

# Factors Associated With HPV Vaccine Initiation, Vaccine Completion, and Accuracy of Self-Reported Vaccination Status Among 13- to 26-Year-Old Men

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## Abstract

Human papillomavirus (HPV) vaccination coverage in young men is suboptimal. The aims of this study were (a) to examine HPV vaccination and factors associated with HPV vaccination in men 13 to 26 years of age and (b) to examine and determine factors associated with accurate self-report of vaccination. Young men ( $n = 400$ ) recruited from a teen health center and a sexually transmitted disease (STD) clinic completed a survey. Accuracy was defined as correct report of at least one dose and number of doses. Mean age was 21.5 years, 104 (26.0%) received at least one vaccine dose and 49 (12.3%) received all three doses. Factors significantly associated with receipt of at least one dose in multivariable models included recruitment site (teen health center vs. STD clinic, adjusted odds ratio [AOR] = 2.75), public versus other insurance (AOR = 2.12), and age (AOR = 0.68). Most young men accurately reported their vaccination status but accuracy of report differed by age: 50.6% of 14- to 18-year-olds, 75.9% of 19- to 21-year-olds, and 93.2% of 22- to 26-year-olds. Most (293, 73.3%) accurately reported number of doses received. Age was associated with accuracy of self-report of at least one vaccine dose (AOR = 1.42), while recruitment site (STD vs. teen health center, AOR = 2.56) and age (AOR = 1.44) were associated with accuracy of self-report of number of vaccine doses. In conclusion, HPV initiation and completion in this study sample were low. Teen health center attendance, public insurance, and younger age were associated with vaccine initiation; older age and STD clinic setting were associated with accurate vaccination self-report.

## Keywords

human papillomavirus, vaccine, accuracy, self-report, men

## Introduction

Incidence rates of oropharyngeal and anal cancers associated with human papillomavirus (HPV) are increasing, and these cancers disproportionately affect men (Chaturvedi et al., 2011; Jemal et al., 2013). Four-valent and nine-valent prophylactic HPV vaccines have been licensed for prevention of HPV infection in young men, and the U.S. Advisory Committee on Immunization Practices of the Centers for Disease Control and Prevention (CDC) recommends routine vaccination of young men 11 to 21 years of age and vaccination of young men 22 to 26 years of age who are considered at high risk for HPV (CDC, 2011). Vaccination has the potential to substantially decrease rates of HPV and associated cancers in men; early studies have demonstrated a significant decrease in HPV infection and related conditions among

women after vaccine introduction (Drolet et al., 2015). However, male vaccination coverage has been low in the United States following the introduction of national recommendations: estimated vaccination coverage in 2014 was 41.7% for 13- to 17-year-old young men (CDC, 2015a), representing a missed opportunity to prevent HPV-related cancers.

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Previous studies, primarily conducted among clinicians and parents, have identified a number of barriers to HPV vaccination that may explain this relatively low vaccination coverage. In a recent meta-analysis of 11 studies, barriers to male HPV vaccination identified by clinicians and parents included a lack of perceived benefit to vaccinating men, lack of awareness that the vaccine could be administered to men, not receiving a clinician recommendation for HPV vaccination, and cost of the vaccine (Holman et al., 2014). Of the two studies that enrolled young men, one demonstrated only modest vaccine acceptability among those who were unvaccinated; young men were more willing to get vaccinated if they perceived that their peers were accepting of HPV vaccination or anticipated regret about acquiring HPV if they did not get vaccinated (Reiter, McRee, Kadis, & Brewer, 2011). The other study that enrolled young men demonstrated that they had favorable attitudes toward vaccination, but did not report high intention to be vaccinated (Gutierrez et al., 2013). A number of studies have also demonstrated system-level barriers to vaccination, such as vaccine cost, lack of insurance coverage for vaccination, and inadequate clinician reimbursement for vaccination (Holman et al., 2014). Finally, demographic factors have been associated with HPV vaccination among men: National data have demonstrated that male HPV vaccine initiation is higher in Black and Hispanic compared with White adolescents and among those living below versus at or above the poverty level (CDC, 2015a). Additional data regarding factors associated with HPV vaccination in young men will be essential in the design of interventions to improve vaccination coverage.

When deciding whether to recommend HPV vaccination, clinicians often rely on self-reported vaccination status, as young men may seek care in different clinical settings and vaccination documentation or registries are not always available. Similarly, researchers conducting studies about HPV vaccination or HPV epidemiology may depend on self-report as medical record documentation may not be available. However, little is known about the accuracy of self-reported HPV vaccination in young men or factors associated with accurate report, as previous studies have focused on accuracy of self-reported HPV vaccination among women. For example, in a study of vaccination self-report versus electronic medical record (EMR) data among adults in a large health care system, the sensitivity of self-reported HPV vaccine status was  $>0.90$ , positive predictive value was 0.80, and negative predictive value was  $>0.90$  among women 18 to 26 years of age (Rolnick et al., 2013). In another study of 991 young women (mean age 26.9 years) with high-grade cervical lesions who were interviewed about their HPV vaccination status and had vaccination records available, 22% were concordant for vaccination history, 61% were

concordant for no vaccination history, 2% were discordant, and 15% were unknown or had missing data from one or both sources (Niccolai, McBride, & Julian, 2014). The authors report that the sensitivity of self-report was 0.96 and specificity was 0.97. In a study of 1183 young women 14 to 26 years of age, sensitivity of self-report was 0.92 and specificity 0.99 (Grimaldi-Bensouda et al., 2013); however, in this study, parents were allowed to report vaccination status for their children. In contrast, a study of self-reported HPV vaccination among 74 adolescent girls (14-17 years of age) demonstrated poor recall of HPV vaccination; underreporting of vaccination was common and the sensitivity of self-report was 0.54 (Stupiansky et al., 2012). Given that previous studies have focused on women, information about the accuracy of self-reported HPV vaccination in young men will be essential to guiding appropriate clinical care decisions and ensuring validity in research studies that include men.

Therefore, a study was designed with the following aims: (a) to examine HPV vaccine initiation and completion in young men 13 to 26 years of age recruited from two clinical settings, (b) to determine factors associated with having initiated the HPV vaccine series in young men, (c) to examine the accuracy of self-report compared with medical record documentation of HPV vaccination, and (d) to determine factors associated with accuracy of self-report.

## Method

Young men 13 to 26 years of age ( $n = 400$ ) were recruited for an epidemiologic study of HPV between 2013 and 2015. Participants were recruited from two sites: a hospital-based teen health center and a health department sexually transmitted disease (STD) clinic. Both sites serve populations that are racially diverse and are predominantly urban and low-income, with public health insurance. The teen health center is a primary care medical home and the majority of patients are 12 to 21 years of age, while the STD clinic functions primarily as site for sexually transmitted infection (STI) testing and treatment, and most patients are older adolescents and adults. Men who had had sexual contact (genital-oral or genital-genital with a male or female partner) were eligible to participate. Only sexually experienced men were eligible two reasons: first, to select for men who were at higher risk for HPV (as the primary outcome of the parent study was vaccine-type HPV infection) and second, to avoid discomfort and embarrassment associated with genital sampling procedures in sexually inexperienced young men.

Men presenting for care in the teen health center or STD clinic were recruited using a sequential sampling

strategy: 400/441 (91%) of those approached agreed to participate. Participants completed a self-administered survey instrument assessing sociodemographic characteristics; knowledge about HPV and HPV vaccines; vaccination history; reproductive health history; substance use history; and sexual behaviors (including same-sex and opposite-sex vaginal, oral and anal sexual behaviors). The survey was available in both English and Spanish, and has been developed and validated in similar populations; details about survey instrument development, scale items, and scale characteristics are provided in previous articles (Conroy et al., 2009; Kahn et al., 2008; Kowalczyk Mullins et al., 2012; Wetzel et al., 2007). For details about the survey items and response categories, see Tables 1 and 2.

Survey responses to items assessing whether the participant had received an HPV vaccine and the number of HPV vaccine doses received were used to determine self-reported vaccination status. Documentation in an EMR system and/or a statewide immunization registry were used to verify vaccination status. Documentation in at least one of these systems was available for 98% of the participants who reported having received the vaccine. The statewide vaccination registry, managed by the Ohio Department of Health, was established in 1997 and is now widely used by practices in the region and state. It is a web-based system that contains over 70 million vaccinations recorded for more than 8 million Ohio residents. Immunization records are entered by participating providers and imported from other electronic sources (e.g., EMR systems and Medicaid claims data). The EMR is considered to be highly accurate for patients receiving vaccinations at the sites where data were collected, as all vaccinations have been entered into the EMR system in these settings since the HPV vaccine was approved for men.

The proportion of young men who initiated and completed the HPV vaccine series was examined, then factors associated with having received at least one HPV vaccine dose were determined. Independent variables included recruitment site (teen health center vs. STD clinic), demographic factors, knowledge about HPV and HPV vaccines, sexual behaviors, and history of an STI. Associations between independent and outcome variables were assessed using a chi-square test, Wilcoxon two-sample test, or *t* test. Those variables associated at  $p < .10$  with the outcome were entered into a multivariable logistic regression model, and variables associated at  $p < .05$  with the outcome were retained in the final model.

The accuracy of self-report of vaccination and factors associated with accurate self-report were then determined. Accuracy was defined as correct self-report of having received versus not received at least one vaccine dose as well as correct self-report of the number of

vaccine doses (0, 1, 2, or 3). For analyses examining the accuracy of HPV vaccine self-report, participant report was considered inaccurate for the eight (2%) participants who reported having received the vaccine but for whom no data were available in either the EMR or the immunization registry. The agreement between self-report and medical record report was measured using a kappa statistic and calculation of positive and negative predictive values. Associations between independent variables (including recruitment site, demographic factors, and knowledge) and accurate self-report were assessed using univariable and multivariable methods similar to those described previously.

## Results

The mean age of participants was 21.5 years (range 14–26), 276 (69%) were Black, 91 (22.8%) White, and 10 (2.5%) Hispanic (Table 1). Most participants (266, 66.5%) were recruited from the STD clinic, 97 (24.3%) had private health insurance, 110 (27.5%) public insurance (Medicaid), and 193 (48.3%) another type or no insurance (this latter group comprises primarily uninsured men). Knowledge about HPV and HPV vaccines was generally poor, with a mean scale score of 4.1 (out of 10) items answered correctly. Most participants ( $n = 241$ , 64.4%) initiated sex between 14 and 17 years of age, mean age at first sexual intercourse was 15.4 years, 165 (41.7%) reported more than 10 lifetime female sexual partners, 183 (45.9%) reported more than one female sexual partner in the past 3 months, and 37 (9.3%) reported at least one male sexual partner in the past 3 months. Half of participants ( $n = 200$ , 50%) reported a history of an STI, 128 (32%) reported smoking at least five packs of cigarettes in their lifetime, and 309 (77.3%) reported having smoked marijuana.

### HPV Vaccine Initiation and Completion

Overall, 104 (26.0%) young men had received at least one HPV vaccine dose and 49 (12.3%) had received all three doses. Initiation differed markedly by age: 69.9% of 14- to 18-year-olds, 32.1% of 19- to 21-year-olds, and 4.9% of 22- to 26-year-olds had received at least one HPV vaccine dose.

Results of univariable analyses are reported in Table 2. Factors associated with receipt of at least one HPV vaccine dose included recruitment site (teen health center vs. STD clinic), race (Black vs. White), younger age, public (vs. private) health insurance, lower knowledge about HPV and HPV vaccines, earlier age of first sex, lower number of lifetime female sexual partners, no history of STIs, and having smoked at least 100 cigarettes in one's lifetime. Results of multivariable analyses are reported in Table 3.

**Table 1.** Participant Characteristics.

Characteristic	N (%)	M (SD)
<i>HPV vaccination status</i>		
Received $\geq 1$ HPV vaccine dose	104 (26.0)	
Received 3 HPV vaccine doses	49 (12.3)	
<i>Accuracy of self-reported HPV vaccination</i>		
Accurate self-report: received vs. not received $\geq 1$ HPV vaccine dose	318 (79.5)	
Accurate self-report: number of HPV vaccine doses received (vaccinated and unvaccinated)	293 (73.3)	
<i>Recruitment site</i>		
Teen health clinic	134 (33.5)	
Health department	266 (66.5)	
<i>Demographic characteristics</i>		
Age (continuous)		21.5 (3.1)
<i>Age (years)</i>		
14-18	83 (20.8)	
19-21	112 (28.0)	
22-26	205 (51.3)	
<i>Race</i>		
White	91 (22.8)	
Black	276 (69.0)	
Other	33 (8.3)	
<i>Ethnicity</i>		
Appalachian	7 (1.8)	
Hispanic	10 (2.5)	
<i>Insured</i>		
Insured plan	234 (58.5)	
Private	97 (24.3)	
Public	110 (27.5)	
None/not sure <sup>a</sup>	193 (48.3)	
<i>HPV and HPV vaccine knowledge (scale score)</i>		
HPV knowledge		3.4 (2.0)
HPV vaccine knowledge		0.7 (0.9)
HPV and HPV vaccine knowledge		4.1 (2.5)
<i>Sexual history</i>		
<i>Age of first sex (years)</i>		
<14	76 (20.3)	
14-17	241 (64.4)	
$\geq 18$	57 (15.2)	
<i>Number of female sex partners, lifetime</i>		
$\leq 1$	53 (13.4)	
2-5	80 (20.2)	
6-10	98 (24.8)	
>10	165 (41.7)	
<i>Number of female sex partners, past 3 months</i>		
0	74 (18.6)	
1	142 (35.6)	

(continued)

**Table 1. (continued)**

Characteristic	N (%)	M (SD)
>1	183 (45.9)	
<i>Number of anal sex partners, lifetime</i>		
0	359 (90.0)	
$\geq 1$	40 (10.0)	
<i>Number of male sex partners, past 3 months</i>		
0	363 (90.8)	
1	20 (5.0)	
>1	17 (4.3)	
<i>History of STI</i>		
History of STI	200 (50.0)	
<i>Substance use</i>		
<i>Smoked at least 100 cigarettes (5 packs) in lifetime</i>		
Smoked at least 100 cigarettes (5 packs) in lifetime	128 (32.0)	
<i>Number of days smoked, past 30 days</i>		
0	257 (64.3)	
1-5	98 (24.5)	
$\geq 6$	45 (11.3)	
<i>Smoked marijuana in lifetime</i>		
Smoked marijuana in lifetime	309 (77.3)	
<i>Number of days smoked marijuana, past 30 days</i>		
0	192 (48.0)	
1-5	152 (38.0)	
$\geq 6$	56 (14.0)	

Note. HPV = human papillomavirus; STI = sexually transmitted infection.

<sup>a</sup>This group largely represents uninsured participants (those who reported in an item assessing insurance status that they were uninsured).

Factors independently associated with receipt of at least one HPV vaccine dose included recruitment site (teen health center vs. STD clinic: adjusted odds ratio [AOR] = 2.75, 95% confidence interval [CI] [1.49, 5.09]), insurance plan (public vs. other/uninsured: AOR = 2.12, 95% CI [1.12, 4.03]), and age (AOR = 0.68, 95% CI [0.60, 0.76]).

### Accuracy of Self-Reported Vaccination

Most young men accurately self-reported vaccination: 318 (79.5%) accurately reported their vaccination status (i.e., having received vs. not received at least one dose) and 293 (73.3%) accurately reported the number of doses received. However, results differed when stratified by age: 50.6% of 14- to 18-year-olds, 75.9% of 19- to 21-year-olds, and 93.2% of 22- to 26-year-olds accurately reported their vaccination status. Overall, the weighted kappa was 0.35 (95% CI [0.24, 0.46]) for having received versus not received at least one dose. The positive predictive value of self-report was 0.62 (95% CI [0.48, 0.74]) and the negative predictive value was 0.82 (95% CI [0.78, 0.86]).

Results of univariable analyses are reported in Table 4. Factors associated with accurate self-report of at least one

**Table 2.** Factors Associated With Receipt of ≥1 HPV Vaccine Dose: Results of Univariable Analyses.

Independent variable	Vaccinated, N (%)	Vaccinated, M (SD)	Unvaccinated, M (SD)	p <sup>a</sup>
<i>Site</i>				
Teen health center	68 (50.8)			<.0001
Health department	36 (13.5)			
<i>Demographic characteristics</i>				
<i>Race</i>				
White	12 (13.2)			.003
Black	85 (30.8)			
Other	7 (21.2)			
<i>Age (years)</i>				
14-18	58 (69.9)			<.0001
19-21	36 (32.1)			
22-26	10 (4.9)			
<i>Ethnicity</i>				
<i>Appalachian</i>				
Yes	3 (42.9)			.31
No	101 (25.7)			
<i>Hispanic</i>				
Yes	3 (30.0)			.77
No	101 (25.9)			
<i>Insured</i>				
Yes	77 (32.9)			.0002
No/not sure	27 (16.3)			
<i>Insurance plan</i>				
Private	12 (12.4)			<.0001
Public	55 (50.0)			
Others	37 (19.2)			
<i>HPV and HPV vaccine knowledge (scale score)</i>				
HPV knowledge		3.0 (2.0)	3.5 (2.0)	.03
HPV vaccine knowledge		0.6 (0.8)	0.7 (0.9)	.42
HPV/HPV vaccine knowledge		3.7 (2.5)	4.3 (2.5)	.04
<i>Sexual history</i>				
<i>Age of first sex (years)</i>				
<14	23 (30.3)			.015
14-17	68 (28.2)			
≥18	6 (10.5)			
<i>Number of female sex partners, lifetime</i>				
≤1	17 (32.1)			.10
2-5	28 (35.0)			
6-10	23 (23.5)			
>10	36 (21.8)			
<i>Number of female sexual partners, past 3 months</i>				
0	23 (31.1)			.55
1	36 (25.4)			
>1	45 (24.6)			

(continued)

**Table 2. (continued)**

Independent variable	Vaccinated, N (%)	Vaccinated, M (SD)	Unvaccinated, M (SD)	p <sup>a</sup>
<i>Number of anal sex partners, lifetime</i>				
0	91 (25.4)			.33
1	13 (32.5)			
<i>Number of male sex partners, past 3 months</i>				
0	91 (25.1)			.14
1	9 (45.0)			
>1	4 (23.5)			
<i>History of STIs</i>				
<i>Any STIs</i>				
Yes	42 (21.0)			.02
No	62 (31.0)			
<i>Substance use</i>				
<i>Smoked at least 100 cigarettes (5 packs) in lifetime</i>				
Yes	15 (11.7)			<.0001
No/not sure	89 (32.7)			
<i>Number of days smoked, past 30 days</i>				
0	85 (33.1)			<.0001
1-5	12 (12.2)			
≥6	7 (15.6)			
<i>Smoked marijuana in lifetime</i>				
Yes	79 (25.6)			.72
No/not sure	25 (27.5)			
<i>Number of days smoked marijuana, past 30 days</i>				
0	51 (26.6)			.88
1-5	40 (26.3)			
≥6	13 (23.2)			

Note. HPV = human papillomavirus; STI = sexually transmitted infection.  
<sup>a</sup>Associations between independent and outcome variables were assessed using a chi-square test, Wilcoxon two-sample test, or *t* test.

HPV vaccine dose included recruitment site (STD clinic vs. teen health center), older age, private versus public health insurance, and higher knowledge about HPV and HPV vaccines. Factors associated with accurate self-report of the number of HPV vaccine doses included recruitment site (STD clinic vs. teen health center), older age, and private versus public health insurance.

Results of multivariable analyses are reported in Table 5. Age (AOR = 1.42, 95% CI [1.29, 1.56]) was associated with accuracy of self-report of receiving or not receiving at least one HPV vaccine dose, and recruitment site (STD

**Table 3.** Factors Associated With Receipt of  $\geq 1$  HPV Vaccine Dose: Results of Multivariable Logistic Regression Analysis.

Variable	Category	AOR	95% CI
<i>Factors associated with receipt of <math>\geq 1</math> HPV vaccine dose</i>			
Recruitment site	Teen health center vs. sexually transmitted disease clinic	2.75	[1.49, 5.09]
Insurance plan	Private vs. other	0.93	[0.40, 2.14]
	Public vs. other	2.12	[1.12, 4.03]
Age (years)	Not applicable	0.68	[0.60, 0.76]

Note. HPV = human papillomavirus; AOR = adjusted odds ratio; CI = confidence interval.

clinic vs. teen health center, AOR = 2.56, 95% CI [1.47, 4.55]), and age (AOR = 1.44, 95% CI [1.30, 1.60]) were associated with accurate self-report of number of HPV vaccine doses received.

## Discussion

In this study, the proportion of young men 13 to 26 years of age who initiated and completed the HPV vaccination series was examined, and factors associated with HPV vaccine initiation in these men were identified. The study population comprised predominantly low-income men, a substantial proportion of whom were uninsured, placing them at relatively high risk for HPV and its clinical consequences. Accuracy of self-report of HPV vaccination and factors associated with accuracy in young men were also determined; these data are essential for providing appropriate clinical care and ensuring validity in research studies, but to our knowledge have not been reported previously.

Overall, only 26.0% of young men had received at least one HPV vaccine dose and 12.3% had received all three doses, far lower than the U.S. national goal of 80%. Vaccination differed substantially by age group, ranging from 69.9% of 14- to 18-year-olds to 4.9% of 22- to 26-year-olds. The proportion of 14- to 18-year-olds who had initiated vaccination was higher than the national rate of 41.7% reported by the CDC (2015a) for boys in a similar age group, 13 to 17 years of age, while the proportion of 22- to 26-year-olds who had initiated vaccination was comparable with the rate of 5.5% reported by the CDC (2015b) in a similar age group, 19- to 26-year-olds. The higher proportion of 14- to 18-year-old men who initiated vaccination in this study as compared with a population-based study may be due to the fact that most of the young men in that age group received primary care in the teen health clinic. The teen health clinic is a medical home, where clinicians tend to strongly and consistently recommend the HPV vaccine. Performance improvement systems are also in place to

**Table 4.** Factors Associated With Accuracy of Self-Reported Vaccination in Males: Results of Univariable Analyses.

Independent variable	Accurate, N (%)	Accurate, M (SD)	Not accurate, M (SD)	$p^a$
<i>Accuracy of self-report: received vs. did not receive <math>\geq 1</math> HPV vaccine dose</i>				
Site				
Teen health center	89 (66.4)			<.0001
Health department	229 (86.1)			
Demographic characteristics				
Race				.39
White	77 (84.6)			
Black	215 (77.9)			
Other	26 (78.8)			
Age (years)				<.0001
14-18	42 (50.6)			
19-21	85 (75.9)			
22-26	191 (93.2)			
Ethnicity				
Appalachian				.14
Yes	4 (57.1)			
No	314 (79.9)			
Hispanic				.45
Yes	311 (79.7)			
No	7 (70.0)			
Insurance				.006
Yes	175 (74.8)			
No/not sure	143 (86.1)			
Insurance plan				.0009
Private	83 (85.6)			
Public	74 (67.3)			
Other	161 (83.4)			
HPV and HPV vaccine knowledge (scale score)				
HPV knowledge		3.5 (2.0)	3.1 (2.0)	.17
HPV vaccine knowledge		0.8 (0.9)	0.6 (0.8)	.17
HPV/HPV vaccine knowledge		4.2 (2.5)	3.7 (2.5)	.10
<i>Accuracy of self-report: number of doses received</i>				
Site				
Teen Health Center	68 (50.8)			<.0001
Health Department	225 (84.6)			
Demographic characteristics				
Race				.03
White	76 (83.5)			
Black	192 (69.6)			
Other	25 (75.8)			

(continued)

**Table 4. (continued)**

Independent variable	Accurate, N (%)	Accurate, M (SD)	Not accurate, M (SD)	p <sup>a</sup>
Age (years)				<.0001
14-18	29 (39.9)			
19-21	73 (65.2)			
22-26	191 (93.2)			
Ethnicity				
Appalachian				.33
Yes	4 (57.1)			
No	289 (73.5)			
Hispanic				.34
Yes	6 (60.0)			
No	287 (73.6)			
Insurance				.0002
Yes	155 (66.2)			
No/not sure	138 (83.1)			
Insurance plan				<.0001
Private	80 (82.5)			
Public	58 (52.7)			
Other	155 (80.3)			
HPV and HPV vaccine knowledge (scale score)				
HPV knowledge		3.5 (2.0)	3.2 (2.0)	.14
HPV vaccine knowledge		0.8 (0.9)	0.6 (0.8)	.26
HPV/HPV vaccine knowledge		4.2 (2.5)	3.8 (2.5)	.09

Note. HPV = human papillomavirus.

<sup>a</sup>Associations between independent and outcome variables were assessed using a chi-square test, Wilcoxon two-sample test, or *t* test.

maximize vaccination coverage, including electronic health record reminder systems and review of vaccination records at every visit. Vaccination coverage in the older age group was extremely low in this study and also nationally; this may be attributable to the lack of a recommendation for all young men in this age group, inconsistent insurance coverage, and the fact that most of the men in this age group in this study were receiving care at an STD clinic which is not a medical home.

Factors independently associated with receipt of at least one HPV vaccine dose included recruitment site (teen health clinic vs. STD), insurance plan (public vs. private), and younger age. Again, the teen health clinic is a primary care medical home with systems in place to optimize vaccination coverage. The finding that those young men with public health insurance were more likely to be vaccinated than those with private or no insurance may be driven by the fact that the primary public health

**Table 5. Factors Associated With Accuracy of Self-Reported Vaccination in Males: Results of Multivariable Logistic Regression Analysis.**

Variable	Category	AOR	95% CI
<i>Model 1: Received vs. did not receive ≥1 HPV vaccine dose</i>			
Age (years)	Not applicable	1.42	[1.29, 1.56]
<i>Model 2: Number of doses of HPV vaccine received</i>			
Recruitment site	Sexually transmitted disease clinic vs. teen health center	2.56	[1.47, 4.55]
Age (years)	Not applicable	1.44	[1.30, 1.60]

Note. HPV = human papillomavirus; AOR = adjusted odds ratio; CI = confidence interval.

insurance, Medicaid, covers the cost of HPV vaccination for men up to 19 years of age. A study utilizing National Health Interview Study data similarly demonstrated that HPV vaccine uptake was lower in those who were privately insured compared with those who were uninsured or publicly insured (Laz, Rahman, & Berenson, 2013). The finding that younger age was associated with vaccination may be due to the fact that public and private insurance are more likely to cover vaccination costs for younger versus older men, providers may recommend vaccination more strongly and consistently to younger men, and parents may have more of an influence on the vaccination of younger men. Previous studies have demonstrated that provider recommendation and parental communication are associated with HPV vaccine initiation in boys aged 13 to 17 years (Bhatta & Phillips, 2015; Gilkey, Moss, McRee, & Brewer, 2012; Reiter, Gilkey, & Brewer, 2013). These results underscore the importance of targeting younger boys for vaccination and the positive impact of a medical home and insurance coverage to maximize HPV vaccine uptake.

Overall, most young men accurately reported their vaccination status: Approximately 80% accurately reported they received or did not receive at least one dose and 73% accurately reported the number of doses received. However, results differed substantially by age: Only half of 14- to 18-year-olds compared with almost 95% of 22- to 26-year-olds accurately reported their vaccination status, and the older men were much more likely to be unvaccinated. In addition, the kappa statistic, measuring agreement between self-report and medical records, was low (0.35), and the positive predictive value of self-report was only 0.62. Although these findings require replication in larger and more diverse study populations, they have significant implications for clinicians and researchers who rely on self-reported vaccination status. Clinicians and researchers should be cautious in

assuming correct self-report of vaccination in men, especially in younger adolescents, and should verify vaccination status whenever possible. Verification will prevent missed opportunities to vaccinate or receipt of extra vaccine doses in clinical settings, and will improve the validity of vaccination assessment in research studies. The findings also imply that electronic health records and immunization registries should be utilized whenever possible to enhance the accuracy of assessment of HPV vaccination status, particularly in younger adolescents.

Factors associated with accuracy of self-report included recruitment site (STD clinic vs. teen health clinic) and older age. The vast majority of the participants in the older age range were recruited from the STD clinic and unvaccinated. Older men tended to report accurately that they had *not* received at least one HPV vaccine dose, whereas younger men tended to report inaccurately that they *had* received at least one HPV vaccine dose (i.e., overreported). Previous studies have also demonstrated higher accuracy of self-reported HPV vaccination among older compared with younger participants and when parents provided information about vaccination status for adolescents, though all studies to our knowledge have been conducted in women only (Grimaldi-Bensouda et al., 2013; Niccolai et al., 2014; Rolnick et al., 2013; Stupiansky et al., 2012). A number of explanations for these findings are possible. Younger men are more likely than older men to be receiving multiple vaccines, sometimes at the same visit, and may not remember the specific vaccine or vaccines that they received. Furthermore, education about vaccines may be more likely to be given to parents of younger men but directly to older men, possibly increasing awareness among older men. Similarly, vaccine information sheets are likely to be given to parents of younger men, but directly to older men. These findings suggest that clinicians should communicate directly and clearly with younger adolescents about the vaccines they are receiving, and provide age- and culturally appropriate information about vaccines to them, to increase their understanding about the vaccines they have received and enhance accuracy of self-report in the future.

Limitations of this study include the cross-sectional design which precludes drawing conclusions about causality, self-report of behaviors which may have limited validity, and possible inaccuracies with respect to medical record documentation of HPV vaccination status.

In conclusion, vaccination coverage was suboptimal in this sample of 13- to 26-year-old men, especially in those who were in the older age range and were attending an STD clinic. Men in the older age group, most of whom had not been vaccinated, tended to report their vaccination status accurately, while men in the younger age group who had been vaccinated tended to report their vaccination status inaccurately.

## Declaration of Conflicting Interests

The author(s) declared the following potential conflicts of interest with respect to the research, authorship, and/or publication of this article: Ms. Higgins was the program manager and Dr. Kahn chaired the review committee for a grant to the Society for Adolescent Health and Medicine evaluating public health demonstration project proposals to improve adolescent vaccination; grant funding for this program was from Merck & Co., Inc. Dr. Kahn cochaired two HPV vaccine clinical trials in HIV-positive individuals, for which Merck & Co., Inc., provided vaccine and immunogenicity titers. The remaining authors declare that there is no conflict of interest.

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