV vaccination completion; HPV vaccination initiation; Human Papillomavirus Vaccination; Parental Barriers to Vaccination

INTRODUCTION[1]

Each year 38,000 new cases of human papillomavirus (HPV) associated cancers occur in the United States.[1] The Advisory Committee on Immunization Practices (ACIP) published its

[1]Abbreviations: ACIP, Advisory Committee on Immunization Practices; CASE, Corroborate, About Me, Science, Explain/Advise; CI, Confidence Intervals; clinician barriers, clinician perceived barriers to delivering the HPV vaccine; clinician knowledge, clinician knowledge about HPV and the HPV vaccination; completion, receipt of three valid HPV vaccine doses; HPV, Human Papillomavirus; initiation, at least one valid HPV vaccine dose; IRR, Incidence Rate Ratio; perceived parental barriers, parental barriers related to the HPV vaccination; REP, Rochester Epidemiology Project

first HPV vaccine recommendations for routine use in females, 11–12 years of age, in 2007.[2] The most recent survey in the United States shows that in 2015, among females 13–17 years of age, only 62.8% had received the first dose in the 3-dose series and only 41.9% had received three or more doses.[3] The ACIP published its recommendations for universal HPV vaccination of males on December 23, 2011.[4] In 2015, among males 13–17 years of age, only 49.8% had received the first dose and only 28.1% had received three or more doses.[3] Rates of HPV vaccine initiation (receipt of at least one valid dose) and completion (receipt of at least three valid doses) are increasing at a much slower rate than the other recently licensed vaccines for adolescents.

A recent systematic literature review summarized HPV vaccination barriers among health care professionals and parents.[5] Health care professionals often identified parental attitudes and financial concerns as barriers to offering the vaccine. Parental barriers included lack of information, inconsistent use of preventive services, cost, low-perceived risk of HPV infection, and potential impact on sexual behavior.[5] Notably, lack of physician recommendation was frequently cited as a primary barrier.[5] Barriers to vaccination and faltering population coverage, point to the critical need to better understand how to engage clinicians in HPV vaccination efforts. Prior research has identified associations between clinicians' knowledge and attitudes about HPV vaccination and self-reported recommendation of the HPV vaccination.[6, 7] However, to our knowledge, the link between clinician knowledge and attitudes and actual vaccination initiation and completion rates at the practice level has not been assessed.

Study Objectives

We evaluated *clinician knowledge* about HPV and HPV vaccination, *clinician barriers* to delivering the HPV vaccine, and *perceived parental barriers* to HPV vaccination. We tested the hypothesis that greater clinician knowledge would be associated with higher rates of HPV vaccination initiation and completion. We also hypothesized that greater clinician barriers and perceived parental barriers regarding HPV vaccination would be associated with lower vaccination rates.

METHODS

We conducted a survey using a validated instrument among primary care clinicians, including physicians, nurse practitioners, and physician assistants in a 27-county geographic region captured by the Rochester Epidemiology Project (REP) to assess clinician knowledge, clinician barriers, and perceived parental barriers regarding HPV vaccination. The REP research infrastructure links medical records from multiple clinicians to individuals residing in the community, and maintains an electronic index of diagnoses, drug prescriptions, and procedural information from these records, as well as hospitalizations, office visits, and emergency room visits.[8] The REP has captured virtually all health care delivered in Olmsted County, Minnesota since 1966 and was recently expanded to include neighboring counties in southeast Minnesota and western Wisconsin.[9–11] We integrated survey data with clinical data from the REP to evaluate associations between clinician knowledge, clinician barriers, and perceived parental barriers with practice-level estimates of

HPV vaccination. The survey component of the reported research was submitted to the Mayo Clinic IRB and deemed to be exempt. The analysis of existing clinical data through the REP and integration with ACS data was submitted and approved by the Mayo Clinic and Olmsted Medical Center IRBs.

Sample and Data Collection

Survey data—A comprehensive list of primary care clinicians within the clinical practices within our defined geographic catchment region was obtained, including information on clinical specialty, mailing address, and email address. Demographic and professional characteristics of primary care clinicians were summarized in Table 1. Data were collected from October 2015 to January 2016. Two modes of data collection were used including a mailed survey and web-based survey (sent via email) to enable an embedded experiment to compare two mixed-mode designs to two single mode designs with respect to response rate, non-response bias, item non-response, and cost per completed survey. The sample of clinicians was randomized to one of the four experimental arms. Details on the embedded experiment will be published separately.

Electronic data on HPV vaccination—The study cohort was obtained by electronically extracting data for all visits among children ages 9–18 to the participating sites from January 1, 2014 through December 31, 2015. The electronic indices of the REP were searched to identify all HPV vaccinations from 1/1/2009–12/31/2015 given using current procedural terminology codes (90649, 90650, 90651). Patients (n=68,272) were assigned to the site of their visits. For patients who visited more than one site (10,153; 15.0%), assignment was made to the site they visited most often from January 2014 through December 2015. In case of a tie in most frequent use, assignment was made to the site visited most recently. Each of the sites included in our analysis have had the HPV vaccine available since 2006.

Survey Instrument

The Hearing Physicians Views–HPV Immunization National Trends Survey, developed by one of our coauthors (STV), was used with minor modifications to fit our population, location, and purpose. [6][7] Clinicians were asked questions to assess their knowledge of HPV and HPV vaccination (*clinician knowledge*); these items are summarized in Table 2. Clinicians were also asked to rate their own barriers to delivering the HPV vaccine (*clinician barriers*) and to rate the frequency with which they encountered parental barriers to HPV vaccination (*perceived parental barriers*); specific survey items are summarized in Tables 3 and 4, respectively.

Analysis

We examined associations between rates of HPV vaccination initiation and completion at the practice level using administrative data and clinician knowledge, clinician barriers, and perceived parental barriers. For HPV-related knowledge, clinician barriers, and perceived parental barriers, responses for initiation and completion within each item set were aggregated into composite scores. For the clinician knowledge score, correct responses were assigned a value of 1 and incorrect or unsure responses were assigned a value of zero. Responses were then summed across the 11 items with scores ranging from 0–11, higher

scores indicating greater knowledge. For the clinician barriers score, responses on the 1 to 5 scale were rescaled to values of 0 to 4 and summed such that higher scores indicated greater clinician barriers and to anchor the minimum value of the scale at zero. Similarly, for perceived the parental barriers score, responses on the 1 to 5 scale were rescaled to values of 0 to 4 and summed such that higher scores indicated greater parental barriers. Total scores ranged from 0–56 for negative clinician attitudes and 0–44 for perceived parental barriers.

Among the eligible population, we defined initiation as having received a single dose of HPV vaccine and we defined completion as having received three or more doses, where the second dose occurred at least one month after the first dose and the third dose at least six months after the first dose and three months after the second dose. Rates of HPV vaccine initiation and completion from January 1, 2014 through December 31, 2015 were determined for each clinic site. Rates of initiation (per site) were obtained by dividing the number of patients assigned to the site who initiated the HPV vaccination series in 2014–2015 by the number eligible for initiation (number assigned to the site in 2014–2015 minus the number who had initiated or completed the HPV vaccination from 2009 through 2013). Similarly, rates of completion (per site) were obtained by dividing the number of patients assigned to the site who completed the HPV vaccination series in 2014–2015 by the number eligible to complete the series (number assigned to the site in 2014–2015 minus the number who completed the HPV vaccination series from 2009 through 2013). This definition of completion is distinct from the often reported definition used for completion rates, which are calculated as a percentage of those who initiate the vaccine.

Poisson regression models were used to test for associations between average clinician knowledge, clinician barriers, and perceived parental barriers at the clinical practice site with rates of initiation and completion. Specific counts of HPV initiation (or completion) at the site level were modeled as the outcome with the eligible population at each site used as an offset. Additional models adjusted for the percentages of females, whites, those ages 9–13 and those with government or self-pay insurance at each site. Results are presented as incidence rate ratios (IRR) representing the increased rate of initiation or completion of the HPV vaccination series for a one-unit increase in the average score, along with 95% confidence intervals (CIs). Clinician barriers scores and perceived parental barriers scores were modeled to assess the change in initiation and completion rates corresponding to a quartile increase across the score range.

RESULTS

A total of 685 clinicians were sent the survey and 280 returned the survey resulting in an overall response rate of 41.0%. A total of 52 clinical sites were represented. Using administrative data, we assessed whether there were any significant differences between survey responders and non-responders by medical specialty and geographic region. No differences were observed by medical specialty (P=0.3). Response rates were higher in the Rochester area and lower in the southeastern Minnesota region (P=0.003).

Clinician Characteristics

The demographic, occupational, and professional characteristics of the primary care clinicians who completed the survey are summarized in Table 1. The majority of respondents reported their primary clinical specialty in family medicine (67.9 %). Over half were physicians (70.0%) and 26.8% were nurse practitioners or physician assistants.

HPV Vaccination Rates

There were 11,407 patients who initiated the series and 5,267 patients who completed the vaccination series in our time frame. The overall HPV vaccination series initiation rate across sites ranged from 11.7% to 43.0%. The overall completion rate, defined as those residents who received three or more doses of HPV vaccine with appropriate spacing, ranged from 2.4% to 27.0%. Overall, of those who initiated in this time frame, 50.7% were female, the median age was 12 years, 81.6% were White, 5.7% were Hispanic, 2.6% were Black and 1.3% were Asian, and 9.6% used government or self-pay insurance. Similarly for those who completed in this time frame, 53.6% were female, the median age was 13 years, 85.7% were White, 5.0% were Hispanic, 2.1% were Black and 1.0% were Asian, and 7.1 % used government or self-pay insurance.

Clinician Knowledge about HPV and HPV Vaccination

Overall, clinician knowledge about HPV and HPV vaccination was high (Table 2). However, only 82.1% of respondents correctly indicated that “most HPV infections resolve without medical attention.” Over a third of respondents (38.9%) incorrectly agreed that “genital warts are caused by the same HPV types that cause cervical cancer.” Finally, only 81.8% of respondents correctly indicated that “HPV causes head and neck cancer.” The composite clinician knowledge score varied across clinical sites ranging from 4.5 to 11 (mean=9.5).

Clinician Barriers to HPV Vaccination

Clinician barriers to HPV immunization included: HPV vaccination is not required for school attendance (50.4%); adding another vaccine to the vaccine schedule (43.6%); concerns about safety (43.2%); discussing sexuality (41.8%); administering a new vaccine with a limited track record of safety (41.8%); and difficulty ensuring that patients will complete the 3-dose HPV series (41.4%); shown in Table 3. The composite clinician barriers score varied across clinical sites ranging from 5 to 40 (mean=21.7).

Perceived Parental Barriers to HPV Vaccination

Clinicians rated how frequently they encountered certain parental barriers to HPV vaccination (Table 4). Perceived parental barriers included: lack of parent education/ understanding about HPV infection (54.0%); parent requests that HPV vaccination be deferred (49.8%); parent believes child is not at risk for HPV infection (48.6%); parent reluctance to discuss sexuality/sexually transmitted infections (36.1%); and parent believes child is too young for the HPV vaccine (34.7%). The composite perceived patient barriers score varied across clinical sites ranging from 8 to 39 (mean=20.6).

Association of Clinician Knowledge and Barriers with HPV Vaccination

Initiation (adjusted IRR, 95%CI=1.05 (1.03, 2.07)) and completion rates (adjusted IRR, 95% CI=1.28(1.24, 1.32)) increased with increasing clinician knowledge scores and increasing perceived parental barriers (Table 5). Greater clinician barriers were significantly associated with lower HPV vaccination series completion rates; however, this association was no longer significant after adjusting for site-level characteristics (Table 5). Rates of initiation (adjusted IRR, 95% CI=0.94(0.91, 0.98)) and completion (adjusted IRR, 95% CI =0.90(0.86, 0.95)) of the HPV vaccination series decreased with increasing perceived parental barriers (Table 5).

DISCUSSION

Greater clinician knowledge was associated with higher HPV vaccination rates at the site level. Consistent with national surveys using the same validated instrument, [6, 7] we observed generally high levels of clinician knowledge. However, knowledge deficits were observed with regard to whether HPV infections resolve without medical intervention, whether genital warts are caused by the same HPV types that cause cervical cancer, and whether HPV is causal in head and neck cancer. We also observed variation in overall knowledge across the clinical practices. These data suggest a need to intervene in the education of clinicians in regards to HPV infections and vaccination; however, interventions limited to clinician education alone have failed to demonstrate improvements in vaccine delivery.[12] The relationship between clinician knowledge and HPV vaccine delivery is likely to be more complex than directly causal.

Our hypothesis that HPV vaccination rates would be associated with clinician barriers was partially confirmed. The HPV series completion rates were associated with clinician barriers but the association became non-significant after adjusting for site-level patient characteristics. This may indicate that clinician barriers are tied to specific patient populations. That is, in clinical sites where certain subpopulations who may be perceived as experiencing or expressing greater barriers to HPV vaccination, clinicians may more frequently report perceived parental barriers. Commonly identified clinician barriers to vaccination included: concerns about vaccine safety, discussing sexuality/sexually transmitted infections, burden of the three-dose series and adding an additional vaccine to the schedule, and the absence of a requirement of the HPV vaccine for school attendance. In contrast to our findings, the most frequently sited barriers identified in a 2011 administration of this survey among a national sample of primary care physicians were the cost of stocking the vaccine and inadequate insurance coverage or reimbursement.[6] Given that the Affordable Care Act requires health care insurance policies to cover the HPV vaccine without copay, coinsurance, or deductible, it is possible that historically reported concerns related to cost and insurance coverage have improved over time.[15] It is also likely that the practices included in our study had relatively uniform support for how the HPV vaccines are ordered, stocked, and stored; whereas, in the previously surveyed national sample there would have been greater variability.

Perceived parental barriers were associated with HPV vaccination rates at the site level. Perceived parental barriers included reluctance to discuss sexuality/sexually transmitted infections; lack of understanding about HPV infection; vaccine deferral/belief the child is

too young for the HPV vaccine; and the belief that the child is not at risk for HPV infection.[16, 17] The alignment of clinicians' perception of parental barriers with barriers often reported by parents, [5] presents an important opportunity for improving vaccination rates. Specifically, clinician recognition and corroboration of parental barriers to HPV vaccination is a vital first step in addressing vaccine hesitancy. A promising method for addressing vaccine hesitancy, in the clinical setting, is the CASE approach—*corroborate, about me, science, and explain/advise*.[18–20] The CASE approach is grounded in clinician recognition and acknowledgement of patient barriers and concerns as a foundation for corroboration of those concerns (*corroborate*), establishment of the clinician's expertise and professional standing (*about me*), summarization of relevant scientific evidence (*science*), followed by the clinician's statement of a strong recommendation as a conclusion of addressing that parental concern (*explain/advise*).

Strengths and Limitations

A significant strength of our study was our use of population-based clinical billing data to assess actual vaccination rates in the population. Another unique strength of our study was the ascertainment of survey data from nurse practitioners and physician assistants in addition to physicians. Conversations around vaccination often occur with practitioners other than physicians, so it is crucial to understand their knowledge and attitudes, as well as those of physicians. Our study is also distinct from prior research in the inclusion of several non-academic community practice sites, as well as the inclusion of both family medicine and pediatric practices.

One limitation of using clinical data is that patients may have had vaccinations in other locations, which may lead to an underestimate of vaccination rates. However, our population coverage in these counties is quite high, which lends greater confidence that we are capturing most vaccinations. The overall response rate for our survey was relatively low, although consistent with rates reported for other surveys of health professionals.[21] While this does not influence the internal validity of our study, it may limit generalizability of the results. Another potential limitation is that response rates were significantly higher in the Rochester, Minnesota region, compared to the remaining geographic region. Thus, our findings may be more characteristic of the former than the latter. It is also possible that those clinicians who were most in favor of the HPV vaccine may have been more likely to complete the survey. This could introduce bias into our estimates of knowledge and barriers. Another factor, which may limit the generalizability of our findings, is that the majority of our respondents were Family Medicine providers, with relatively fewer Pediatric and Internal Medicine providers.

The cross sectional study design limits the extent to which we can draw conclusions about causal associations between the factors we assessed in our survey and HPV vaccination rates. Additionally, we summed items regarding knowledge, attitudes, and perceived parental barriers weighting each as having equal value. However, certain knowledge deficits such as not knowing the ACIP recommendations or not understanding the link between HPV and cancer are likely to have a greater impact on clinician recommendation than other knowledge deficits, such as lacking awareness that most HPV infections resolve on their

own. Furthermore, with clinician attitudes perceived parental barriers, we assumed the unit-value differences between the five valences. These simple arithmetic assumptions facilitated our analysis, but readers certainly could argue one barrier might carry more weight than another. For example, barriers related to vaccine safety and efficacy, which also reflect a knowledge deficit, may have a greater impact on clinician recommendation than other barriers that are further removed from the clinician experience, such as the upfront cost of purchasing private stock HPV vaccine.

The ACIP recently approved recommendationsfor a 2-dose HPV vaccination series for those 9 through 14 years of age and the 3-dose series for those initiating at older ages. While movement to a 2-dose series will likely improve completion rates among those ages 9 to 14 years, this change may introduce schedule confusion for older adolscents and young adults. Thus, we believe the problems with both initiation and completion, particularly since the second dose as the final dose (given the data) must occur six months or more after the first dose, will still apply.

CONCLUSIONS

Consistent with our hypothesis, we found that greater knowledge of HPV and HPV vaccination was associated with higher rates of HPV vaccination initiation and completion. We also found support for the hypothesis that perceived parental barriers to HPV vaccination are associated with lower vaccination rates. Identification of practice sites with knowledge gaps and corresponding lower rates of vaccination will guide efforts to design interventions that can overcome the knowledge gaps and improve HPV vaccine delivery. Furthermore, understanding frequently encountered negative clinician attitudes and perceived parental barriers provides insight into the factors to be addressed when designing clinician- and parent-directed interventions.

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HIGHLIGHTS

- Clinician knowledge of HPV was high with some gaps in knowledge observed. Greater clinician knowledge and HPV vaccine initiation/completion are associated.
- Clinician barriers to HPV vaccination: safety, discussing sexuality, patient burden.
- Perceived parental barriers and site-level HPV initiation/completion are associated.

Table 1

Demographic, Occupational and Professional Characteristics of Primary Care Clinicians

Characteristics	**N**[1]	**%**
Race/Ethnicity		
White	241	86.1
Non-white	39	13.9
Primary Clinical Specialty		
Pediatrics	44	16.1
Family Medicine	186	67.9
Obstetrics/Gynecology/Other	1	0.4
Primary Care Internal Medicine	39	14.2
Medical Degree		
MBBS/MD/DO	196	70
NP/PA	75	26.8
Other	3	1.1
Board Certification		
Pediatrics	41	14.6
Family Medicine	174	62.1
Internal Medicine	34	12.1
	Median	**Q1, Q3**
Years since Residency	13	3, 24
Age in years	45	35, 56

[1]Total N=280, not all measures sum to 280 due to missing values

Table 2

Clinician Knowledge about HPV and HPV Vaccine[1]

Clinician questions/responses,[2] (T/F)	Correct, %	Incorrect or Unsure, %	Missing, %
Most HPV infections resolve without medical intervention (T)	82.1	16.5	1.4
Treatment of cervical dysplasia/cancer permanently eliminates the causative infection (F)	91.4	7.9	0.7
Genital warts are caused by the same HPV types that cause cervical cancer (F)	60.4	38.9	0.7
Almost all cervical cancers are caused by HPV infection (T)	92.9	6.7	0.4
The ACIP, CDC, ACP, ACOG, AAFP, and AAP recommend the bivalent, quadrivalent, and nonavalent HPV vaccine for all females ages 11 to 26 years with permission to start at 9 to 10 years of age (T)	93.6	6.0	0.4
The ACIP, CDC, ACP, ACOG, AAFP, and AAP recommend the quadrivalent and nonavalent HPV vaccine for all males ages 11 to 21 years with permission to start at 9 to 10 years of age and for males at high risk or seeking immunity 22 to 26 years of age (T)	90.4	8.9	0.7
Females who have been diagnosed with HPV infection should not be given the HPV vaccine (F)	91.4	8.2	0.4
Males who have been diagnosed with HPV infection should not be given the HPV vaccine (F)	90.7	8.9	0.4
HPV causes vulvar, vaginal, and anal cancers in women (T)	91.8	7.8	0.4
HPV causes anal cancers in men (T)	95.4	4.2	0.4
HPV causes head and neck cancers (T)	81.8	17.8	0.4

[1] N=280

[2] Correct response is shown in True/False (T/F)

Abbreviations: AAFP, American Academy of Family Physicians; AAP, American Academy of Pediatrics; ACIP, Advisory Committee on Immunization Practices; ACOG, American Congress of Obstetricians and Gynecologists; ACP, American College of Physicians; CDC, Centers for Disease Control and Prevention; HPV, Human Papillomavirus

Table 3

Clinician Barriers to HPV vaccination (N=280)

How strongly would you agree or disagree that the following are barriers related to immunizing your patients against HPV?	Disagree, %	Neither Disagree/Agree, %	Agree, %	Missing, %
Your concerns about vaccine safety	45.4	10.7	43.2	0.7
Your concerns about vaccine efficacy	63.2	18.9	17.9	0
Discussing sexuality/sexually transmitted infections	42.1	14.6	41.8	1.4
Vaccinated teens practicing riskier sexual behaviors	61.8	18.2	20.0	0
Administering a new vaccine with a limited track record of safety	42.9	15.4	41.8	0
Adding another vaccine to the vaccine schedule	41.8	14.6	43.6	0
Lack of information about the HPV vaccine	58.6	16.4	24.6	0.4
The upfront cost of purchasing private stock HPV vaccine	62.1	26.8	10.4	0.7
The cost of stocking HPV vaccine	67.9	25.4	6.4	0.4
Lack of adequate reimbursement for HPV vaccination	65.0	27.1	7.1	0.7
Failure of some insurance companies to cover the cost of vaccination	51.8	24.3	23.6	0.4
The time it takes to discuss HPV vaccination with patients and/or parents	54.3	16.4	28.9	0.4
Difficulty ensuring that patients will complete the 3-dose HPV vaccination series	38.2	20.0	41.4	0.4
HPV vaccination is not required for school attendance	29.3	20.0	50.4	0.4

Abbreviations: HPV, Human Papillomavirus

Table 4

Perceived Parental Barriers to HPV vaccination.

How often have you experienced the following parental barriers to immunizing 9 to 17 year old patients against HPV?	Occasionally/Never, %	About half time, %	Usually/Always, %	Missing, %
Issues related to vaccine safety	49.8	21.8	23.0	5.4
Issues related to vaccine efficacy	70.7	13.8	10.8	4.6
Parent reluctance to discuss sexuality/sexually transmitted infections	32.6	25.9	36.1	5.4
Parent concern that adolescent will assume that a parent who agrees to HPV vaccination condones premarital sex	47.7	18.0	29.8	4.6
Parent concern that vaccinated child will practice riskier sexual behaviors	49.0	18.4	28.0	4.6
Lack of parent education/understanding about HPV infection	20.5	20.9	54.0	4.6
Parent requests that HPV vaccination be deferred	18.0	27.6	49.8	4.6
Parent believes child is not at risk for HPV infection	28.0	18.4	48.6	5.0
Parent won’t consent to vaccination	42.3	23.9	29.3	4.6
Parent believes child is too young for the HPV vaccine	31.4	29.3	34.7	4.6
Parent concern about negative media reports related to the HPV vaccine	54.0	20.1	20.9	5.0

Abbreviations: HPV, Human Papillomavirus

Table 5

Association of Clinician Knowledge, Clinician Barriers, and Perceived Parental Barriers with HPV Initiation and Completion

	Vaccine Series Initiation		Vaccine Series Completion[1]	
Site-level characteristics	**Unadjusted Model, IRR (95% CI)**	**Adjusted Model[2], IRR (95% CI)**	**Unadjusted Model, IRR (95% CI)**	**Adjusted Model[2], IRR (95% CI)**
Clinician Knowledge[3]	1.03 (1.01, 1.05)	1.05 (1.03, 1.07)[5]	1.24 (1.20, 1.27)	1.28 (1.24, 1.32)[5]
Clinician Barriers[4]	1.01 (0.98, 1.03)	0.99 (0.96, 1.02)	0.93 (0.90, 0.97)	0.97 (0.93, 1.01)
Perceived Parental Barriers[4]	0.93 (0.89, 0.96)	0.94 (0.91, 0.98)[5]	0.79 (0.75, 0.83)	0.90 (0.86, 0.95)[5]

[1] Completion defined as those 9 to 18 year old residents who received 3 or more doses of HPV vaccine where the second dose occurred at least one month after the first dose and the third dose at least 6 months after the first dose and 3 months after the second dose.

[2] Adjusted for percent white, percent female, percent ages 9–13 and percent with government insurance or self-pay at each site.

[3] Poisson regression was used to estimate incident rate ratio per unit change in the measure.

[4] Poisson regression was used to estimate incident rate ratio per quartile increase in the measure.

[5] Represents statistically significant associations that persist after adjustment

Abbreviations: HPV, Human Papillomavirus