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Predictors of Human Papillomavirus Vaccine Completion among Low-Income Latina/o Adolescents

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Abstract

Purpose: The purpose of this longitudinal study was to identify individual and interpersonal factors associated with human papillomavirus (HPV) vaccine series completion in a sample of low-income Latina/o adolescent girls and boys.

Methods: Caregiver-adolescent dyads (N=161) were recruited from a rural Federally Qualified Health Center in southwest Florida when the adolescent (aged 11–17) received the first dose of HPV vaccine. Dyads completed a baseline assessment that measured demographic and cultural characteristics, past medical history, provider-patient communication, HPV knowledge, health beliefs about completing the series, and the adolescent's experience receiving the first dose. Using

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Implications and Contribution

Rates of HPV vaccine series completion among U.S. adolescents are unacceptably low. To inform future interventions, this longitudinal study identified key caregiver and adolescent factors associated with series completion among low-income Latina/o adolescents. Findings point to the importance of involving both health care providers and parent-adolescent dyads in intervention efforts.

multivariable logistic regression we identified caregiver and adolescent-related factors associated with series completion (receipt of three doses of HPV vaccine within one year of initiation), as indicated in the adolescent's medical record and state immunization registry.

Results: Within one year of initiation, 57% (n=92) completed the 3-dose series. Missed opportunities for completion were observed for 20% of the sample who returned to the clinic. Caregiver-related predictors of completion included education, self-efficacy to complete the series, and knowledge of the required number of doses. Adolescent-related predictors included age, influenza vaccination within the past two years, having a chronic medical condition, reason for the baseline visit, and receipt of written information about HPV vaccination from a health care provider.

Conclusions: Findings highlight important opportunities for improving completion of the HPV vaccine series among Latina/o adolescents. Intervention efforts should involve health care providers and parent-adolescent dyads and prioritize evidence-based strategies for reducing missed opportunities for series completion.

Keywords

Adolescents; Papillomavirus Vaccines; Hispanic Americans; Vulnerable Populations; Psychosocial Factors

Human papillomavirus (HPV) vaccination is a safe and effective strategy for preventing HPV-related cancers, yet vaccination rates in the United States remain well below target goals [1]. Data from the 2017 National Immunization Survey-Teen indicate that 65.5% of 13–17 year-old adolescents, respectively, have received at least one dose of HPV vaccine [2]. Rates of series completion are even lower with only 53% and 44% of adolescent girls and boys, respectively, meeting criteria for series completion (i.e., three doses per the original guidelines or two doses if the first dose was administered before the child's 15th birthday, per updated guidelines from December 2016) [2, 3]. Of additional concern, recent studies suggest that timely follow-through (i.e., completion of the series within one year of initiation) has declined over time [4]. Identifying factors that facilitate and hinder series completion is critical for the development of effective interventions to increase HPV vaccine completion.

The current study sought to identify predictors of HPV vaccine series completion in a sample of low-income Latina/o adolescents. We focused on this population given the multiple social disadvantages (e.g., poverty, low educational attainment, low healthy literacy, poor access to care) that disproportionately affect Latinos and increase their risk for cancer-related morbidity and mortality [5, 6]. For instance, the incidence of cervical cancer is 40% higher among Latina women compared to White women living in the United States [5]. We conducted a prospective study to identify both modifiable and non-modifiable predictors of series completion. Most previous studies on completion have involved retrospective reviews of electronic medical records or health database claims and focused largely on socio-demographic characteristics and health care utilization [7–11]. While this prior work identifies subgroups that could benefit from targeted interventions, it offers less insight into the content for such interventions. The current study helps fill this gap in the literature.

The purpose of this longitudinal study was to identify factors associated with HPV vaccine series completion among Latina/o adolescents. The study was guided by a multilevel socioecological framework that identifies individual (e.g., psychosocial health beliefs, cultural characteristics), interpersonal (e.g., provider recommendation), organizational (e.g., clinic procedures), and societal factors (e.g., Vaccines for Children program) that can influence HPV vaccination [12]. Our study focused primarily on factors from the first two levels. We used the Theory of Planned Behavior (TPB) [13] and the Health Belief Model (HBM) [14] to identify health beliefs associated with series completion. The TPB proposes that attitudes, subjective norms, and perceived behavioral control inform people's intentions to engage in a health behavior (i.e., complete the vaccine series), which in turn are believed to directly affect behavior. The HBM proposes that people's decisions to engage in health behavior are a function of their perceived susceptibility to and perceived severity of the threat (HPV infection), as well as their self-efficacy and perceived benefits and barriers to engaging in the health behavior. We examined individual- and interpersonal-level factors associated with series completion for both members of the parent-adolescent dyad.

Methods

Participants and Procedure

Caregiver-adolescent dyads were recruited from the pediatrics clinic of a rural Federally Qualified Health Center (FQHC) in southwest Florida when the adolescent received the first dose of HPV vaccine. To be eligible, youth had to receive the first dose of HPV vaccine the day of the baseline assessment, be 11–17 years old, identify as Hispanic or Latina/o, and be able to read or understand English and/or Spanish. The caregiver accompanying the adolescent had to meet these last two aforementioned criteria to be eligible for the study. All study materials were available in English and Spanish and assessments were conducted in participants' preferred language. The baseline assessment took place between July 2014 and May 2016. One year from baseline, we accessed the adolescent's electronic health record (EHR) to determine whether they received additional doses of HPV vaccine. We also consulted the Florida Immunization Registry (Florida SHOTS) to capture any doses received at other clinics in Florida. All youth received the first dose of HPV vaccine before the Advisory Committee on Immunization Practices implemented the change to a 2-dose series [3]; thus series completion was defined as receipt of three doses within one year of initiation. The study was approved by university Institutional Review Boards.

With the assistance of clinic staff, caregiver-adolescent dyads (N=164) were recruited by the bilingual Latina project coordinator. Once the vaccine was ordered, the nurse notified the coordinator of the recruitment opportunity. After introducing the study, the coordinator obtained informed consent and child assent from the caregiver and adolescent, respectively. The coordinator left the exam room during vaccine administration and then returned to conduct the baseline assessment. Caregivers were invited to complete a face-to-face interview. Adolescents could complete an interview or paper-pencil survey; most (97%) chose the survey. The coordinator helped the adolescent begin the survey and then interviewed the caregiver. The coordinator reassured the adolescent that she was available to answer questions and provide assistance if needed. On average, adolescent and caregiver

assessments took about 15 and 30 minutes, respectively, to administer. Dyads unable to complete the assessment that day (n=33) could complete it later via phone or at a location of their choosing. Adolescents and caregivers received a $15 and $25 gift card, respectively, for their participation. Following standard clinical practice, caregivers were asked to schedule an appointment for their daughter/son's second dose of HPV vaccine before leaving the clinic.

Data from three dyads were excluded due to ineligibility (i.e., the adolescent received the second dose of HPV vaccine the day of the baseline assessment). Thus our final sample included 161 caregiver-adolescent dyads. In total, 41 of the 202 potentially eligible dyads declined participation or never responded to the study coordinator's invitation to enroll, corresponding to an 80% enrollment rate.

Measures

Caregiver and adolescent assessments are available in the supplemental material.

Caregiver Assessment.—We assessed caregiver and child demographics, cultural characteristics, past medical history, provider-caregiver communication, HPV knowledge, and health beliefs about their daughter/son completing the HPV vaccine series. Cultural characteristics included country of birth, years in the United States if foreign-born, interview language, acculturation, and migrant farm work. Acculturation was assessed with the 42-item Abbreviated Multidimensional Acculturation Scale [15], which includes two subscales representing acquisition of U.S. culture (U.S. acculturation; Cronbach's alpha α=.96; a measure of internal consistency) and retention of Latina/o culture (Latina/o enculturation; α=.93), respectively. We also assessed history of abnormal Pap test and personal and/or family history of HPV-related disease. Caregivers were asked whether a health care provider instructed them to return their daughter/son to the clinic for additional doses of HPV vaccine.

HPV and HPV vaccine knowledge were assessed with ten and five true/false items, respectively [16]. Composite scores were computed for each knowledge domain by assigning one point for each correct response. Participants who had not heard of HPV or HPV vaccine prior to the baseline visit received a score of zero on the respective composite. Additionally, caregivers were asked how many doses of HPV vaccine they thought their child was supposed to receive. If the caregiver gave a response other than "three doses," the coordinator clarified the correct answer before continuing the interview.

Items assessing TPB and HBM health beliefs were drawn from Mullins and colleagues [17] and adapted to reflect beliefs about series completion. To reduce participant burden, most constructs were assessed with one or two items. Composite scores were computed for multiple-item constructs. TPB constructs included attitudes toward childhood vaccines, attitudes toward series completion, subjective norms, perceived behavioral control, and intentions to complete the series. HBM constructs included perceived susceptibility, perceived severity, self-efficacy to complete the series, and benefits of and barriers to completion. Perceived barriers included time constraints, daughter/son's fear of shots, vaccine safety perceptions, and concerns about sexual disinhibition.

Adolescent Assessment.—We assessed cultural characteristics (interview language, acculturation), HPV knowledge, health beliefs, provider-adolescent communication, and the adolescent's experience receiving the first dose of HPV vaccine. Acculturation was assessed with the 12-item Brief Acculturation Rating Scale for Mexican Americans-II for Children and Adolescents [18], which includes two subscales representing U.S. acculturation (α=.70) and Latina/o enculturation (α=.85), respectively. To assess HPV knowledge, youth were asked whether HPV causes cancer in girls and boys and how many "shots" they thought they were supposed to receive. As with caregivers, the correct number was clarified before completing the remainder of the survey. Adolescents were asked whether they had seen or heard an ad for the HPV vaccine. Similar to caregivers, health beliefs items were drawn from previous research [17]. TPB constructs included subjective norms and intentions to complete the series. HBM constructs included perceived susceptibility, perceived severity, benefits of and barriers to completion.

Youth were asked whether a health care provider talked with them about various topics during the baseline visit (e.g., benefits and side effects of HPV vaccination) and explained what HPV is and how it is spread. Adolescents also reported whether a provider gave them or their caregiver written information about HPV vaccination and told them to return to the clinic for additional doses of HPV vaccine. Finally, youth were asked about anxiety when receiving "shots" and any side effects (i.e., pain, dizziness) experienced after vaccine administration. Provider communication and visit experience items were drawn from previous research [19, 20].

Medical Record Data.—One year from the baseline visit we accessed the adolescent's EHR to assess whether additional doses of HPV vaccine were received and the date(s) of administration. Additional variables drawn from the EHR included: reason for clinic visit at baseline (e.g., well-child visit), additional vaccines administered at baseline, receipt of influenza vaccine in the past two years, vaccine-related adverse events in the past year, diagnosis with a chronic medical condition (e.g., asthma, obesity), clinic visits in the past year, and whether the adolescent's caregiver received a reminder (e.g., magnet, reminder card) at baseline to return for the remaining doses of HPV vaccine.

Statistical Analyses

The primary outcome variable was HPV vaccine series completion defined as receipt of three doses of HPV vaccine within one year of initiation (yes/no). To assess timeliness of HPV vaccination we calculated the interval between each dose. To assess missed opportunities for completion—defined as contact with the clinic that did not result in the adolescent receiving additional doses to complete the series (excluding acute/emergency visits where HPV vaccine may have been contraindicated)—we compared completion rates among adolescents who did vs. did not return to the clinic at least 2 times within the one year follow-up period. We used univariable logistic regression to identify caregiver and adolescent correlates of HPV vaccine completion. All variables associated with completion at $p \leq .10$ were subsequently entered into a multivariable logistic regression analysis. Separate multivariable analyses were conducted for caregiver and adolescent predictors, as

well as a combined multivariable model that included both. Analyses were conducted with SPSS Version 23.

Results

Sample Characteristics

Sample characteristics for caregivers and adolescents are provided in Tables 1 and 2, respectively. Eleven percent of caregivers reported having no formal education. The large majority of caregivers were foreign-born and conducted the baseline assessment in Spanish. Approximately 44% of families had at least one household family member who engaged in migrant farm work. Most youth initiated the series at age 11 years and were accompanied to the clinic by their mother. The majority of adolescents received public insurance and were eligible for free school meals.

Over 90% of adolescents were attending the clinic for a well-child visit when they initiated the series. Youth received an average of three vaccines at baseline, with 61% receiving the adolescent platform. Vaccine-related adverse events documented in the EHR were mild and rare and thus are not discussed further. Over two-thirds of adolescents reported that a provider told them to return for more doses of HPV vaccine, but only 39% reported receiving written information about HPV vaccination from a provider.

HPV Vaccine Series Completion, Timeliness, and Missed Opportunities

Within one year of initiation, 57% (n=92) of adolescents completed the 3-dose series, 26% (n=42) received two doses, and 17% (n=27) received only the initial dose of HPV vaccine. Among completers, the mean interval between doses 1 and 2 was 69 days (SD=18), between doses 2 and 3 was 152 days (SD=52), and between doses 1 and 3 was 221 days (SD=55). All youth met the recommended minimum interval between each dose. Forty-two percent (n=68) of completers received all three doses within seven months of initiation. Eighteen adolescents (11%) never returned to the clinic during the follow-up period. Excluding visits with contraindications, 59% of the sample (n=95) returned to the clinic at least twice within the follow-up period, of whom 80% (n=76 or 47% of the total sample) completed the series. Thus missed opportunities for completion were observed for n=19 adolescents (20% of the subset with ≥2 visits or 12% of the total sample).

Caregiver Predictors of Series Completion

Univariable predictors of completion included caregiver education, knowledge of the correct number of doses required, self-efficacy to complete the series, and intentions to complete the series (Table 1). Relative to adolescents whose caregivers completed some grade school, middle school, and/or high school, the odds of completion were 65% and 72% lower among youth whose caregivers had no formal education or a high school diploma or more education, respectively. The odds of completion were nearly twice as high among adolescents of caregivers who knew (vs. did not know) the correct number of doses. Higher scores on both self-efficacy and intentions to complete the series were associated with greater odds of completion. In the multivariable analysis, caregiver education and self-

efficacy emerged as statistically significant independent predictors, with a marginally significant relationship observed for knowledge of the required number of doses.

Adolescent Predictors of Series Completion

Univariable predictors of completion included age, acculturation, influenza vaccination, having a chronic medical condition, vaccine safety perceptions, pain after the injection, reason for the baseline clinic visit, provider recommendation to return for more doses, and receipt of written information about HPV vaccination (Table 2). The odds of completion were twice as high among youth who initiated the series at age 11 or 12 relative to those who initiated between ages 13–17. Likewise, adolescents who received influenza vaccine in the past two years had twice the odds of completing the series. Adolescents with a chronic condition were less likely to complete the series, as were youth who received the first dose during a well-child visit. We observed a crossover interaction between U.S. acculturation and Latina/o enculturation such that adolescents who scored low on both scales or high on both scales were most likely to complete the series. Youth who perceived HPV vaccination to be safer were more likely to be completers. Adolescents who reported pain after the first dose had over twice the odds of completing the series relative to those who reported no pain. Finally, receiving written information about HPV vaccination and reporting that a provider instructed them to return for more doses were associated with a 145% and 131% increase in the odds of completion, respectively. In the multivariable analysis, age, influenza vaccination, chronic condition, reason for baseline visit, and receipt of written information emerged as statistically significant independent predictors, with marginally significant relationships observed for provider recommendation and acculturation.

Combined Multivariable Model

When caregiver and adolescent univariable predictors were entered simultaneously into a multivariable model, the following statistically significant independent predictors of completion were identified: caregiver education, adolescent age, influenza vaccination, chronic medical condition, and reason for baseline visit (Table 3). Marginally significant relationships were observed for caregiver knowledge of the required number of doses, caregiver self-efficacy, and adolescent report of receiving written information about HPV vaccination.

Discussion

This longitudinal study investigated predictors of HPV vaccine series completion in a sample of low-income Latina/o adolescents. Within one year of initiation, 57% of adolescents completed the 3-dose series, a percentage that is nearly identical to current national rates of series completion among Hispanic adolescents [2]. Missed opportunities for series completion were observed for approximately 20% of the sample with sufficient clinical contact. The study identified several individual and interpersonal-level predictors of HPV vaccine series completion specific to Latina/o caregivers and their adolescent daughters or sons. Findings have important implications for clinical practice and interventions aimed at increasing series completion among low-income Latina/o adolescents.

Results were largely consistent with previous research, although several notable differences and some new findings were observed. Consistent with previous studies, completion was associated with caregiver education, caregiver self-efficacy, knowledge of the required number of doses (caregivers only), provider recommendation to return for additional doses (adolescents only), and the reason for the clinic visit when the first dose was administered [19, 21–25]. Similar to Gold and colleagues [19], we observed lower rates of completion among youth who initiated the series during a well-child visit versus an immunization-only or follow-up visit. Findings for caregiver education mirrored those from Henry and colleagues [23], who observed higher rates of completion among 13–17 year-old boys whose mothers had <12 years of education compared to those whose mothers had a college degree or more. Consistent with previous research demonstrating the importance of provider recommendation for promoting HPV vaccine [26–30], youth who recalled that a provider gave them or their caregiver written information about HPV vaccination were more likely to complete the series. Such information could serve as an extra prompt to complete the series, particularly among patients who do not remember or understand the need to return for additional doses. Similar to a study of adolescents from rural-frontier states [31], we observed higher rates of completion among youth who received an influenza vaccine within the past two years. This finding could reflect the generally positive attitudes toward childhood vaccination held among Latina/o families [32, 33] and/or more frequent clinic visits, which would provide greater opportunities for completion [10].

Contrary to previous findings [23, 31, 34], we observed higher rates of completion among 11–12 year-olds relative to 13–17 year-olds. Higher completion rates in younger vs. older adolescents could reflect recent campaigns emphasizing the importance of series completion prior to age 13 [35, 36]. We also found that adolescents with a chronic medical condition were less likely to complete the series. Although such youth may require more frequent clinic visits for disease management, lower completion rates in this subgroup could reflect larger complexities faced by low-income families around managing their child's chronic condition(s). Finally, although caregiver acculturation was not directly associated with completion, it is possible that it affected series completion indirectly via parents' knowledge or health beliefs.

This work has important implications for clinical practice as well as interventions promoting HPV vaccine series completion among Latina/o adolescents. Findings underscore the central role of health care providers in encouraging completion. In addition to making strong recommendations for initiation [27–30], it is vital that providers clarify the number and timing of additional doses and convey the importance of completing the series. Furthermore, findings suggest that such communications should be directed at both parents and adolescents and be supplemented with written information. Ideally, any such information should be tailored to patients' reading level and preferred language. Findings also highlight the importance of involving parent-adolescent dyads in HPV vaccination intervention efforts. Such interventions should focus on enhancing parents' self-efficacy to complete the series, promoting collaborative patient-provider communication [30], and reducing missed opportunities for series completion. Evidence-based strategies for improving completion include asking parents to schedule the next appointment before leaving the clinic, using automated reminder/recall systems with parents and providers, conducting provider training,

and offering immunization-only visits [37–40]. Finally, we observed lower rates of completion among Latina/o adolescents with a chronic medical condition, youth who initiated the series after age 12, and adolescents who received the first dose during a well-child visit, suggesting these subgroups may need additional attention to ensure series completion.

The current findings and their generalizability should be considered in light of study strengths and limitations. Strengths include its longitudinal design, assessment of parent-adolescent dyads, emphasis on potentially modifiable predictors (e.g., health beliefs), and focus on an underserved rural Latina/o population. Limitations include the relatively small sample, potentially incomplete data in adolescents' medical records, and the possibility that participating in the baseline assessment affected completion rates. Although migrant farmworker status did not predict completion, over 40% of families engaged in migrant farm work; thus it is possible that adolescents moved out of state or completed the series elsewhere. Further, this study was primarily limited to individual and interpersonal predictors of completion. Identifying organizational and societal factors that influence series completion should be a priority for future research. With respect to generalizability, we suspect the current findings would generalize most straightforwardly to other low-income and immigrant groups receiving care in FQHCs across the country, although more research is needed.

Conclusions

Rates of HPV vaccine series completion among U.S. adolescents continue to lag well below target levels. Findings from the present study highlight important opportunities for increasing series completion among Latina/o adolescents. Future interventions should reduce missed opportunities for series completion and engage providers, parents, and adolescents in intervention efforts. Ultimately, increasing rates of series completion could serve to reduce disparities in HPV-related cancers.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Abbreviations:

HPV	Human Papillomavirus

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Table 1.

Caregiver Variables: Descriptive Statistics (Overall and by Completion Status) and Results from Univariable and Multivariable Logistic Regression Analyses

	N (%)	No. completers/Total No. in category (%)		Univariable Analysis OR (95% CI)	Multivariable Analysis[a] OR (95% CI)
	Mean (SD)	Non-completers Mean (SD) n = 92	Completers Mean (SD) n = 69		
Demographics					
Age in years	37.84 (6.33)	37.44 (6.67)	38.14 (6.09)	1.02 (0.97, 1.07)	
Race[b]					
Other or unknown	131 (81)	75/131 (57)		REF	
White	30 (19)	17/30 (57)		0.98 (0.44, 2.18)	
Education					
Grades 1–12[c]	118 (74)	76/118 (64)		REF	REF
No formal education	18 (11)	7/18 (39)		0.35 (0.13, 0.98) *	0.58 (0.17, 1.87)
High school grad or more	24 (15)	8/24 (33)		0.28 (0.11, 0.70) *	0.18 (0.07, 0.48) *
Gender					
Male	4 (3)	2/4 (50)		REF	
Female	157 (98)	90/157 (57)		1.34 (0.18, 9.78)	
Daughter/son eligible for free meals[d]					
No	2 (1)	1/2 (50)		REF	
Yes	139 (99)	79/139 (57)		1.32 (0.08, 21.48)	
Relationship status					
Married	79 (49)	45/79 (57)		REF	
Living with partner	49 (30)	29/49 (59)		1.10 (0.53, 2.26)	
Divorced	10 (6)	6/10 (60)		1.13 (0.30, 4.33)	
Single	23 (14)	12/23 (52)		0.82 (0.33, 2.09)	
Daughter/son's mother					
No	7 (4)	2/7 (29)		REF	
Yes	154 (96)	90/154 (58)		3.52 (0.66, 18.69)	

	N (%)	No. completers/Total No. in category (%)		Univariable Analysis OR (95% CI)	Multivariable Analysis[a] OR (95% CI)
	Mean (SD)	Non-completers Mean (SD) n = 92	Completers Mean (SD) n = 69		
Health insurance					
None	124 (78)	71/124 (57)		REF	
Private	18 (11)	9/18 (50)		0.75 (0.28, 2.01)	
Public	17 (11)	10/17 (59)		1.07 (0.38, 2.99)	
Cultural Characteristics					
Born in U.S.					
No	136 (85)	79/136 (58)		REF	
Yes	25 (16)	13/25 (52)		0.78 (0.33, 1.84)	
Region of birth					
United States	25 (16)	13/25 (52)		REF	
Mexico	96 (61)	56/96 (58)		1.29 (0.53, 3.13)	
Central America	37 (23)	21/37 (57)		1.21 (0.44, 3.36)	
Years in U.S.[e]					
5–15 years	68 (50)	39/68 (57)		REF	
16–25 years	50 (37)	30/50 (60)		1.12 (0.53, 2.34)	
>25 years	18 (13)	10/18 (56)		0.93 (0.33, 2.65)	
Interview language					
Spanish	128 (80)	76/128 (59)		REF	
English or combination	33 (21)	16/33 (49)		0.64 (0.30, 1.39)	
Acculturation[f]					
U.S. acculturation	2.31 (0.75)	2.39 (0.77)	2.24 (0.74)	0.86 (0.54, 1.36)	
Latina/o acculturation	3.20 (0.46)	3.19 (0.50)	3.21 (0.43)	1.03 (0.49, 2.18)	
Interaction term	--	--	--	0.98 (0.36, 2.64)	
Migrant farm work					
Entire family	37 (23)	20/37 (54)	REF		
Parent/other member	34 (21)	19/34 (56)	1.08 (0.42, 2.75)		
No one in family	88 (55)	51/88 (58)	1.17 (0.54, 2.54)		
Past Medical History					

	N (%)	No. completers/Total No. in category (%)		Univariable Analysis OR (95% CI)	Multivariable Analysis[a] OR (95% CI)
	Mean (SD)	Non-completers Mean (SD) n = 92	Completers Mean (SD) n = 69		
Abnormal Pap smear[g]					
No or don't know	93 (59)	54/93 (58)		REF	
Yes	64 (41)	36/64 (56)		0.93 (0.49, 1.77)	
Personal/family history HPV-related disease					
No or don't know	136 (86)	80/136 (59)		REF	
Yes	23 (15)	10/23 (44)		0.54 (0.22, 1.31)	
HPV Knowledge					
Knowledge # doses required					
Incorrect or don't know	76 (47)	37/76 (49)		REF	REF
Correct (3 doses)	85 (53)	55/85 (65)		1.93 (1.03, 3.64) *	2.04 (0.97, 4.28) +
HPV knowledge[h]	3.57 (3.20)	3.74 (3.22)	3.43 (3.20)	0.97 (0.88, 1.07)	
HPV vaccine knowledge[i]	1.44 (1.76)	1.29 (1.68)	1.55 (1.82)	1.09 (0.91, 1.31)	
Health Beliefs					
HBM Health Beliefs[j]					
Benefits	3.68 (0.50)	3.63 (0.50)	3.71 (0.50)	1.34 (0.72, 2.52)	
Time barrier	1.68 (0.76)	1.75 (0.77)	1.63 (0.75)	0.80 (0.53, 1.21)	
Sex disinhibition barrier	1.74 (1.05)	1.83 (1.16)	1.67 (0.95)	0.86 (0.62, 1.20)	
Daughter/son afraid of shots	2.53 (1.05)	2.54 (1.05)	2.52 (1.07)	0.98 (0.72, 1.32)	
Vaccine safety	3.78 (0.38)	3.76 (0.39)	3.79 (0.37)	1.19 (0.51, 2.80)	
Perceived severity	3.47 (0.85)	3.51 (0.83)	3.43 (0.87)	0.89 (0.61, 1.30)	
Perceived susceptibility	3.15 (0.89)	3.18 (0.89)	3.14 (0.89)	0.95 (0.65, 1.39)	
Self-efficacy to complete	3.78 (0.46)	3.68 (0.58)	3.86 (0.33)	2.47 (1.15, 5.32) *	2.50 (1.03, 6.06) *
TPB Health Beliefs[j]					
Attitudes toward vaccines	3.85 (0.51)	3.81 (0.53)	3.89 (0.49)	1.37 (0.72, 2.61)	
Attitudes toward completion	3.69 (0.48)	3.73 (0.45)	3.67 (0.50)	0.76 (0.39, 1.50)	

	N (%)	No. completers/Total No. in category (%)		Univariable Analysis OR (95% CI)	Multivariable Analysis[a] OR (95% CI)
	Mean (SD)	Non-completers Mean (SD) n = 92	Completers Mean (SD) n = 69		
Subjective norms	12.47 (3.20)	12.25 (3.21)	12.63 (3.19)	1.04 (0.94, 1.15)	
PBC	3.91 (0.29)	3.88 (0.32)	3.92 (0.27)	1.57 (0.54, 4.57)	
Intentions to complete	3.86 (0.37)	3.78 (0.45)	3.92 (0.27)	3.05 (1.19, 7.81) *	1.61 (0.52, 4.99)
Provider Communication					
Provider told CG to return[k]					
No	32 (20)	16/32 (50)		REF	
Yes	129 (80)	76/129 (59)		1.43 (0.66, 3.12)	
Reminder given to CG[l]					
No	7 (5)	4/7 (57)		REF	
Yes	150 (96)	86/150 (57)		1.01 (0.22, 4.66)	

Note. REF = Reference category in logistic regression analysis. OR = odds ratio. CI = confidence interval. HBM = Health Belief Model. TPB = Theory of Planned Behavior. PBC = Perceived behavioral control. CG = caregiver.

[a]Variables associated with completion at the univariable level ($p \leq .10$) were entered simultaneously into a multivariable analysis.

[b]Most participants described their race as “Hispanic” or “Latina/o”; such responses were coded as “unknown.”

[c]Completed some grade school, middle school, and/or high school.

[d]20 participants are missing a response to this question because it was added to the interview after data collection had already begun.

[e]Limited to foreign-born caregivers (n=136)

[f]Scores could range from 1.0 to 4.0, with higher numbers signifying greater orientation toward the respective culture.

[g]Not applicable to male caregivers (n=4).

[h]Scores ranged from 0 to 9 with higher scores representing greater knowledge about HPV infection.

[i]Scores ranged from 0 to 5 with higher scores representing greater knowledge about HPV vaccination.

[j]Scores on all health beliefs except subjective norms ranged from 1–4 with higher values indicating more endorsement. Subjective norms was computed by taking the product of multiple items and thus could range from 1–16.

[k]Self-reported by the caregiver.

[1] Indicates whether caregiver received some kind of reminder to return for the remaining doses (e.g., magnet, reminder card), as recorded in the adolescent's medical record.

[*] $p \leq .05$;

[+] $p \leq .10$.

Table 2.

Adolescent Variables: Descriptive Statistics (Overall and by Completion Status) and Results from Univariable and Multivariable Logistic Regression Analyses

	N (%) Mean (SD)	No. completers/Total No. in category (%) Non-completers Mean (SD) n = 92	Completers Mean (SD) n = 69	Univariable Analysis OR (95% CI)	Multivariable Analysis[a] OR (95% CI)
Demographics[b]					
Age of youth at first dose					
13–17 years	29(18)	12/29 (41)		REF	REF
11 or 12 years	132 (82)	80/132 (61)		2.18 (0.96, 4.94)[+]	3.41 (1.12, 10.39)[*]
Gender					
Male	86 (53)	50/86 (58)		REF	
Female	75 (47)	42/75 (56)		0.92 (0.49, 1.71)	
Race[c]					
Other or unknown	134 (83)	76/134 (57)		REF	
White	27(17)	16/27 (59)		1.11 (0.48, 2.57)	
Health insurance					
None	10 (6)	5/10 (50)		REF	
Private	5 (3)	2/5 (40)		0.67 (0.08, 5.88)	
Public	145 (91)	85/145 (59)		1.42 (0.39, 5.11)	
Cultural Characteristics					
Born in US[b]					
No	5 (3)	2/5 (40)		REF	
Yes	156 (97)	90/156 (58)		2.05 (0.33, 12.59)	
Interview language					
Spanish	3 (2)	1/3 (33)		REF	
English or combination	158 (98)	91/158 (58)		2.72 (0.24, 30.58)	
Acculturation[d]					
U.S. acculturation	4.28 (0.62)	4.20 (0.68)	4.34 (0.57)	1.61 (0.93, 2.79)[+]	1.88 (0.97, 3.63)[+]

	N (%)	No. completers/Total No. in category (%)		Univariable Analysis OR (95% CI)	Multivariable Analysis[a] OR (95% CI)
	Mean (SD)	Non-completers Mean (SD) n = 92	Completers Mean (SD) n = 69		
Latina/o acculturation	2.97 (0.97)	2.87 (0.97)	3.04 (0.97)	1.19 (0.84, 1.69)	0.99 (0.65, 1.51)
Interaction term	--	--	--	2.18 (1.15, 4.11)*	1.67 (0.82, 3.39)
Past Medical History					
Received influenza vaccine[e]					
No	51 (32)	23/51 (45)		REF	REF
Yes	110 (68)	69/110 (63)		2.05 (1.05, 4.02)*	2.87 (1.17, 7.08)*
Has chronic condition[f]					
No	87 (54)	58/87 (67)		REF	REF
Yes	74 (46)	34/74 (46)		0.43 (0.22, 0.81)*	0.32 (0.15,0.70)*
HPV Knowledge					
HPV causes cancer in girls?					
No or Don't know	131 (81)	75/131 (57)		REF	
Yes	30 (19)	17/30 (57)		0.98 (0.44, 2.18)	
HPV causes cancer in boys?					
No or don't know	138 (86)	81/138 (59)		REF	
Yes	23(14)	11/23 (48)		0.65 (0.27, 1.56)	
How many shots needed?					
Incorrect or don't know	113 (71)	67/113 (59)		REF	
Correct (3 shots)	47 (29)	25/47 (53)		0.78 (0.39, 1.55)	
Seen ad for HPV vaccine					
No or don't know	140 (87)	81/140 (58)		REF	
Yes	21 (13)	11/21 (52)		0.80 (0.32, 2.01)	
Health Beliefs					
HBM Health Beliefs[g]					
Benefits	3.49 (0.67)	3.45 (0.69)	3.52 (0.66)	1.15 (0.72, 1.84)	
Time barrier	2.09 (0.79)	2.17 (0.77)	2.03 (0.80)	0.80 (0.53, 1.20)	
Afraid of shots	2.52 (0.97)	2.52 (0.97)	2.62 (1.01)	1.11 (0.81, 1.52)	

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	N (%)	No. completers/Total No. in category (%)		Univariable Analysis OR (95% CI)	Multivariable Analysis[a] OR (95% CI)
	Mean (SD)	Non-completers Mean (SD) n = 92	Completers Mean (SD) n = 69		
Vaccine safety	3.33 (0.74)	3.16 (0.81)	3.45 (0.65)	1.71 (1.09, 2.68) *	1.49 (0.85. 2.62)
Perceived severity	2.69 (1.01)	2.70 (1.01)	2.69 (1.02)	0.99 (0.72, 1.35)	
Perceived susceptibility	2.65 (0.88)	2.76 (0.83)	2.58 (0.90)	0.79 (0.54, 1.14)	
TPB Health Beliefs[g]					
Subjective norms	12.15 (3.41)	12.03 (3.53)	12.22 (3.34)	1.02 (0.92, 1.12)	
Intentions to complete	3.36 (0.90)	3.32 (0.98)	3.39 (0.83)	1.09 (0.76, 1.54)	
Experience Factors					
Gets nervous before shots					
No	65 (41)	35/65 (54)		REF	
Yes	95 (59)	57/95 (60)		1.29 (0.68, 2.43)	
Degree of nervousness today					
Not at all	30 (19)	17/30 (57)		REF	
A little	99 (62)	55/99 (56)		0.92 (0.42, 2.18)	
A lot	32 (20)	20/32 (63)		1.28 (0.46, 3.52)	
Experienced pain					
No	14 (9)	5/14 (36)		REF	REF
Yes	147 (91)	87/147 (59)		2.61 (0.83, 8.17) +	1.45 (0.33, 6.32)
Experienced dizziness					
No	145 (90)	84/145 (58)		REF	
Yes	16 (10)	8/16 (50)		0.73 (0.26, 2.04)	
Number of shots received[h]	3.23 (0.80)	3.16 (0.76)	3.28 (0.83)	1.21 (0.82, 1.80)	
Received adolescent platform[i]					
No	50 (31)	24/50 (48)		REF	
Yes	111 (69)	68/111 (61)		1.71 (0.87, 3.36)	
Well-child visit at baseline[j]					
No	15 (9)	12/15 (80)		REF	REF
Yes	146 (91)	80/146 (55)		0.30 (0.08, 1.12) +	0.15 (0.03, 0.88) *

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	N (%)	No. completers/Total No. in category (%)		Univariable Analysis OR (95% CI)	Multivariable Analysis[a] OR (95% CI)
	Mean (SD)	Non-completers Mean (SD) n = 92	Completers Mean (SD) n = 69		
Year dose 1 administered					
2014	35 (22)	17/35 (49)		REF	
2015	85 (53)	48/85 (57)		1.37 (0.62, 3.03)	
2016	41 (26)	27/41 (66)		2.04 (0.81, 5.15)	
Provider Communication[k]					
Provider told youth to return					
No or don't know	54 (34)	23/54 (43)		REF	REF
Yes	107(67)	69/107 (65)		2.45 (1.25, 4.78)*	2.26 (0.98, 5.24)+
Provider gave written info					
No or don't know	99 (62)	49/99 (50)		REF	REF
Yes	62 (39)	43/62 (69)		2.31 (1.18, 4.51)*	2.83 (1.17, 6.81)*
Provider talked about:					
HPV infection					
No or don't know	101 (63)	54/101 (54)		REF	
Yes	60 (37)	38/60 (63)		1.50 (0.78, 2.89)	
Benefits of HPV vaccine					
No or don't know	115 (71)	64/115 (56)		REF	
Yes	46 (29)	28/46 (61)		1.24 (0.62, 2.49)	
Side effects of HPV vaccine					
No or don't know	121 (75)	69/121 (57)		REF	
Yes	40 (25)	23/40 (58)		1.02 (0.50, 2.10)	
Cervical cancer					
No or don't know	143 (89)	84/143 (59)		REF	
Yes	18 (11)	8/18 (44)		0.56 (0.21, 1.51)	
Genital warts					
No or don't know	148 (92)	87/148 (59)		REF	
Yes	13 (8)	5/13 (39)		0.44 (0.14, 1.40)	
Provider explained what HPV is					

	N (%) Mean (SD)	No. completers/Total No. in category (%) Non-completers Mean (SD) n = 92	Completers Mean (SD) n = 69	Univariable Analysis OR (95% CI)	Multivariable Analysis[a] OR (95% CI)
No or don't know	98 (61)	59/98 (60)		REF	
Yes	63 (39)	33/63 (52)		0.73 (0.38, 1.38)	
Provider explained how HPV is spread					
No or don't know	146 (91)	86/146 (59)		REF	
Yes	15 (9)	6/15 (40)		0.47 (0.16, 1.38)	

Note. REF = Reference category in logistic regression analysis. OR = odds ratio. CI = confidence interval. HBM = Health Belief Model. TPB = Theory of Planned Behavior.

[a] Variables associated with completion at the univariable level ($p \leq .10$) were entered simultaneously into a multivariable analysis.

[b] As reported by the adolescent's caregiver.

[c] Most caregivers described their daughter/son's race as "Hispanic" or "Latina/o"; such responses were coded as "unknown."

[d] Scores could range from 1.0 to 5.0, with higher numbers signifying greater orientation toward the respective culture.

[e] To assess whether the adolescent received the influenza vaccine within the past two years we consulted both the adolescent's medical record and the state immunization registry (Florida SHOTS).

[f] Obtained from the adolescent's medical record. To the best of our knowledge, none of the chronic medical conditions were contraindicated for HPV vaccination.

[g] Scores on all health beliefs except subjective norms ranged from 1–4 with higher values indicating greater endorsement. Subjective norms was computed by taking the product of multiple items and thus could range from 1–16.

[h] Total number of vaccines received at the baseline clinic visit; Data obtained from the adolescent's medical record.

[i] The adolescent platform includes the tetanus, diphtheria, and acellular pertussis (Tdap) vaccine, meningococcal conjugate vaccine, and first dose of HPV vaccine; Data obtained from the adolescent's medical record.

[j] Baseline visit was a well-child visit vs. some other type (e.g., immunization visit, follow-up visit).

[k] Self-reported by the adolescent.

* $p \leq .05$;

+ $p \leq .10$.

Table 3.

Results from Combined Caregiver and Adolescent Multivariable Logistic Regression Analysis Predicting Series Completion

	Multivariable Analysis OR (95% CI)
Caregiver education	
Grades 1–12[a]	REF
No formal education	1.02 (0.22, 4.65)
High school grad or more	0.28 (0.08, 0.94)*
Caregiver knowledge # doses required	
Incorrect or don't know	REF
Correct (3 doses)	2.58 (0.99, 6.73)+
Caregiver self-efficacy to complete[b]	2.87 (0.94, 8.73)+
Caregiver intentions to complete[b]	1.31 (0.34, 5.11)
Age of youth at first dose	
13–17 years	REF
11 or 12 years	3.32 (1.04, 10.61)*
Received influenza vaccine[c]	
No	REF
Yes	3.61 (1.36, 9.62)*
Has chronic condition[d]	
No	REF
Yes	0.33 (0.14, 0.79)*
Adolescent perceptions of vaccine safety[b]	1.58 (0.85, 2.94)
Adolescent score U.S. acculturation	1.42 (0.67, 3.01)
Adolescent score Latina/o enculturation	0.91 (0.58, 1.45)
Adolescent acculturation by Enculturation	1.57 (0.70, 3.52)
Experienced pain	
No	REF
Yes	1.71 (0.37, 7.88)
Well-child visit at baseline[e]	
No	REF
Yes	0.14 (0.02, 0.89)*
Provider told youth to return[f]	
No or don't know	REF
Yes	1.76 (0.70, 4.44)
Provider gave written info[f]	
No or don't know	REF
Yes	2.38 (0.91, 6.23)+

Note. REF = Reference category in logistic regression analysis. OR = odds ratio. CI = confidence interval.

[a]Completed some grade school, middle school, and/or high school.

[b]Scores ranged from 1–4 with higher values indicating greater endorsement.

[c]To assess whether the adolescent received the influenza vaccine within the past two years we consulted both the adolescent's medical record and the state immunization registry (Florida SHOTS).

[d]Obtained from the adolescent's medical record. To the best of our knowledge, none of the chronic medical conditions were contraindicated for HPV vaccination.

[e]Baseline visit was a well-child visit vs. some other type (e.g., immunization visit, follow-up visit).

[f]Self-reported by the adolescent.

[*] $p \leq .05$;

[+] $p \leq .10$.