

## Recall of Human Papillomavirus (HPV) Vaccination History Among Adolescents

David A. Klein<sup>1\*</sup>, Amy M. Thompson<sup>2</sup>, Barbara L. Bowsher<sup>2</sup>, Anneke C. Bush<sup>3</sup> and Jane Shen-Gunther<sup>4</sup>

<sup>1</sup>Department of Family Medicine, Fort Belvoir Community Hospital, VA, USA

<sup>2</sup>Department of Pediatrics, San Antonio Military Medical Center, TX, USA

<sup>3</sup>Clinical Research Division, Lackland Air Force Base, TX, USA

<sup>4</sup>Department of Clinical Investigation and Department of Obstetrics and Gynecology, San Antonio Military Medical Center, TX, USA

\*Corresponding author: David A. Klein, Department of Family Medicine, Fort Belvoir Community Hospital, 9300 DeWitt Loop, Fort Belvoir, VA 22060, USA, Tel: 571-231-1808; E-mail: david.a.klein26.mil@mail.mil

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### Abstract

**Objective:** Data examining the accuracy of patients' ability to recall their HPV vaccination history are sparse and conflicting, and generally suggest that adolescents often report this information inaccurately. This study aims to elucidate accuracy of HPV vaccination recall among a diverse sample of female and male adolescents.

**Methods:** Adolescents (N=224, ages 12-23) recruited from a large military primary care clinic completed a questionnaire regarding sociodemographics, clinical variables, and HPV vaccination history. Electronic databases were searched to determine each participant's recorded vaccination history. Accuracy of recall was calculated for initiation and completion of the series; and age- and gender-based comparisons were conducted.

**Results:** 224 adolescents aged 12-23 enrolled in the study; 217 provided complete data. Electronic records showed that 59.5% of the adolescents initiated, whereas 40.1% completed the 3-shot series. Of the 217 participants, 65.9% correctly recalled initiation (or lack of initiation) and 56.2% correctly recalled completion (or lack of completion). In bivariate analysis, older adolescents had more accurate recall of initiation compared to younger adolescents ( $p < 0.002$ ); however, there was no difference between gender ( $P < 0.195$ ), race ( $P < 0.104$ ), or sexual debut ( $P < 0.196$ ). Furthermore, 40.5% of adolescents who have had vaginal, oral, or anal intercourse completed the series.

**Conclusion:** Among adolescents in a diverse, vaccination-centric clinical setting, recall of HPV-related vaccination status is often inaccurate, and should be interpreted with caution. The level of inaccuracy found in this study, which is consistent with prior studies, has important implications for clinicians and researchers who depend on self-reporting of vaccination status for vaccine-related efforts.

**Keywords:** Human Papilloma Virus; Vaccine; Vaccination; Recall; Accuracy; Self-report; Adolescent; Teen

### Abbreviations:

HPV: Human Papilloma Virus

### Introduction

The etiologic role of human papillomavirus (HPV) in cancers of the genital tract, anus, and oropharynx is well established; over 5% of the worldwide cancer burden can be attributed to HPV infection [1,2]. As a preventive strategy against HPV-related morbidity and mortality, the Advisory Committee on Immunization Practices (ACIP) recommends that all adolescents between the ages of 11 and 12 receive the 3-dose HPV vaccine series, with catch up protocols highly encouraged [3]. However, the CDC's 2012 National Immunization Survey-Teen (NIS-Teen) has revealed that uptake of the HPV vaccination series is less than that of other recommended vaccinations: approximately 54% of girls and 21% of boys aged 13-17 in the United States have initiated the vaccination series, whereas 34% of girls and 7% of boys have

completed the series [4]. Lower uptake has been associated with lack of health insurance, younger age, failure to receive childhood vaccinations, African American race, low healthcare utilization, negative vaccine attitudes, and low vaccine knowledge [5].

In order for clinicians to properly immunize adolescents, use of self-reported vaccination history is frequently employed. This is especially useful when records are not available or parents are unable to provide this information. Similar considerations apply to research regarding uptake and effectiveness of vaccinations. However, data examining accuracy of patient self-report are sparse and conflicting, and generally suggest that adolescents are often inaccurate when reporting their vaccination history [6-10].

The few existing studies related to patient recall of the HPV series are limited by sample size and population characteristics including lack of male participants [9-12]. Therefore, this study aims to further elucidate validity of self-reported HPV-related vaccination history among a diverse group of female and male adolescents in a medical system with well-established vaccination records [13]. To the best of the authors' knowledge, this is the first study to examine recall of the HPV series in male participants of any age.

## Methods

Approval to conduct this study was obtained by the Institutional Review Board of San Antonio Military Medical Center, TX. In 2013, 224 patients aged 12-23 were recruited over 4 months from a large military-affiliated primary care clinic in San Antonio, TX, USA that empanels approximately 7,000 adolescents who are eligible for care due to their parent's or guardian's military affiliation. Using convenience sampling, patients were approached before they completed their medical visit; if interested, each adolescent provided assent to participate in the study. Patients were excluded from the study if they were unable to consent to participation (e.g. presenting under the age of 18 without their parent) or unable to complete the study questionnaire due to a disability. If the patient was under age 18, consent was also obtained from their parent or legal guardian. Participants then completed a study questionnaire regarding sociodemographics, risk behaviors, and vaccination history that was modified from a questionnaire used in prior study of HPV infection [14-15]. Participants were instructed to avoid consulting their parents for answers to survey questions until they submitted the questionnaire. Without access to handheld vaccination records (which are rarely carried in this medical system), patients were asked if they received any doses of a vaccination against Human Papillomavirus (HPV) infection. Possible answers were limited to one of the following choices: "0, 1, 2, or 3, 'I'm not sure', or 'I'm not sure, but had at least one.'"

A member of the research team searched two large databases, AHLTA (Armed Forces Health Longitudinal Technology Application) and ASIMS (Aeromedical Services Information Management System), which are collectively comprehensive for true vaccination status for vaccinations received worldwide in the military healthcare system.

In terms of initiation of the HPV vaccination series, "correct recall" was defined as the proportion of adolescents who correctly reported receiving either no vaccination - or at least 1 HPV vaccination - of all adolescents in the designated group. Those who were "unsure" of their vaccination status were considered to have demonstrated incorrect recall. Vaccinations identified in the aforementioned databases were considered the reference standard.

For completion of the HPV vaccination series, "correct recall" was defined as the proportion of adolescents who correctly reported receiving all three vaccinations - or lack of all three vaccinations - of all adolescents in the designated group. For this measure, adolescents who were "unsure" or were "unsure but had at least one vaccination" were considered incorrect. Thus, for both initiation and completion, "correct recall" would equal (true positive cases + true negative cases) / total participants in the group, which is equivalent to the percent agreement in a standard 2x2 table. Differences in correct recall between subgroups (i.e. gender, race, and sexual debut) were assessed with Pearson's Chi-Square, Fisher's Exact Test or logistic regression at a significant level of  $\alpha=0.05$ , and odds ratios with 95% confidence intervals were calculated using SPSS (v.19, 2010).

Diagnostic sensitivity, specificity, positive predictive value, and negative predictive values were calculated for initiation and completion of vaccination series. Sensitivity was defined as the proportion of participants who recalled initiation (or completion) of vaccination series out of all who initiated (or completed) based on the medical record. Specificity was defined as the proportion of participants who recalled non-initiation (or non-completion) of vaccination series out of all who did not initiate (or complete) based

on the medical record. The positive predictive value (PPV) was defined as the proportion of participants who correctly recalled initiation (or completion) of the vaccination series out of all who recalled initiation (or completion); the converse defined the negative predictive value (NPV).

## Results

224 adolescents aged 12-23 enrolled in the study (mean 17.2, SD 2.4). 4 participants (3 female, 1 male) were excluded after enrollment because they reported receiving at least one HPV vaccination at a clinic outside of the Military Healthcare System, and 3 male participants were excluded due to missing data on their study questionnaire. Therefore, 217 patients were included in the final analysis. 62.7% were female. 41.9% identified as non-Hispanic white, 24.9% as African American, 27.7% as Hispanic, and 5.5% as mixed ethnicities or other. Over half reported previous engagement in vaginal, oral, and/or anal intercourse (Table 1).

Participant Characteristics	n (%)
<b>Age</b>	
12-14	29 (13.4)
15-17	92 (42.4)
18-19	56 (25.8)
20-23	40 (18.4)
<b>Gender</b>	
Female	136 (62.7)
Male	81 (37.3)
<b>Race/Ethnicity</b>	
Non-Hispanic White	91 (41.9)
African American	54 (24.9)
Hispanic	60 (27.7)
Other	12 (5.5)
<b>Initiation of Vaginal, Oral, or Anal Intercourse</b>	
Yes	116 (53.5)
No	98 (45.1)
Missing	3 (1.4)

**Table 1:** Characteristics of Participants (n=217).

Electronic records showed that 59.5% (129/217) of adolescents initiated and 40.1% (87/217) completed the 3-shot series. Of the 217 participants, 65.9% correctly recalled initiation (or lack of initiation) and 56.2% correctly recalled completion (or lack of completion) of the 3-dose vaccination series (i.e. percent agreement; Tables 2 and 3). The diagnostic performance of self-report versus medical records for initiation of the HPV series was as follows: sensitivity 74.4 (96/129), specificity 53.4 (47/88), positive predictive value 70.1 (96/137), negative predictive value 58.8 (47/80) (Table 2); for completion of the series: sensitivity 48.3 (42/87), specificity 61.5 (80/130), positive

predictive value 45.7 (42/92), negative predictive value 64.0 (80/125) (Table 3).

	Medical Records			P Value
	Received Vaccine	No Vaccine	Correct Recall <sup>b</sup> (%)	
<b>Gender-Specific Reporting</b>				<0.195 <sup>a</sup>
<b>Female Self-Report (n=136)</b>			69.1	
Received Vaccine	74	9		
No Vaccine	6	20		
Unsure	19	8		
<b>Male Self-Report (n=81)</b>			60.5	
Received Vaccine	22	5		
No Vaccine	3	27		
Unsure	5	19		
<b>Age-Specific Reporting</b>				<0.002 <sup>a</sup>
<b>12-14 (n=29)</b>			48.3	
Received Vaccine	8	2		
No Vaccine	1	6		
Unsure	6	6		
<b>15-17 (n=92)</b>			64.1	
Received Vaccine	37	3		
No Vaccine	6	22		
Unsure	12	12		
<b>18-19 (n=56)</b>			60.7	
Received Vaccine	25	7		
No Vaccine	2	9		
Unsure	6	7		
<b>20-23 (n=40)</b>			90	
Received Vaccine	26	2		
No Vaccine	0	10		
Unsure	0	2		
<b>All Participants Self Report (n=217)</b>			65.9	
Received Vaccine	96	14		
No Vaccine	9	47		
Unsure	24	27		

**Table 2:** Initiation of HPV Vaccination Series: Agreement of Gender- and Age-Specific Self-Report to Medical Records (n=217). Notes: <sup>a</sup>Initiation=one or more doses; Of all participants self-report: sensitivity 74.4 (i.e. 96/(96+9+24)), specificity 53.4 (i.e. 47/(47+14+27)), positive predictive value 70.1 (i.e. 96/(96+14+27)),

negative predictive value 58.8 (i.e. 47/(47+9+24)). <sup>b</sup>Correct Recall = proportion of participants who accurately identify vaccination status (either receiving zero vaccinations, or receiving at least one vaccination) based on medical records; those who are "unsure" are incorrect. <sup>a</sup>OR Female (vs. Male) 1.46, 95% CI .82-2.60. OR 20-23 to <20: 2.34, 95% CI 1.06-5.17

	Medical Records			P Value
	Received Full Series	Did Not Complete Series	Correct Recall <sup>b</sup> (%)	
<b>Gender-Specific Reporting</b>				< 0.171 <sup>a</sup>
<b>Female Self-Report (n=136)</b>			55.1	
Received Full Series	36	5		
Did Not Complete Series	8	39		
Unsure	31	17		
<b>Male Self-Report (n=81)</b>			58	
Received Full Series	6	1		
Did Not Complete Series	1	41		
Unsure	5	27		
<b>Age-Specific Reporting</b>				<0.043 <sup>a</sup>
<b>12-14 (n=29)</b>			44.8	
Received Full Series	3	1		
Did Not Complete Series	1	10		
Unsure	4	10		
<b>15-17 (n=92)</b>			55.4	
Received Full Series	16	0		
Did Not Complete Series	4	35		
Unsure	20	17		
<b>18-19 (n=56)</b>			50	
Received Full Series	10	5		
Did Not Complete Series	3	18		
Unsure	8	12		
<b>20-23 (n=40)</b>			75	

Received Full Series	13	0		
Did Not Complete Series	1	17		
Unsure	4	5		
<b>All Participants Self Report (n=217)</b>			56.2	
Received Vaccine	42	6		
Did Not Complete Series	9	80		
Unsure	36	44		

**Table 3:** Completion of HPV Vaccination Series: Agreement of Gender- and Age-Specific Self-Report to Medical Records (n=217). Note: <sup>a</sup>Completion = 3 doses; Of all participants self-report: sensitivity 48.3 (i.e. 42/(42+9+36)), specificity 61.5 (i.e. 80/(80+6+44)), positive predictive value 45.7 (i.e. 42/(42+6+44)), negative predictive value 64.0 (i.e. 80/(80+9+36)). <sup>b</sup>Correct Recall=proportion of participants who accurately identify vaccination status (including completing series, or not completing series) based on medical records; those who are "unsure" or "unsure but at least one" are incorrect. <sup>c</sup>OR Female (vs. Male): 0.889, 95% CI 0.51-1.55. OR 20-23 (vs<20): 2.77, 95% CI 1.28-6.

Of all female participants, 72.7% started and 55.2% completed the series; the percent of correct recall is 69.1% and 55.1%, respectively. Of all male patients, 37% started and 14.8% completed the series; the percent of correct recall is 60.5% and 58%, respectively. Compared to their male peers, female participants were more likely to initiate the HPV series (OR 4.55, 95% CI 2.53-8.19) and complete the series (OR 7.07, 95% CI 3.51-14.24). Of all patients who reported sexual debut (i.e. vaginal, oral, or anal intercourse), 59.5% initiated and 40.5% completed the series (Table 4).

	History of Sexual Debut (n)	Initiation of series (n, %)	Completion of series (n, %)
<b>Age (n=116)</b>			
12-14	2	1 (50)	0 (0)
15-17	45	28 (62.2)	21 (46.7)
18-19	39	23 (59)	14 (35.9)
20-23	30	17 (56.7)	12 (40)
Total	116	69 (59.5)	47 (40.5)

**Table 4:** HPV Vaccination among Adolescents Who Report Vaginal, Oral, and/or Anal Intercourse. 4 patients who report sexual debut were eliminated due to incomplete data.

In bivariate analysis, older adolescents had more accurate recall of initiation compared to younger adolescents ( $p < 0.002$  overall; OR age 20-23: 2.34, 95% CI 1.06-5.17 vs. ages 12-19); however, there was no difference between gender ( $P < 0.195$ ) or race ( $P < 0.104$ ). Furthermore, adolescents who have had vaginal, oral, or anal intercourse were no more likely to accurately recall initiation of their HPV vaccination

history than those who have not ( $p < 0.196$ ). Older adolescents maintained more accurate recall of completion of the vaccination series compared to younger adolescents ( $P < 0.043$  overall; OR ages 20-23 compared to ages 12-19: 2.77, 95% CI 1.28-6.01).

## Discussion

This study identified significant discrepancies between reported and recorded vaccination status among this diverse adolescent study population. Approximately one-third of adolescents incorrectly recalled initiation of the HPV series, and approximately half incorrectly recalled completion of the series. The findings may be counterintuitive in the context of the study environment, which requires mandatory vaccination review - and likely discussion and familiarization - at each previous patient visit. Awareness, however, may be confounded by receipt of multiple simultaneous vaccinations, time from vaccination, as well as variable perceptions of the HPV series by patients, parents, and clinicians. Military dependent adolescents, on average, are highly mobile and are seen by multiple clinicians over time [16,17].

The vaccination rate in the study population appears to be on par with national efforts. It is unclear why uptake of the vaccination in males lags females in this study environment, since continual vaccination review would be expected to mitigate the common reasons for non-vaccination, including logistical and clinician-related barriers, in male patients [18]. It is possible that the more recent recommendation for routine HPV vaccination among males as compared to the longer standing recommendation among females contributes to the disparity.

In this study population, most of the inaccuracy in participant reporting is due to either underreporting or being "unsure" of vaccination status. Most adolescents did not over-report (which, if occurred, would preclude receipt of the HPV series). Instead, adolescents in this population may be at risk for unnecessary vaccinations or underestimation of HPV vaccination uptake in research studies that rely on self-report. The health systems impact would be twofold: (1) increased health expenditure from redundant vaccine dosages, and (2) indeterminate effectiveness of a prophylactic intervention.

In comparison to prior publications, the level of inaccuracy in self-reporting found in this study is consistent with that found by Stupiansky et al. [10]., who found a percent agreement for initiation of the HPV series of 59.5 in a sample of 74 female 14-17 year olds [10]. In addition, Grimaldi-Bensouda et al. found that in a group of 1,183 females ages 14-26, sensitivity of correct recall for initiation of the HPV series was 91.6; however, those aged 14-17 were approximately three times as likely to demonstrate disagreement as compared to those aged 18-26 (OR: 2.78, 95% CI 1.36-5.67) [9]. Rolnick et al. found a sensitivity for recall of 91.2 in adult females, which was higher than that the sensitivity of 72.6 for the hepatitis B series (which combined male and female participants) [12].

These findings have important implications for clinicians and researchers who depend on self-reporting of vaccination status for vaccine-related efforts. It also further supports the need for national vaccination databases to aid in tracking vaccinations from one setting to another [10].

Recall of initiation of the HPV series had no association with onset of sexual intercourse. Recent evidence suggests that receipt of the

series does not increase high-risk sexual behaviour [10,19,20]. The extent to which adolescents were able to accurately recall their vaccination history in this study makes it unlikely that vaccination changes sexual behavior. Conversely, it is concerning that sexually active adolescents incorrectly identify their HPV vaccination status. This may suggest a need for improved education on the HPV vaccination series. It is similarly concerning that approximately 40% of sexually active teens did not yet initiate and 60% did not complete the HPV vaccination series, which suggests that these teens are at high risk for HPV transmission.

A limitation of this study is the sample size. Specifically, the youngest and oldest age groups had fewer subjects than the 15-17 and 18-19 age groups. This may result in bias of our measured outcomes; however, the data did reveal a critical factor that impacts recall of vaccination, which is young age. Another limitation is that subject recruitment was derived from one large primary care clinic which may not be representative of other teen populations throughout the U.S. Since the study design was cross-sectional, causality for the differences in vaccination recall could not be established. This study did not survey parents or guardians who, if available, sometimes help adolescents boost recall in clinical or research situations [11]. However, parental recall has not been shown to be universally more reliable than that of their child [10]. Furthermore, the exclusion of patients who presented under the age of 18 without their parents may have biased recruitment and therefore generalizability of the results; however, potential participants were rarely excluded due to this criteria alone. Finally, confirmation of vaccination outside of the Military Healthcare System (MHS) was not performed (due to research regulatory challenges) which potentially may alter the outcome metrics. Due to the expense associated with vaccination in the civilian healthcare system, we believe very few if any subjects received the HPV vaccination outside the MHS.

## Conclusions

The diverse sample of participants in this study, which may be the first to include males, contributes to our understanding of vaccination recall among adolescents. Future research should evaluate educational efforts to improve vaccination recall and knowledge to facilitate completion of HPV vaccination. These efforts should include the evaluation of the effectiveness of innovative methods for vaccination tracking and prompting including smartphone applications and other technology. Among adolescents in a diverse, vaccination-centric clinical setting, recall of HPV vaccination status is often inaccurate, and should be interpreted with caution.

## Disclaimer

The view(s) expressed herein are those of the authors and do not reflect the official policy or position of Brooke Army Medical Center, the U.S. Army Medical Department, the U.S. Army Office of the Surgeon General, the Department of the Army, the Department of the Air Force, the Department of Defense, or the U.S. Government.

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