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Caregiver and Adolescent Factors Associated with Delayed Completion of the Three-Dose Human Papillomavirus Vaccination Series

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Contributions

LW, STC, JK, CJH, SF and DB participated in study design, study recruitment, acquisition of data, analysis and interpretation of findings, manuscript preparation. RH participated in analysis, interpretation of findings, and manuscript preparation. AB, KE, BP, MJM, and JS participated in acquisition of data, study recruitment, interpretation of findings. All authors participated in the development of the manuscript and approved the final version for journal submission.

Conflict of Interest Statement

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Abstract

Background—Delayed completion of human papillomavirus vaccination (4vHPV) series is common. We sought to identify factors associated with delay.

Methods—This substudy was part of a large prospective, multi-site study recruiting 9-17 year old girls at the time of their third 4vHPV dose to assess immunogenicity associated with prolonged dosing intervals. At participating sites, parents/legal guardians (caregivers) of all enrolled girls (9-17 years old) and enrolled girls aged 14-17 years were approached for participation. Caregivers completed a questionnaire measuring adolescent and caregiver sociodemographic characteristics, caregiver attitudes and beliefs about on-schedule HPV vaccination and HPV vaccine safety, adolescent's health behaviors, barriers to accessing health care, provider office vaccination practices and a Rapid Estimate of Adult Literacy in Medicine (REALM). Participating girls completed a separate questionnaire measuring their attitudes and beliefs about on-schedule HPV vaccination and HPV vaccine safety. Delay was defined as receiving the third 4vHPV dose >12 months after the first. Bivariate, multinomial logistic regression and multivariate logistic regression analyses were used to identify factors predicting delayed completion.

Results—Questionnaires were completed by 482 caregivers and 386 adolescents; 422 caregivers completed a REALM. Delayed 4vHPV dosing occurred in most adolescents (67%). In multivariate analyses, predictors of delayed completion included caregiver demographic factors (self-reported black vs. white race and high school or less education vs. college or more) and an interaction between caregiver's inability to get an immunization appointment as soon as needed and adolescent's type of insurance.

Conclusions—Caregiver's race and educational level, accessibility of immunization appointments, and adolescent's insurance type were found to be related to delays in completion of 4vHPV, but caregiver or adolescent attitudes and beliefs about on-schedule HPV vaccination or HPV vaccine safety were not. Therefore, interventions to improve adherence to recommended vaccination schedules could benefit from a focus on improving access to immunizations.

ClinicalTrials.gov (NCT01030562).

Keywords

Human papillomavirus; Vaccine; Completion; Adherence

1. Introduction

Three human papillomavirus (HPV) vaccines are licensed in the United States (U.S.). A three dose schedule was recommended for all until December 2016 (1). The three dose schedule continues to be recommended for 15 through 26 year olds. However, recipients often do not complete the three dose series according to the recommended intervals. In the

US, the majority of girls completing the series have not received the three vaccinations within 12 months (2-4). Therefore, understanding the reasons for delay in completing the series remains important because effective interventions are needed to increase adherence to all vaccination schedule recommendations, which has the potential to improve disease prevention.

Previous studies have examined factors associated with on-time completion of multi-dose vaccines by adolescents as summarized in a recent meta-analysis (5). Minority racial or ethnic groups and inadequate health insurance coverage were risk factors for low completion while parental healthcare seeking behavior was positively associated with completion, however, many of the earlier studies were conducted at a single site or within only one healthcare system. They did not examine both parental and adolescent contextual and individual characteristics and other health behaviors. Or they did not assess attitudes and beliefs about on-schedule vaccination (5-9). Therefore, the aim of this study was to examine the association between adolescent and parent/legal guardian (henceforth named *caregiver*) factors and delay in completion of the HPV vaccine series by using data collected from adolescents and their caregivers at multiple U.S. study sites.

2. Methods

2.1 Study design and population

As part of a large, prospective, multi-site study (Vaccine, In Press), healthy girls aged 9-17 years were enrolled at the time of their third quadrivalent HPV vaccine (4vHPV) dose to assess immunogenicity associated with nonstandard intervals between doses. For this substudy, caregivers of all enrolled girls (aged 9-17 years) and enrolled girls, aged 14-17 years, were approached for participation in this substudy to assess factors associated with delayed completion. Caregivers participating in the substudy completed a questionnaire and a Rapid Estimate of Adult Literacy in Medicine (REALM). Adolescents participating in this substudy completed a separate questionnaire to assess their own attitudes and beliefs about on-schedule HPV vaccination and HPV vaccine safety. Completion of the adolescent questionnaire was limited to girls 14 years because the adolescent questionnaire was based on items validated among individuals 14 years. Caregiver and adolescent questionnaires had unique items. Caregiver's and adolescent's questionnaires were accepted and included in analyses even if only one person (caregiver or adolescent) participated. Recruitment occurred in eight pediatric, adolescent, and family medicine practices located in Georgia, Missouri, Maryland, Ohio, Pennsylvania, and Tennessee from June 2010 to December 2011. Detailed enrollment criteria can be found on ClinicalTrials.gov (NCT01030562). Each institution's Institutional Review Board approved the study. Incentives were provided to all participants. Adolescents provided assent and parents/legal guardians provided consent.

2.2. Study procedures

Medical records were reviewed for dates of previous HPV immunizations. Adolescents completed a short questionnaire. Caregivers completed a questionnaire with more items than the adolescent questionnaire (described below). Adolescents and caregivers completed

confidential, paper-pencil questionnaires separately. Caregivers completed a Rapid Estimate of Adult Literacy in Medicine (REALM) with trained study staff.

2.3. Measures

The rationale for which measures were chosen was based on a review of the literature for factors previously determined to be associated with vaccine completion, delayed completion of immunization series and adherence to immunization recommendations. We drew on expert opinion when associations between measures and delays in completion had not been previously reported. The Andersen-Aday model of health care utilization served as the conceptual model to inform measurement choices (10-12). A majority of items included on the adolescent and caregiver questionnaire, including scales, were drawn from previous studies and modified to be relevant for HPV vaccination completion (13-23). Site teams and clinical staff reviewed questionnaires for face validity, readability, and understandability. The adolescent and caregiver questionnaires were pilot tested with 20 adolescents and 20 caregivers at two study sites.

The adolescent questionnaire only included items to assess the adolescent's attitudes and beliefs about on-schedule HPV vaccination and HPV vaccine safety at the time of the third dose. The caregiver questionnaire assessed the caregiver's attitudes and beliefs about on-schedule HPV vaccination, HPV vaccine safety, and impact of HPV on their adolescent's behavior (13-15).

Additionally, the caregiver questionnaire included items to assess the adolescent's sociodemographic characteristics (21, 24), educational accommodations (24), household characteristics (22, 24), financial status (21, 24, 25), insurance coverage (24), and health behaviors (19, 24). The caregiver questionnaire assessed the caregiver's report of the adolescent's health status (19), barriers to accessing health care (24), and global assessment of the adolescent's health care (19). It also included items to assess the caregiver's sociodemographic characteristics (21, 24), educational level (24), relationship to the adolescent (22, 24), level of satisfaction with the adolescent's health care provider's communication (19), and experience with office vaccination practices (19). We assessed office vaccination practices at the level of the caregiver, rather than the level of the office in order to assess these practices at the individual, rather than the group, level.

The REALM assessed caregiver health literacy (23). Health literacy was chosen as a measure based on previous work suggesting associations between caregiver health literacy and utilization of children's preventive services (26).

The primary outcome measure was time to completion of three 4vHPV doses, calculated as days between the adolescent's first and third 4vHPV doses. Recommended dosing for all ages during the study was 0, 2, and 6 months (27). Delayed completion was defined as receiving the third dose more than 365 days after initiating 4vHPV (4, 28).

2.4. Statistics

Descriptive statistics were generated for responses to each questionnaire item, and responses were categorized. Cronbach's alpha was used to evaluate the internal consistency and

reliability of scales measuring the following factors: benefits of receiving all three HPV shots on schedule, social norms for on-schedule vaccination, and satisfaction with health care provider's communication. Data from all sites were combined after comparison of type of insurance and caregiver level of education revealed no statistically significant differences between sites.

To assess shifts in overall distributions, data were summarized using scatterplots with LOESS smoothers and box plots using the number of days between the first and third 4vHPV doses as the dependent variable. Single factor multinomial logistic regression models were used to identify factors associated with delayed completion. Delayed completion was categorized into a not-delayed (<12 months between the first and third dose) and three delayed categories: >12-24 months, >24-36 months, and >36 months between the first and third doses. Twelve months was defined as 365 days.

Factors that were significantly associated with delayed completion ($p < .05$ in either the >36-month category or in >1 nonadherence category) in one or more multinomial logistic regression models were considered for inclusion as possible predictor variables in the multivariate logistic regression models. Correlations between possible predictor variables were tested with Pearson correlations. For variables with high correlation with each other (>0.7), one variable was chosen for inclusion in the multivariable model based on clinical relevance. All selected variables and interactions were included in the model. A stepwise selection process was used to identify which variables and interactions remained in the model at the $p = .05$ significance level. A backward selection process was performed to confirm the model selection of predictor variables and interactions.

3. Results

Questionnaire responses from 482 caregivers and 386 adolescents provided information for 549 adolescents (Figure 1). Among these 549 adolescents with responses from a caregiver questionnaire, an adolescent questionnaire, or both, a majority (67%) had delayed completion. Of these, 32% completed the third dose in >12-24 months, 21% completed in >24-36 months, and 14% completed in >36 months.

Characteristics of adolescents, their caregivers, and health care system are described in Table 1. Adolescents had a mean age of 14.6 years, 63.4% had public insurance, and 9.3% experienced a gap in insurance coverage since the first 4vHPV dose. Among caregivers, 54.6% self-reported their race as black and 47.1% reported their level of education as high school or less. Nearly 80% of caregivers had a health literacy equivalent to at least a high school education (Table 1). Nearly one-quarter (23.9%) of caregivers reported that they were unable to get an appointment for an immunization visit as soon as the caregiver thought the adolescent needed the appointment.

Adolescent and caregiver attitudes and beliefs about on-schedule HPV vaccination and HPV vaccine safety are presented in Table 2. Mean scale scores were calculated if scales with Cronbach's alpha were >0.7 . The mean scale score for benefits of receiving HPV vaccination on schedule was 3.8 out of 5 for caregivers and 3.7 out of 5 for adolescents, indicating that

most respondents endorsed the benefits of on-schedule dosing. The majority (79.4%) of caregivers disagreed or strongly disagreed with the statement, “Your daughter may practice riskier sexual behaviors after HPV vaccination because she will feel protected against HPV.” Approximately half (54.7%) agreed or strongly agreed with the statement, “Your daughter may practice safer sexual behaviors after HPV vaccination because she will be better educated about HPV.”

The results of multinomial logistic regression models, that included adolescents with caregiver questionnaires, are shown in Table 3. Neither caregiver nor adolescent attitudes and beliefs about on-schedule HPV vaccination or HPV vaccine safety were associated with delayed completion.

Caregiver and adolescent factors that were significantly associated ($p < .05$) with delayed completion in one or more of the three models are shown in Table 3. Caregiver factors associated with delayed completion included: caregiver’s black race, lower caregiver education (high school education or less vs some college or more), and lower health literacy (equivalent to 7th to 8th grade vs high school or more). Additionally, factors related to accessing care for the adolescent reported by the caregiver that were significantly associated with delayed completion included: not getting an appointment for the adolescent’s immunizations as soon as the caregiver thought it was needed and delays experienced in accessing care for the adolescent during the past 12 months, specifically: inability to get through on the telephone, inability to obtain appointments for adolescent’s medical care quickly enough. Adolescent factors included history of smoking within the last 30 days, public insurance, insurance gap since the first HPV dose, a household member receiving support from food programs, one parent household, and an unmarried parent, and the adolescent having fewer (0-1) primary care health visits in the past 12 months.

In the multinomial regression models, the strength of each factors’ association with delayed completion increased with longer duration from initial vaccine dose to vaccine series completion. That is, the significant odds ratios were highest for the model in which >36 months was the outcome variable and lowest for the model in which >12 to 24 months was the outcome variable.

The initial multivariable logistic regression model included selected predictor variables, shown in Table 3, and used delayed completion (receiving the third dose more than 365 days after initiating 4vHPV) as the outcome variable. This analysis showed persistent significance for lower caregiver education; adolescent with public insurance; caregiver not getting an appointment for immunizations as soon as the caregiver thought it was needed, and, during the past 12 months, inability to obtain an appointment for the adolescent’s medical care quickly enough and the adolescent having fewer primary care health visits. An interaction occurred with stepwise and backward selection between type of insurance (public vs private) and caregiver’s not getting an appointment for immunization as soon as the caregiver thought it was needed. An interaction occurred with stepwise but not backward selection between caregiver level of education and adolescent’s number of primary health visits in the past 12 months.

Because behaviors occurring longer than 12 month ago may be predictive of delayed completion in this study population, a second multivariable logistic regression model set was constructed based on the initial multivariable analysis, excluding predictors that were limited to assessment of behaviors in the last 12 months (number of adolescent's primary care health visits, caregiver ability to obtain appointments for adolescent's medical care quickly enough, ability to get through on the telephone). The model showed that the best predictors of delayed completion were caregiver reported black race (OR, 2.04; 95% confidence interval [CI], 1.19-3.49) and caregiver reported high school education or less (OR, 1.53; 95% CI, 0.90-2.56). An interaction was noted between insurance-type and not getting an appointment for immunizations as soon as the caregiver thought it was needed. Upon further examination, among privately insured adolescents, those whose caregivers reported not being able to get an appointment when needed were approximately nine times more likely to have delayed completion compared to privately insured adolescents whose caregivers could get an appointment when needed (OR 8.77; 95% CI, 3.32-27.67). Among publically insured adolescents, those whose caregivers could not get an appointment when needed were nearly two times more likely to have delayed completion compared to publically insured adolescents whose caregivers could get an appointment when needed (OR 1.83; 95% CI, 0.81-4.58). Among adolescents whose caregiver reported not getting an appointment for immunizations as soon as the caregiver thought it was needed, delayed completion was less likely for publically insured adolescents compared to privately insured adolescents (OR 0.62; 95% CI, 0.17-2.15). Among adolescents whose caregivers reported getting an appointment for immunizations as soon as the caregiver thought it was needed, delayed completion was more likely for publically insured adolescents compared to privately insured adolescents (OR, 2.97; 95% CI, 1.63-5.47).

4. Discussion

In this multi-site study of adolescent girls aged 9-17 years receiving their third 4vHPV dose and their caregivers, we identified factors associated with delayed completion of the vaccine series. We defined delayed completion as receiving the third 4vHPV dose more than 12 months after the first dose. Overall, factors associated with delays included caregiver self-report of black race and caregiver with a high school education or less. Caregiver's reported inability to get an appointment for immunization as soon as the caregiver thought it was needed was associated with delay only if the adolescent had private adolescent insurance.

The majority of adolescents receiving their third 4vHPV dose had delayed completion; more than one-third completed vaccination longer than two years after the first dose. This rate of delayed completion is similar to rates reported in other populations (4, 29, 30). We identified factors associated with delayed vaccination among three groups with different time intervals to delayed vaccine completion (>12-24 months, >24-36 months, >36 months) and found that strength of associations increased with longer time intervals to vaccine completion. The increasing strength with a longer interval supports the validity of these findings. This also suggests adolescents faced similar barriers to completing 4vHPV regardless of whether their third dose was slightly or substantially delayed.

Strengths of this study include that it takes into account both adolescent and caregiver attitudes and beliefs about on-schedule HPV vaccination and vaccine safety, as well as caregiver concerns regarding the impact of HPV vaccination on adolescent behaviors at the time of the third vaccine dose. Our analyses demonstrated that adolescent and caregiver attitudes and beliefs were not associated with delayed completion. A previous study of the three dose hepatitis B vaccination in adults similarly found no association between perceived benefit of vaccination, attitudes towards vaccination and social norms with completion (9, 31).

Based on our study, black race of the caregiver is a predictor of delayed completion. Adolescents whose caregivers self-reported their race as black compared to white were more likely to experience delayed completion. This association remained significant when adjusting for caregiver educational level and adolescent type of insurance, as well as caregiver report of being able to get appointments for immunizations when the caregiver thought they were needed. Unlike previous studies assessing time to completion of HPV vaccines, we chose to use caregiver race, rather than the adolescent's race, as a predictor variable not only because race is a known predictor of access to health care but also because the caregiver, rather than the adolescent, often initiates adolescent health care appointments and must consent for vaccination. Our findings are consistent with the few other studies that have included adolescent race as a risk for nonadherence to on-time completion of HPV (29, 32, 33) and hepatitis B vaccination (34). Our and these other data however contrast with one retrospective study of a single health care system, where black race of the adolescent was not a significant predictor in adjusted analyses of on-time completion. It is important to note however, that analyses in this study were not adjusted for other socioeconomic, educational, or household characteristics or for attitudes or beliefs about the vaccine (3). Given the racial disparities encountered in HPV-related cancers, addressing access to the HPV vaccine for adolescents of black caregivers will be important to realize the vaccine's full benefit.

Regardless of insurance type, adolescents whose caregivers could not get an appointment for immunizations as soon as they thought it was needed were more likely to have delayed completion compared to adolescents whose caregivers could get an appointment. This finding for HPV4 is consistent with longstanding recommendations, including those of the Community Preventive Services Task Force, for immunization delivery programs to increase availability of immunization appointments (35, 36). Additionally, among privately insured adolescents, those not being able to get an appointment for immunizations were nine times more likely to have delayed completion compared to those who could get an appointment. Among publically insured adolescents, those not being able to get an appointment for immunizations were two times more likely to have delayed completion compared to those who could. These findings suggest that improving access to immunizations may be beneficial, especially for privately insured adolescents. Increasing accessibility and ease of obtaining vaccinations may be facilitated by adjusting office systems so that caregivers can obtain appointments more easily and expanding community based vaccination programs (3, 7, 35-37).

Recommendations for administration of the vaccines by the Center for Disease Control and Prevention Advisory Committee on Immunization Practices were recently changed for 9 to

14 year- olds from a three dose (0, 1-2, and 6 months, with a 12-week interval recommended between the second and third dose) to a two dose schedule 6-12 months apart (1). Adoption of the newly approved two-dose schedule for HPV vaccine for 9-14 year olds will hopefully increase the ease of completing the vaccine series, but this remains to be studied (1). We anticipate that similar factors will be related to delays in completion of the two-dose schedule in younger girls, but research is needed to confirm this.

There were several limitations to this study. A selection bias may have occurred since this study required patient enrollment. This study was initiated when HPV vaccination was only recommended for girls, therefore, only girls were enrolled. In addition, we measured factors at the time of the third 4vHPV dose instead of the first dose, there were some factors that we could not measure but may have impacted timing of completion, such as physician recommendation or caregiver and adolescent HPV vaccine knowledge at the time of vaccine initiation (6-8). Although a number of factors were associated with delayed completion in multinomial regression models, many of these were not associated with delayed completion in the adjusted multivariable models. Further research is warranted to determine the role of some of these factors known to be associated with health outcomes, for example, health literacy (38).

Among adolescent girls completing the three-dose 4vHPV schedule in the primary care setting, delays in completion of 4vHPV were associated with caregiver report of black race or high school education or less as well as adolescents type of insurance and their caregiver ability to obtain an immunization appointment for the adolescent as soon as it was needed. Additionally, delays in completion of the 4vHPV were not associated with adolescent or caregiver attitudes and beliefs about on-schedule HPV vaccination and vaccine safety, and caregiver concerns regarding the impact of HPV vaccination on adolescent behavior. Interventions to decrease delays in vaccine series completion aimed at changing individual attitudes about on-schedule vaccination or vaccine safety may not be successful in improving vaccination completion. Our findings support continued recommendations and efforts within health care delivery systems and by public health officials to increase access to and ease of obtaining HPV vaccination.

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Abbreviations

CI	confidence interval
HPV	human papillomavirus
4vHPV	quadrivalent human papillomavirus vaccine
OR	odds ratio
REALM	Rapid Estimate of Adult Literacy in Medicine
U.S.	United States
VTEU	Vaccine and Treatment Evaluation Unit
WIC	The Special Supplemental Nutrition Program for Women, Infants, and Children

Highlights

- Delays in completion of the human papillomavirus vaccine (4vHPV) are commonplace.
- Predictors of delayed completion included caregiver race, level of education, and vaccine access
- Attitudes and beliefs about HPV vaccination were not associated with delayed completion.

Figure 1.
Number of adolescents with information from caregiver questionnaire, adolescent questionnaire, or both.

Table 1

Caregiver, Adolescent, and Health Care System Characteristics

	Mean (SD)	No. (%)
		(N = 482)
Caregiver Characteristics		
Age, y ^a	40.7 (8.1)	
Race ^a		
African American		263 (54.6)
White		198 (41.1)
Other ^b		21 (4.4)
Level of education ^a		
High school or less		227 (47.1)
Some college, technical school, or higher		255 (52.9)
Health literacy grade equivalent (n=422) ^{c,d}		
High school		334 (79.1)
7th to 8th grade		65 (15.4)
6th grade or below		23 (5.5)
Employment status ^a		
Full-time or part-time		278 (57.7)
Unemployed		204 (42.3)
Caregiver relationship to adolescent (n=481) ^{a,d}		
Mother		428 (89.0)
Father		34 (7.1)
Grandparent		6 (1.2)
Legal guardian or other		13 (2.7)
Adolescent Characteristics		
Age, y (n=549) ^e	14.6 (1.7)	
Educational accommodations ^{a,f}		141 (29.3)
Insurance (n=481) ^{a,d}		
Public		305 (63.4)
Private		167 (34.7)
Not insured		9 (1.9)
Amount of vaccination covered by insurance ^a		
All		373 (77.4)

	Mean (SD)	No. (%) (N = 482)
Some		21 (4.4)
None		40 (8.3)
Don't know		48 (10.0)
Gap in insurance since first HPV vaccine dose ^a		45 (9.3)
Delay in vaccine dose due to cost ^a		12 (2.5)
Household member received reduced or free lunches ^a		321 (66.6)
Household member received WIC support ^a		60 (12.4)
Two parents in household ^a		263 (54.6)
Parents married ^a		176 (36.5)
Visits to health care provider's office in the past 12 months, No. (n=480) ^{a,d}		
0		41 (8.5)
1		114 (23.8)
2		127 (26.5)
3		88 (18.3)
4		53 (11.0)
5-9		39 (8.1)
10		18 (3.8)
Health status (n=481) ^{a,d}		
Excellent/very good		396 (82.3)
Good/fair/poor		85 (17.7)
Smoked in past 30 days ^e		28 (5.1)
Health Care System Characteristics		
Practice-based strategies to increase immunizations		
Reminders: No reminders received after 1st HPV shot to return for 2nd or 3rd shots ^a		242 (50.2)
Appointment availability: Not getting an appointment for immunization visit as soon as caregiver thought adolescent needed it ^a		115 (23.9)
Global rating of quality of adolescent health care service (n=479) ^{a,d,g}		
0-6		17 (3.6)
7-10		462 (96.4)
Satisfaction with adolescent health care provider's communication, always/usually (n=482) ^{a,d,h}		
Scale score	3.7 (0.55)	
Explained things in an easy-to-understand way		
For caregiver		325 (88.8)

	Mean (SD)	No. (%) (N = 482)
For adolescent		324 (88.5)
Listened carefully to caregiver		325 (88.8)
Showed respect		330 (90.2)
Spent enough time with adolescent		316 (86.3)
Barriers leading to delay in medical care in past 12 months		
Couldn't get through on the telephone		30 (6.2)
Couldn't obtain an appointment quickly enough		96 (19.9)
Had to wait too long to see the doctor		47 (9.8)
Office wasn't open when adolescent could get there		32 (6.6)
Didn't have transportation		76 (15.8)

Abbreviation: HPV, human papillomavirus; WIC, The Special Supplemental Nutrition Program for Women, Infants, and Children.

^aPer caregiver report.

^bIncludes multiracial, Asian, Native American or Alaska Native, other, and unknown.

^cMeasured using the Rapid Estimate of Health Literacy in Medicine.

^dTotal less than 482 due to missing data.

^ePer adolescent report on case report form.

^fAdolescent with individual educational plan, accommodation, special education, or repeated grade.

^gUsing any number from 0 to 10, where 0 is the worst health care possible and 10 is the best health care possible, what number would you use to rate all of your daughter's health care in the last 12 months?

^hCronbach's alpha = 0.84 using never, sometimes, usually, and always.

Table 2

Adolescent and Caregiver Attitudes and Beliefs about HPV Immunization and On-Schedule HPV Immunization

Measures	Adolescents ^a (n=386)		Caregivers ^b (n=482)	
	Mean SD)	No. (%)	Mean SD)	No. (%)
HPV Immunization				
Perceived impact of HPV immunization on daughter's behavior				
Will practice riskier sex because she will feel protected		NA		n=480 ^c
Strongly agree				13 (2.7)
Agree				27 (5.6)
Neither agree nor disagree				59 (12.3)
Disagree				157 (32.7)
Strongly disagree				224 (46.7)
Will practice safer sex because she is better educated		NA		n=479 ^c
Strongly agree				109 (22.8)
Agree				153 (31.9)
Neither agree nor disagree				143 (29.9)
Disagree				35 (7.3)
Strongly disagree				39 (8.1)
Safety of HPV immunization				
Importance of HPV vaccine safety when deciding to initiate HPV vaccination		n = 385 ^c		n = 480 ^c
Not at all important		5 (1.3)		4 (0.8)
Somewhat important		39 (10.1)		81 (16.9)
Very important		341 (88.6)		395 (82.3)
How safe/unsafe do you think HPV vaccine is today?		N = 385 ^c		n = 480 ^c
Very safe		118 (30.6)		279 (58.1)
Somewhat safe		221 (57.4)		149 (31.0)
Neither safe nor unsafe		39 (10.1)		36 (7.5)
Somewhat unsafe		2 (0.5)		7 (1.5)
Very unsafe		5 (1.3)		9 (1.9)
On-Schedule HPV Immunization				
Benefits of receiving all three HPV shots on schedule, disagree/strongly disagree ^d				
Scale score	3.7 (0.8)		3.8 (0.8)	
Is safer		51 (13.2)		41 (8.5)
Better protects health		42 (10.9)		47 (9.8)
Better protects from cervical cancer		42 (10.9)		39 (8.1)
Better protects from genital warts		51 (13.2)		54 (11.2)

Measures	Adolescents ^a (n=386)		Caregivers ^b (n=482)	
	Mean SD)	No. (%)	Mean SD)	No. (%)
Social norms for on-schedule HPV vaccination, agree/strongly agree ^e				
Scale score	3.8 (0.7)		4.4 (0.7)	
Health care provider		363 (94.0)		449 (93.2)
Most people I know		176 (45.6)		236 (49.0)
My friends		190 (49.2)		226 (46.9)
My parents ^a / Other main caregiver ^b		330 (85.5)		228 (47.3)
My family besides my parents ^a / Other members of daughter's family besides her main caregivers ^b		216 (56.0)		260 (53.9)

Abbreviations: HPV, human papillomavirus; NA, not included on group questionnaire.

^a Assessed with adolescent questionnaire

^b Assessed with caregiver questionnaire

^c Total less than sample size due to missing data.

^d Cronbach's alpha: adolescents = .86, caregivers = .84.

^e Cronbach's alpha: adolescents = .82, caregivers = .81.

Table 3

Results of Unadjusted Multinomial Logistic Regression Models: Variables Associated with Completion of Three Doses in 13-24 months, 25-36 months, and More Than 36 months vs 12 Months or Less.

Measures	>12-24 months vs 12 months		>24-36 months vs 12 months		>36 months vs 12 months		Selected for Multivariable Analysis
	OR	95% CI	OR	95% CI	OR	95% CI	
Caregiver race							Yes
Black vs white	2.2 ^a	1.4-3.6	2.9 ^a	1.7-4.9	6.1 ^a	3.1-13.0	
Other ^b vs white	1.9	0.5-8.0	4.5 ^a	1.3-17.9	7.7 ^a	1.6-36.6	
Caregiver level of education (high school or less vs college or higher)	1.5	0.9-2.4	1.8 ^c	1.1-3.0	2.3 ^a	1.2-4.1	Yes
Caregiver health literacy ^d							Yes
6th Grade or below vs high school	2.7	0.9-10	3.1	0.9-12.0	1.7	0.2-8.8	
7th to 8th Grade vs high school	1.7	0.8-3.7	2.7 ^c	1.3-5.9	2.8 ^c	1.1-6.8	
Adolescent insurance (public vs private)	2.4 ^a	1.5-3.8	2.5 ^a	1.5-4.2	7.1 ^a	3.4-16.3	Yes
Gap in adolescent insurance since first HPV dose (yes vs no)	1.8	0.8-4.4	1.9	0.8-4.9	3.2 ^c	1.2-8.6	Yes
Household member received free lunch (yes vs no)	1.9 ^a	1.2-3.1	3.2 ^a	1.8-5.6	3.2 ^a	1.7-6.6	No
Household member received WIC support (yes vs no)	2.3 ^c	1.0-5.6	3.5 ^a	1.5-8.4	4.4 ^a	1.8-11.2	No
Number of parents in household (one vs two)	1.6 ^c	1.0-2.6	2.3 ^a	1.4-3.8	2.6 ^a	1.4-4.9	Yes
Parents married (unmarried vs married)	1.9 ^a	1.2-3.1	2.8 ^a	1.6-4.8	3.6 ^a	1.9-7.4	Yes
Adolescent visits to health care provider's office in the past 12 months, No.							Yes
0-1 vs >4	2.6 ^c	1.3-5.6	7.0 ^a	2.9-19.2	13.5 ^a	3.6-88.6	
2-4 vs >4	1.3	0.7-2.5	2.2	0.9-5.7	4.8 ^c	1.4-30.9	
Adolescent smoked in past 30 days (yes vs no)	0.4	0.1-1.2	0.2 ^c	0.02-0.7	1.3	0.5-3.3	No

Measures	>12-24 months vs 12 months		>24-36 months vs 12 months		>36 months vs 12 months		Selected for Multivariable Analysis
	OR	95% CI	OR	95% CI	OR	95% CI	
Appointment availability: Caregiver got an appointment for immunization as soon as caregiver thought adolescent needed it (no vs yes)	4.2 ^a	2.3-8.1	4.3 ^a	2.3-8.7	4.2 ^a	2.0-9.1	Yes
Couldn't get through on the telephone in past 12 months (yes vs no)	2.9	1.0-10.8	3.5 ^c	1.1-13.1	4.1 ^c	1.1-16.5	Yes
Couldn't obtain an appointment quickly enough in past 12 months (yes vs no)	1.9 ^c	1.0-3.5	1.9	1.0-3.6	3.3 ^a	1.6-6.7	Yes

Abbreviations: CI, confidence interval; HPV, human papillomavirus; OR, odds ratio (unadjusted); WIC, The Special Supplemental Nutrition Program for Women, Infants, and Children.

^a p<0.01.

^b Includes multiracial, Asian, Native American or Alaska Native, other, and unknown.

^c p >0.01 and <0.05.

^d Measured using the Rapid Estimate of Health Literacy in Medicine.