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Trends in and Characteristics Associated with HPV Vaccination Initiation Among Men
Who Have Sex with Men, 2014- 2017

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Abstract

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By Caitlin Loretan

BACKGROUND: Rates of HPV and HPV-associated cancers are high among MSM. Expansion of HPV vaccination in MSM up to age 26 was established in 2011. Since then, very little research has explored national trends in vaccine uptake among this population.

METHODS: Data from the 2014-2017 American Men's Internet Survey was used. Men aged 15-32 were included in the analyses. Estimated annual percentage changes (EAPC) were used to evaluate relative change in vaccination initiation. Linear trends in vaccine uptake were assessed using Cochran-Armitage test for trend. Poisson regression was used to identify predictors of vaccination initiation.

RESULTS: The proportion of MSM reporting receipt of ≥ 1 HPV vaccine rose from 22.5% in 2014 to 37.6% in 2017 (test for trend $p < 0.0001$). MSM residing in the Midwest and in large metro areas show the greatest EAPC (24.85%, 17.35%). Trends in vaccine initiation among MSM in rural locations increased from 2014-2016, but has stayed constant from 2016 – 2017, with 28.25% coverage. Of the 4,290 men reporting HPV vaccine receipt across these years, predictors for vaccination included age (adjusted prevalence ratio (aPR): 3.07, 95% confidence interval (CI): 2.97, 3.17); having health insurance (aPR = 1.80, 95% CI: 1.53, 2.17); and having been seen by a healthcare provider (HCP) in the past 12 months (aPR = 1.80, 95% CI: 1.62, 2.07). Other significant predictors included residence in the Northeast and large metro areas, higher household income, disclosure to HCP, and gonorrhea and/or chlamydia diagnosis in the past 12 months.

CONCLUSIONS: Overall, HPV vaccine coverage among MSM appears to be increasing overall, with access to healthcare and insurance being important correlates of HPV vaccine initiation. Despite favorable trends in vaccine coverage, the 2017 coverage rate of 38% remains below the recommended coverage of 80% for MSM ≤ 26 years of age, with rural locations starting to fall behind.

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INTRODUCTION

In the US, prior studies have estimated the population of men who have sex with men (MSM) to be 3.9% (3.5%-4.4%) of the adult male population, or roughly 4.3 – 5.4 million men (1, 2). Human papillomavirus (HPV) is a common sexually transmitted infection (STI) that results in 4.6 million annual incident cases of HPV in men, and a prevalence of HPV in MSM as high as 74.8% (3). Roughly 15,000 annual cases of HPV-associated cancers are diagnosed among US men, with many of the cases occurring in MSM and men with HIV infection (4). HPV is associated with 91% of anal cancers, 70% of oropharyngeal cancers, and 63% of penile cancers. Rates of anal cancer are roughly 17 times greater in MSM compared to heterosexual men (5). A one-year study found that oncogenic HPV-16 and -18 were detected in 37% of MSM aged 16 - 30 years (5).

In 2007, the Advisory Committee on Immunization Practices (ACIP) first established a recommendation for HPV vaccination in girls and young women (6). Two years later the FDA expanded licensure of the vaccine to males, and in 2011 ACIP expanded HPV vaccination recommendations to include routine administration to boys aged 11 – 12 years and catch-up recommendations for males aged 13 – 21 years. The revised recommendations also included routine vaccination of MSM and immunocompromised individuals up to age 26 (7). MSM are an important risk group because, unlike heterosexual men, they are less likely to benefit from HPV vaccination among women (8).

Several studies have looked at HPV vaccine uptake in MSM. Provider recommendation is a key predictor of vaccine uptake. Among individuals who received a health care provider's

recommendation, vaccine uptake was consistently high – close to 70% across all gender identities (9). Other predictors of vaccine uptake were HIV status and disclosure of sexual identity to provider (3, 5, 10). Gorbach et al. found that HIV-positive men were more likely to report vaccination vs. HIV-negative men (27.8% vs. 13.1%). Estimates of disclosure of sexual identity to HCPs vary. Among studies that looked at disclosure of sexual orientation to HCP in adult and adolescent LGBTQ persons, 33% - 75% reported not disclosing their identity (11, 12). Disclosure of sexual identity is an important factor in increasing HPV vaccination rates among MSM because providers are able to recommend appropriate testing, vaccination, and treatment for diseases that disproportionately affect the MSM community, including HPV, other STIs, and HIV (13).

According to the 2014 National Immunization Survey-Teen (NIS-Teen), only 22% of all male adolescents aged 13-17 years completed the HPV vaccination series (14). However, vaccine coverage among MSM is still unclear. The Young Men's HPV Study conducted in Los Angeles, CA and Chicago, IL between July 2012 and August 2014 found 13.7% and 4.6% of male LGBT persons reported receiving at least one dose and all 3 doses of the HPV vaccine, respectively (4). The ≥ 1 HPV vaccine coverage rate derived from National HIV Behavioral Surveillance data from 2014 was 17.2% among MSM aged 18-26 years (15). Other studies have found rates of HPV vaccination among MSM ranging from 6% - 21% (3, 5, 16, 17).

The rate of HPV vaccination among all individuals including MSM remains below the desired level of 80% coverage. While one study evaluated the trend of HPV vaccination among girls in Texas between 2008 and 2010, no studies have examined trends in HPV vaccination

among MSM (18). To evaluate the trend of HPV vaccination among MSM, we reviewed data from a national sample of MSM between the years of 2014 and 2017. In addition, we evaluated participant characteristics associated with HPV vaccine initiation among MSM to expand upon published information, using a large, geographically distributed sample.

METHODS

PARTICIPANTS

We analyzed data from the American Men's Internet Survey (AMIS). AMIS is an annual web-based, cross-sectional survey used to collect self-reported data on demographics, HIV risk behaviors, HIV and STD testing behaviors, and use of preventive services among a convenience sample of internet-using MSM in the US. Each AMIS cycle was conducted from approximately August through December of the corresponding year. Eligibility criteria included: 15 years of age or older, identifying as male, residing in a US state or dependent area, able to take the survey in English or Spanish, and reporting having had anal or oral sex with a man at least once. Detailed methods regarding survey design and recruitment have been previously reported (19). Some recruitment was performed by e-mailing previous participants. The recruitment method was coded and manually added to the data set. Only data from the initial year of participation was included for participants who were recruited using this method.

MEASURES

The study's primary outcome of interest was self-reported uptake of ≥ 1 dose of HPV vaccine. Using the 2011 ACIP age-related recommendation for HPV vaccination among MSM, we included men in our study who would have been no older than 26 years of age in 2011. This restricted our sample to men up to age 29 years old in 2014, 30 years old in 2015, 31 years old in 2016, and 32 years old in 2017. Age was categorized into the following groups: 15-21, 22-26, and 27-32 years. These categories were selected based on consistent use in other studies of MSM and HPV vaccination (4, 8, 9). Other variables included in the analysis were race/ethnicity, education level, annual household income, Census region, urban/rural classification, health insurance status, having seen a HCP in the past 12 months, disclosure of sexual identity to HCP, anal sex without using a condom in the past 12 months, ever tested for HIV, HIV status, ever diagnosed with a viral STI, gonorrhea and/or chlamydia diagnosis in the past 12 months, and syphilis diagnosis in the past 12 months.

DATA ANALYSIS

The Cochran-Armitage test for trend was used to test the interaction between survey year and having received ≥ 1 HPV vaccine, to determine if there was a significant linear association. Estimated annual percentage change (EAPC), a relative measure of percent change, was calculated using a logistic regression model with dichotomized HPV vaccine as the outcome and

survey year as the exposure; for region and urbanicity, evaluation of EAPC was restricted to category of interest. Parameter estimates from the model were used to calculate EAPC and upper and lower 95% confidence intervals (95% CI). We calculated descriptive frequencies and bivariate analyses using Pearson χ^2 to assess associations between self-reported HPV vaccination initiation and demographic, behavioral, and health-related characteristics for the 2017 survey data. Potential factors associated with ≥ 1 HPV vaccine dose were evaluated using a multivariate Poisson regression with robust error variances to estimate adjusted prevalence ratios (aPR) for variables found to be statistically significant in bivariate analyses (20). Significance was assessed at an $\alpha = 0.05$ level. All analyses were conducted using SAS v.9.4 (SAS Institute, Cary, NC).

RESULTS

During the study period, 39,591 eligible individuals completed the AMIS survey. 16,607 (42%) met our age restriction; of these 15,723 (95%) were not recruited from previous study years. HPV vaccination status was reported as unknown for 1,788 individuals and 88 left the question blank and were categorized as missing. Of the remaining 13,857 respondents with HPV vaccine receipt data, 4,290 (31%) reported receiving ≥ 1 HPV vaccine (**Table 1**). Of participants who reported receiving ≥ 1 HPV vaccine, 513 (12%) did not report an age at first vaccination. Of those that did report an age, the mean age of first vaccination was 18.4 years.

The mean age of the sample was 23.5 years. Almost two thirds (64.5%) of participants were non-Hispanic white; 20% were Hispanic/Latino, 6% were non-Hispanic black, and 10% were some other race. Close to half (44%) were college/postgraduates, 39% lived in a large central metro area, and 37% lived in the South. The distribution of annual household income was relatively equal between categories: 23% reported income between \$0-\$19,999, 27% reported \$20,000-\$39,999, 26% reported \$40,000-\$74,999, and 23% reported \geq \$75,000. The demographic distributions observed for the 2017 respondents were similar to the demographics observed across all 4 years of data.

OVERALL HPV VACCINE TREND

From 2014 to 2017, the proportion of MSM reporting receipt of \geq 1 HPV vaccine rose from 22.5% to 37.6% (Z-statistic = -13.05, p-value < 0.0001); an absolute increase of 15.1%. The relative increase, EAPC, was 17.4% (95% CI: 14.6% - 20.2%) (**Image 1**).

HPV VACCINE TREND BY URBANICITY AND REGION

From 2014 to 2017, increase in \geq 1 HPV vaccine was found in all but one category of region and urbanicity. In rural areas, the proportion vaccinated increased from 2014 to 2016 (18.7% to 28.3%) but remained constant in 2017. The EAPC for rural areas was 14.3% (95% CI: 4.0% – 25.5%) (**Image 2**). By region, the Northeast continued to see the greatest percent of vaccine

initiation. The proportion vaccinated changed from 30.7% to 49.3%, EAPC of 19.8 (95% CI: 14.5% – 25.3%). The Midwest had the highest EAPC, 24.9% (95% CI: 18.3% – 31.8%) (**Image 3**).

CORRELATES OF HPV VACCINATION

Among the 3,407 MSM from 2017 for which HPV vaccine information was available, HPV vaccine receipt was significantly associated with age ($\chi^2 = 215.19$, $p < 0.0001$), region ($\chi^2 = 55.55$, $p < 0.0001$), urbanicity ($\chi^2 = 21.13$, $p < 0.0001$), household income ($\chi^2 = 47.46$, $p < 0.0001$), having any health insurance ($\chi^2 = 42.36$, $p < 0.0001$), having seen a HCP in the past 12 months ($\chi^2 = 62.60$, $p < 0.0001$), having revealed their sexual identity to their HCP ($\chi^2 = 5.87$, $p = 0.0154$), and having been clinically diagnosed with gonorrhea and/or chlamydia in the past 12 months ($\chi^2 = 11.36$, $p = 0.0008$) (**Table 2**).

All of the aforementioned variables individually associated with HPV vaccine receipt remained significant in multivariate analyses (**Table 3**). Men aged 15-21 years were over three times as likely to have initiated HPV vaccination compared to men aged 27-32 years (aPR = 3.1, 95% CI: 2.97, 3.17); men aged 22-26 were nearly twice as likely to have initiated HPV vaccination compared to men aged 27-32 (aPR = 1.8, 95% CI: 1.58, 1.98). Reporting any health insurance (aPR = 1.8, 95% CI: 1.53, 2.17) and HCP visit in past 12 months (aPR = 1.8, 95% CI: 1.62, 2.07) were additional significant factors associated with vaccine uptake. Men in the Northeast were 1.4 times more likely to have received ≥ 1 HPV vaccine compared to men in the South (aPR =

1.4, 95% CI: 1.31, 1.38), and men in large central metro areas were more likely to have received ≥ 1 vaccine compared to men in rural areas (aPR = 1.3, 95% CI: 1.24, 1.37). Disclosure of sexual identity to HCP (aPR = 1.4, 95% CI: 1.35, 1.52), and having been diagnosed with gonorrhea and/or chlamydia in the past 12 months (aPR = 1.2, 95% CI: 1.07, 1.33) were associated with ≥ 1 HPV vaccine.

DISCUSSION

This is the first study to evaluate the trend of HPV vaccine uptake among MSM in the US. This study provides evidence that HPV vaccination initiation among MSM in the US has increased significantly from 2014 to 2017; the EAPC indicates a relative 17% per year increase in prevalence of HPV vaccination initiation. The absolute increase from 2014 to 2017 was 15%. These increases are encouraging and align with other studies that have reported yearly increases among other target populations. Results from the 2016 NIS-Teen survey indicated an increase in HPV vaccination rate among adolescents aged 13-17 years. Among adolescent males alone, receipt of ≥ 1 dose increased by 6.2%, ≥ 2 doses increased by 4.6%, and ≥ 3 doses increased by 3.4% between 2015 and 2016. The authors reported an average 5.0% increase in coverage of ≥ 1 HPV vaccine per year, nationally, between 2013 and 2016. The average coverage among males and females combined increased from 56.1% to 60.4% for ≥ 1 dose between 2015 – 2016 (21).

In 2017, 38% of MSM in our study population reported ≥ 1 HPV vaccine. This coverage rate is higher than anticipated. Previous studies with similar populations have reported rates of HPV vaccination among MSM in the range of 6%-21% (3, 5, 16). These study populations were 26.5%-75.6% non-Hispanic white (3-5, 15, 16), 44.3% - 63% college educated (4, 5, 15, 16), and 75% - 82.4% had health insurance (3, 15, 16). However, these prior studies were conducted using data from early stages of HPV vaccine implementation among boys and young men from smaller samples of MSM (4, 15, 17). Even though we observed a significant increase in HPV vaccination rate among MSM, it is still well below the Healthy People 2020 target of 80%, and below the coverage rate of 56% for ≥ 1 dose among males reported from the 2016 NIS-Teen survey. (21).

In addition to overall trend, we looked at trends of HPV vaccination among MSM by region and urbanicity. Other studies have found that MSM residing in the Northeast and West have higher HPV vaccine coverage rates (15, 22). We found increasing trends in ≥ 1 HPV vaccine for all regions. Among 2017 respondents alone, MSM living in the Northeast and West more likely to have received ≥ 1 HPV vaccine compared to MSM residing in the South. Overall trends from 2014-2017 indicate that the Midwest may be improving their HPV vaccination initiation among MSM; among our study population, we found proportion of vaccinated MSM in the Midwest surpassed the West by 2016. The South remains behind in coverage, but our results show the potential for improvement over the next few years, indicated by an EAPC of 19.8%.

Among 2017 respondents alone, MSM living in large central metro areas were significantly more likely to be vaccinated compared to MSM in rural areas. Trends from 2014-2017 indicate that rural areas may be starting to fall behind. From 2016- 2017, we did not find an increase in ≥ 1 HPV vaccine; the only category within region and urbanicity to not see an annual increase. This finding is supported by a previous study that reported rural adult residents were less likely to have heard of HPV compared to urban populations, and of those who had heard of HPV, 40% had not heard of the HPV vaccine or that HPV can cause cervical cancer (23). Other reasons for low uptake may include distance needed to travel to HCP and lack of alternative health resources, such as vaccine safety nets (24). Additionally, MSM in rural areas may be less comfortable disclosing their sexual identity due to anticipated stigma (25). Further research should be conducted to investigate the proposed reasons for low HPV vaccination receipt in rural areas to help improve strategies for increased HPV vaccination rates. This could include providing additional vaccine resources, such as travel clinics in rural locations.

Factors found to be associated with HPV vaccination in this study are similar to those observed in other studies involving MSM and LGBT persons. MSM who have any form of health insurance, have seen a HCP in the past 12 months, and have informed their HCP of their sexual identity are significantly more likely to have received ≥ 1 HPV vaccination (3, 15). However, as other studies have found, many MSM do not disclose their sexual identity to their HCP (11, 12, 26). Only 61% of men in our study who received ≥ 1 HPV vaccine reported that they had informed their HCP provider of their sexual identity. It is important that MSM feel comfortable

informing their HCP of their sexual identity so that they receive appropriate health care and education, including being counseled on the fact that the HPV vaccination window does not close at 21 like it does for heterosexual men. MSM have an additional 5 years within which to initiate the series and protect themselves and their partners from HPV (26).

MSM diagnosed with gonorrhea and/or chlamydia in the past 12 months were more likely to have received ≥ 1 HPV vaccination compared to MSM without. This finding may be associated with seeing a HCP - MSM who seek care may be more likely to get tested and therefore receive diagnoses of other STIs. However, in our study there is not a relationship between vaccine uptake and either syphilis diagnosis in the past 12 months or ever being diagnosed with a viral STI. The discrepancy might be due to high rates of chlamydia and gonorrhea infection in the US among MSM. The rate of gonorrhea among MSM increased 151% from 2010 – 2015 (27). There were an estimated 3,435 cases of gonorrhea per 100,000 MSM in 2016. Coinfection of gonorrhea and chlamydia is common. A study of STD Surveillance Network (SSuN) jurisdictions found gonorrhea and chlamydia co-infection in 20% of visits with positive gonorrhea infections and 26% of visits with positive chlamydia infections. The authors reported that these were likely underestimates due to frequent lack of concurrent testing (28). The estimated rate of syphilis in 2016 was much lower than gonorrhea at 200 to 400 cases per 100,000 MSM (27)

Unlike other studies, we did not find an association between HIV status and receipt of ≥ 1 HPV vaccine (4, 16). This could be due to underreporting of HIV status, lack of knowledge of HIV

status, or lack of testing in our study population. Among the 2017 participants, 64.5% reported negative HIV status, 3.5% reported positive HIV status, and 31.3% reported never testing for HIV. HIV prevalence was similar among men who had initiated the HPV vaccine compared to those who had not. Among individuals who did receive ≥ 1 HPV vaccine, 38.4% were HIV negative, 37.3% were HIV positive, and 36.1% had never been tested. The prevalence of HIV among MSM in the United States is approximately 15%, which is higher than the prevalence we found in our study sample (29).

This study is subject to limitations. First, AMIS is dependent on self-report; answers may be subject to recall error or reluctance to elaborate on confidential health information, like HIV status. However, participants completed the survey anonymously, which should have reduced social desirability bias. Second, our population may not be entirely representative of the true MSM population in the US since a large percentage of our population was non-Hispanic white and well-educated. Representativeness in studies of MSM is an important consideration, and while research has demonstrated remarkable comparability in the types of men recruited via social media-based recruitment and venue-time-space sampling, minority MSM are noticeably under-represented in this AMIS cohort (30). More research is needed, especially among minority MSM, to understand if the correlates of HPV vaccination are similar or different to those observed here. Lastly, we are only able to evaluate HPV vaccine initiation, not completion. Completion of the vaccine series is necessary to provide maximum protection against oncogenic HPV genotypes, and it is worth exploring whether and how series completion

rates among MSM differ from initiation rates, as well as how those rates compare to initiation and completion rates for other target populations. Any disparities observed would reveal potential areas for targeted outreach.

The prevalence of receiving ≥ 1 HPV vaccination among MSM has increased significantly from 2014 – 2017 among participants of the AMIS study, although the vaccination rates remain below desired levels, most notably among rural populations. More research needs to be conducted among a broader base population, such as a representative of the true underlying MSM population in the US. Characteristics of MSM who receive ≥ 1 HPV vaccination indicate that there is a need for providers to obtain accurate sexual histories to in turn be able to provide accurate recommendations regarding HPV vaccination. Many studies, including this one, indicate that important factors for HPV vaccination in MSM are having a HCP, providing that HCP with information about one's sexual identity, and having the HCP recommend the vaccine. While previous studies have reported that MSM are often aware of and educated about the link between HPV and cancer, they are not as likely to receive a recommendation for HPV vaccination if they do not disclose their sexual identity to their provider (3, 5, 9). Future HPV studies should explore barriers and facilitators to disclosure of sexual identity to HCP, particularly in rural areas; such research will serve to improve providers' abilities to educate and vaccinate MSM before exposure to oncogenic HPV genotypes (31).

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TABLE 1. Distribution of characteristics among MSM self-reporting ≥ 1 HPV vaccination, American Men's Internet Survey (AMIS), United States, 2014-2017

	Total (N = 4,290)	%
Age (years)		
15-21	2137	49.8
22-26	1524	35.5
27-32*	629	14.7
Race/Ethnicity		
Non-Hispanic white	2762	65.3
Non-Hispanic black	202	4.8
Hispanic/Latino [†]	835	19.8
Other [‡]	428	10.1
Education		
High school degree or less	1020	24.2
Some college or technical degree	1498	35.6
College degree or postgraduate	1693	40.2
Region		
Northeast	1049	24.5
Midwest	880	20.5
South	1348	31.4
West	1011	23.6
Location		
Large central metro	1800	42.0
Suburban	943	22.0
Small/medium metro	1218	28.4
Rural	326	7.6
Health insurance status		
Any [§]	3638	95.4
None	175	4.6
Annual household income		
<\$20,000	775	23.2
\$20,000-\$39,999	782	23.4
\$40,000-\$74,999	748	22.4
\geq \$75,000	1032	30.9
Seen HCP in last 12 months		
Yes	3613	91.9
No	317	8.1

* Maximum age of 32 years based on HPV vaccination recommendation age of 26 years for MSM in 2011

[†] Any race

[‡] Including Asian, Native Hawaiian, Pacific Islander, American Indian, Alaskan Native, and Multiracial

[§] Including private health plan purchased through an employer, private health plan purchased through an exchange (i.e. Obamacare), Medicaid or Medicare, other Medical Assistance program, TRICARE, Veterans Administration coverage or other health care plan

TABLE 2: Bivariate Analyses of HPV Vaccination and Demographic and Health-Related Characteristics, American Men's Internet Survey (AMIS), United States, 2017

	Total	No Reported HPV Vaccine		≥ 1 HPV Vaccine		χ^2 test statistic	ρ^*
		N	%	N	%		
Age (years)						215.1932	<0.0001
15-21	1385	702	33.0	683	53.3		
22-26	1126	696	32.8	430	33.5		
27-32 [†]	896	727	34.2	169	13.2		
Total	3407	2125		1282			
Race/Ethnicity						5.4898	0.1393
Non-Hispanic white	1999	1246	59.7	753	59.8		
Non-Hispanic black	196	137	6.6	59	4.7		
Hispanic/Latino [‡]	827	504	24.1	323	25.7		
Other [§]	325	201	9.6	124	9.8		
Total	3347	2088		1259			
Education						5.3154	0.0701
High school degree or less	886	525	25.2	361	28.7		
Some college or technical degree	1952	662	31.8	390	31.0		
College degree or postgraduate	1404	898	43.1	506	40.3		
Total	3342	2085		1257			
Region						55.553	<0.0001
Northeast	608	308	14.5	300	23.4		
Midwest	650	392	18.4	258	20.2		
South	1318	885	41.6	433	33.8		
West	829	540	25.4	289	22.6		
Total	3405	2125		1280			

Table 2 continued	Total	No Reported HPV Vaccine		≥ 1 HPV Vaccine		χ ² test statistic	ρ*
		N	%	N	%		
Location						21.1335	<0.0001
Large central metro	11371	819	38.5	552	43.1		
Suburban	710	422	19.9	288	22.5		
Small/medium metro	1055	691	32.5	364	28.4		
Rural	269	193	9.1	76	5.9		
Total	3405	2125		1280			
Health insurance status						42.3627	<0.0001
Any [†]	2759	1665	86.3	1094	93.8		
None	336	264	13.7	72	6.2		
Total	3095	1929		1166			
Annual Household income						47.4603	<0.0001
<\$20,000	551	344	21.1	207	21.1		
\$20,000-\$39,999	640	420	25.8	220	22.4		
\$40,000-\$74,999	699	486	29.8	213	21.7		
≥\$75,000	724	381	23.4	343	34.9		
Total	2614	1631		983			
Seen HCP in last 12 months						62.5969	<0.0001
Yes	2535	1502	80.3	1033	91.1		
No	470	369	19.7	101	8.9		
Total	3005	1871		1134			
Out to HCP						5.8714	0.0154
Yes	932	540	55.4	392	61.5		
No	679	434	44.6	245	38.5		
Total	1611	974		637			

Table 2 continued	Total	No Reported HPV Vaccine		≥ 1 HPV Vaccine		χ ² test statistic	p*
		N	%	N	%		
Ever tested for HIV						1.2941	0.2553
Yes	2318	1433	68.1	885	70.0		
No	1049	670	31.9	379	30.0		
Total	3367	2103		1264			
HIV Positive						0.0575	0.8105
Yes	118	74	5.3	44	5.0		
No	2162	1332	94.7	830	95.0		
Total	2280	1406		874			
Diagnosed with Gonorrhea or Chlamydia, past 12 months^{//}						11.3600	0.0008
Yes	356	192	9.4	164	13.1		
No	2949	1861	90.6	1088	86.9		
Total	3305	2053		1252			
Diagnosed with Syphilis, past 12 months^{//}						0.4854	0.4860
Yes	102	60	2.9	42	3.4		
No	3203	1993	97.1	1210	96.6		
Total	3305	2053		1252			
Diagnosed with viral STI, ever^{//}						0.0198	0.8881
Yes	299	187	9.1	112	9.0		
No	2989	1857	90.9	1132	91.0		
Total	3288	2044		1244			
Anal sex with condom, past 12 months						0.0217	0.8828
Yes	2240	1398	76.6	842	76.4		
No	686	426	23.4	260	23.6		
Total	2926	1824		1102			

* p-values are based on Pearson's χ^2 test of expected frequencies. Bolded p-values indicate significance at the 0.05 level.

† Maximum age of 32 years based on HPV vaccination recommendation age of 26 years for MSM in 2011

‡ Any race

§ Including Asian, Native Hawaiian, Pacific Islander, American Indian, Alaskan Native, and Multiracial

¶ Including private health plan purchased through an employer, private health plan purchased through an exchange (i.e. Obamacare), Medicaid or Medicare, other Medical Assistance program, TRICARE, Veterans Administration coverage or other health care plan

// Diagnosed by physician

TABLE 3. Multivariate analyses of factors associated with HPV vaccination among study participants, AMIS Study, United States, 2017

	aPR*	95% CI
Age (years)		
15-21	3.07	2.97 - 3.17
22-26	1.77	1.58 - 1.98
27-32 [†]	<i>Reference</i>	
Region		
Northeast	1.35	1.31 - 1.38
Midwest	1.08	0.96 - 1.21
South	<i>Reference</i>	
West	1.11	1.01 - 1.23
Location		
Large central metro	1.30	1.24 - 1.37
Suburban	1.18	1.14 - 1.25
Small/medium metro	1.03	0.97 - 1.10
Rural	<i>Reference</i>	
Health insurance status		
Any [‡]	1.80	1.53 - 2.17
None	<i>Reference</i>	
Annual household income		
<\$20,000	0.87	0.84 - 0.91
\$20,000-\$39,999	0.82	0.79 - 0.84
\$40,000-\$74,999	0.81	0.75 - 0.86
≥\$75,000	<i>Reference</i>	
Seen HCP in last 12 months		
Yes	1.80	1.62 - 2.07
No	<i>Reference</i>	
Out to HCP		
Yes	1.40	1.35 - 1.52
No	<i>Reference</i>	
Diagnosed with Gonorrhea or Chlamydia, past 12 months[§]		
Yes	1.19	1.07 - 1.33
No	<i>Reference</i>	

* aPR = adjusted prevalence ratio

[†] Maximum age of 32 years based on HPV vaccination recommendation age of 26 years for MSM in 2011

[‡] Including private health plan purchased through an employer, private health plan purchased through an exchange (i.e. Obamacare), Medicaid or Medicare, other Medical Assistance program, TRICARE, Veterans Administration coverage or other health care plan

[§] Diagnosed by physician

FIGURE 1: Percent of MSM who self-reported receiving ≥ 1 HPV vaccine and 95% confidence intervals, AMIS, 2014-2017.

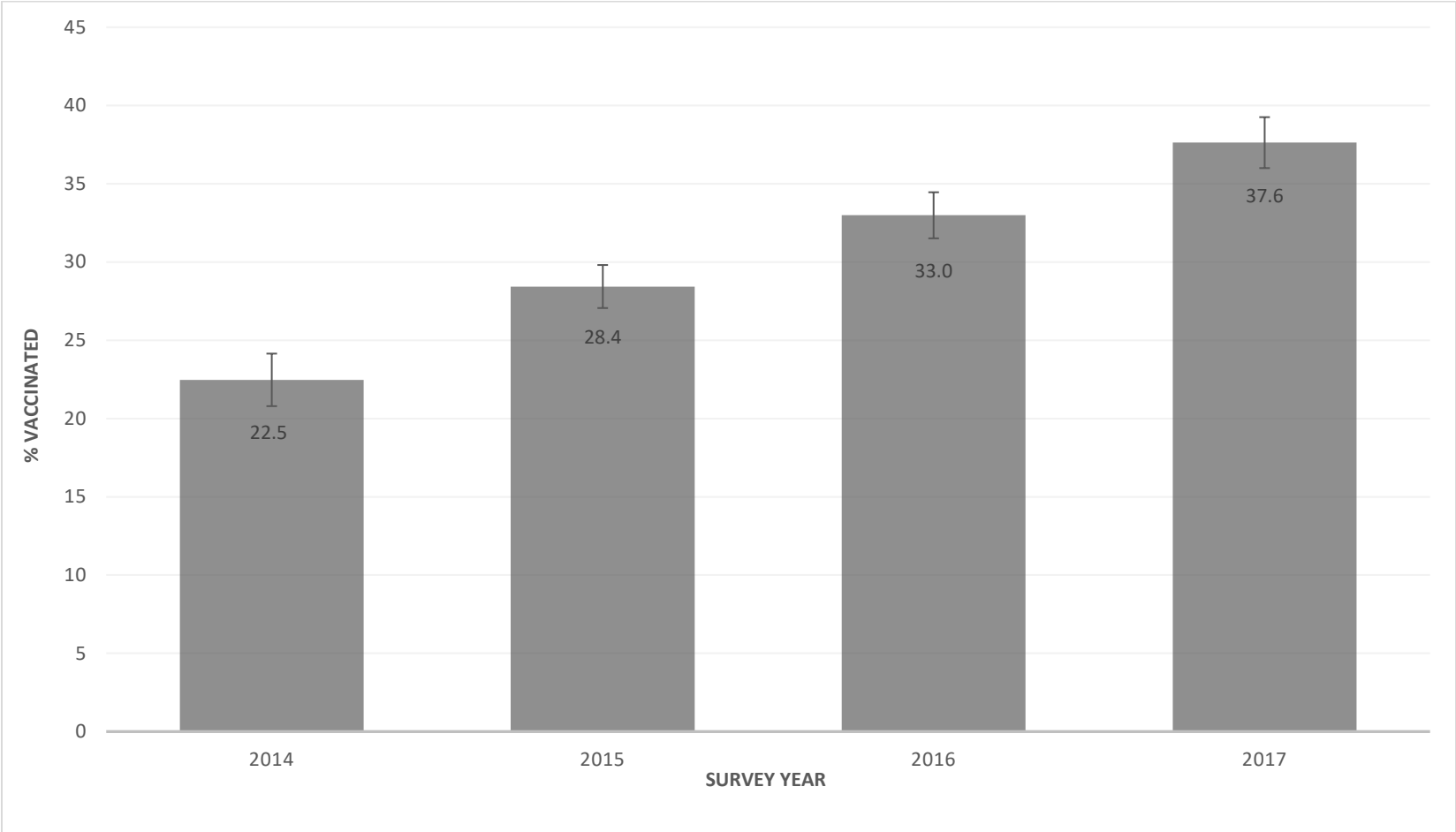


FIGURE 2: Percent of MSM who self-reported receiving ≥ 1 HPV vaccine by urbanicity with EAPC, AMIS, 2014-2017.

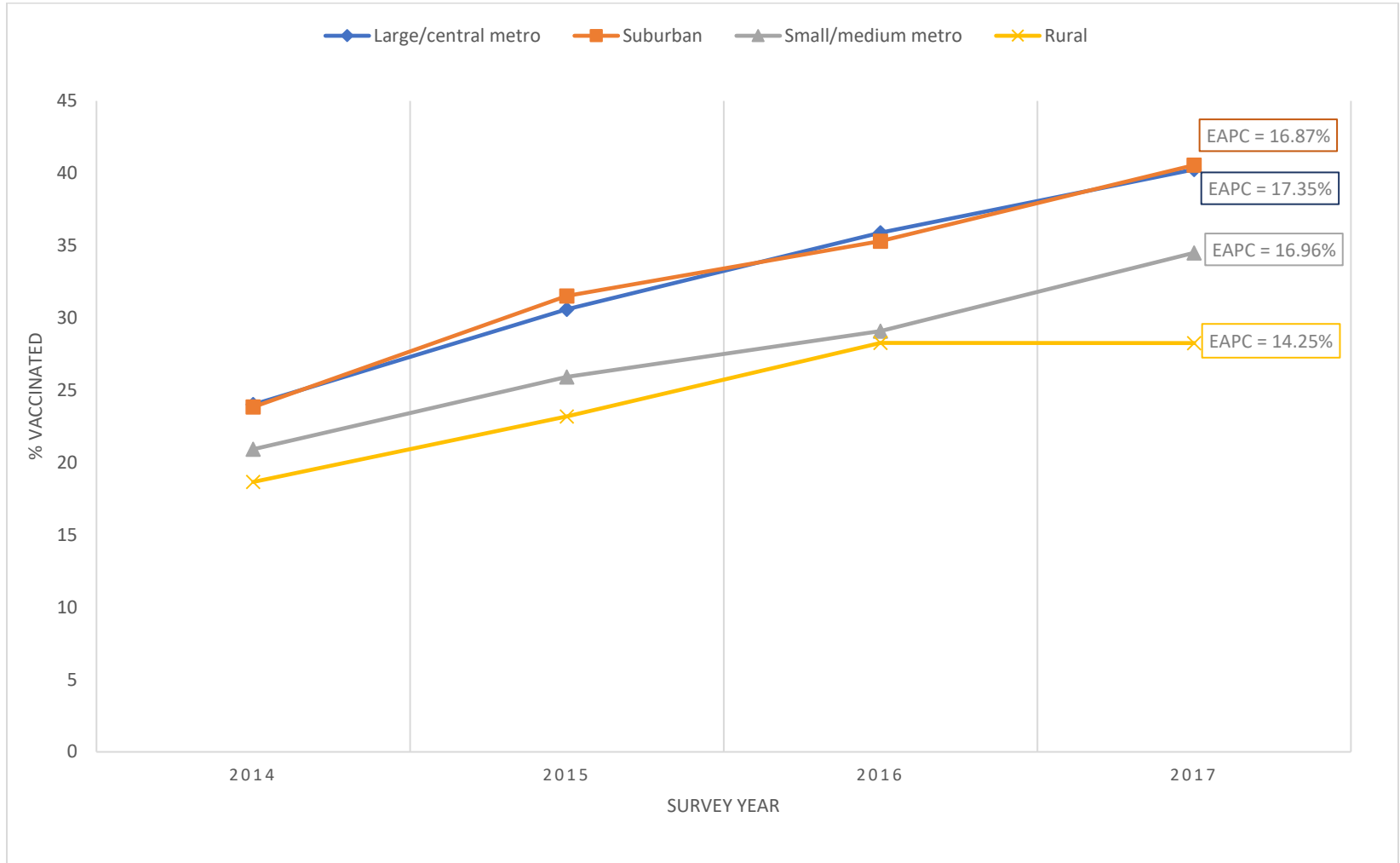


FIGURE 3: Percent of MSM who self-reported receiving ≥ 1 HPV vaccine by region with EAPC, AMIS, 2014-2017.

