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Sexual positioning practices and anal human papillomavirus infection among young men who have sex with men and transgender women — Chicago, Illinois, 2016–2018

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Abstract

Background.—Human papillomavirus (HPV) is the most common sexually transmitted infection in the United States; men who have sex with men (MSM) have higher prevalence of infection and related disease compared with other men. We assessed whether differences in HPV acquisition exist among MSM according to their sexual positioning practices as well as self-reported receipt of HPV vaccination.

Methods.—We enrolled young MSM and transgender women aged 18–26 years in Chicago, Illinois (N=666). Participants self-reported history of HPV vaccination, and submitted self-collected anal swab specimens for type-specific HPV detection using an L1-consensus PCR assay. Multivariable logistic regression analyses were used to assess relationships between sexual positioning practices and detection of any HPV or quadrivalent HPV vaccine (4vHPV) types by vaccination status, defined as self-reported receipt of ≥1 HPV vaccine dose versus none.

Results.—Among 666 participants, 400 (60.1%) had any anal HPV, and 146 (21.9%) had a 4vHPV type. Among vaccinated participants, 18, 36, and 177 reported exclusively insertive,

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exclusively receptive, or both sexual positioning practices, respectively. Compared to participants reporting exclusively insertive anal sex, odds of any HPV were significantly higher among participants engaging exclusively in receptive anal sex (aOR=5.90, 95% CI: 2.52–13.78) as well as those engaging in both (aOR=3.32; 95% CI: 1.71–6.44). Vaccinated participants, compared with unvaccinated participants, had lower odds of 4vHPV-type HPV regardless of sexual positioning practices (aOR=0.56; 95% CI: 0.34–0.92).

Conclusion.—Adult men and transgender women who practice anal receptive sex have high prevalence of infection with any HPV. Routine vaccination of all adolescents is expected to reduce HPV-related disease incidence among adult MSM and transgender women as vaccinated cohorts age.

Brief Summary

MSM and transgender women who practice anal receptive sex have high prevalence of infection with any HPV which might be reduced by providing vaccination before first engaging in anal sex.

Keywords

HPV; sexual and gender minorities; sexual behavior; sexually transmitted diseases; papillomavirus vaccines

Introduction

Human papillomavirus (HPV) is the most common sexually transmitted infection (STI) in the United States, with approximately 14.1 million new infections annually.[1] More than 200 types of HPV have been identified[2]; types are tissue-tropic and a few dozen are known to infect mucosal tissue.[3] These HPV types are further divided into either low-risk or high-risk types, with low-risk HPV types 6 and 11 being responsible for over 90% of anogenital warts,[4] and high-risk HPV types 16 and 18 causing the majority of HPV-associated cancers, including cervical, vaginal, vulvar, anal, penile and oropharyngeal cancers.[5] In the United States, 91% of anal cancers each year are attributable to any HPV type, with 79.4% attributable to HPV types 16 and 18.[5]

Men who have sex with men (MSM) have substantially higher prevalence of both HPV infection and anal cancer compared with other men.[6,7] Among MSM, those living with HIV, compared to HIV-negative individuals, have an even higher prevalence of HPV infection, with HPV type 16 most commonly detected.[6] Co-infection with HIV and HPV has been associated with progression of anal intraepithelial neoplasms,[8] with one study noting prevalence of anal cancer to be three times higher among those diagnosed with HIV compared to HIV-negative individuals (135 versus 45 per 100,000).[6] In a prospective study of anal cancer screening, anal HPV was highly prevalent among all MSM, and cytologic abnormalities including anal intraepithelial neoplasia of all grades (AIN) and grade 3 or worse (AIN3+) were more common among HIV-positive individuals compared to HIV-negative individuals.[7] A cross-sectional study of MSM without HIV identified significant associations with high-grade squamous intraepithelial lesions including infection with any anal HPV type and infection with a greater number of HPV types.[9]

Among MSM, differences in prevalence of HPV infection may also exist according to their sexual positioning practices during anal sex. Regarding sexual positioning practices, previous research observed that 83% of MSM in an Australian study participated in both insertive and receptive anal sex and 20% indicated participating in both practices in their most recent sexual encounter.[10] Furthermore, men engaging in receptive or reciprocal anal sex, rather than being exclusively the insertive partner during anal sex, have a significantly higher prevalence of STIs, including both bacterial and viral STIs.[11] Receptive anal sex partners, therefore, may be at unique risk for HPV-associated anal cancer[12] due to the intersection of higher prevalence of HPV and HIV infections,[13,14] increased likelihood of rectal tearing during sex leading to greater susceptibility to infection,[15,16] and potential for pre-malignant lesions of the rectal mucosa as a result of HPV infection.[8,17]

HPV vaccination is routinely recommended for U.S. adolescents including boys and girls at age 11 or 12 years.[18] Since 2009, two prophylactic HPV vaccines have been licensed for use in males: quadrivalent HPV vaccine (4vHPV), which protects against HPV types 6, 11, 16, and 18, and nonavalent HPV vaccine (9vHPV), which protects against HPV types 6, 11, 16, 18, 31, 33, 45, 52, and 58.[18] During 2011 through 2019, HPV vaccination was recommended for men through age 21 years and MSM through age 26 years, as well as women, transgender persons, and men with certain immunocompromising conditions including HIV.[18] Accordingly, between 2013 and 2018, the percentage of U.S. men aged 18–26 years who had ever received ≥1 dose of HPV vaccine rose from 7.7% in 2013 to 27.0% in 2018.[19] Less robust research exists specifically among MSM, however, as of 2017, 17.9% of all MSM and 32.8% of young MSM in the U.S> had received ≥1 dose of the vaccine.[20] In Chicago, the proportion of male adolescents age 13–17 years with ≥3 doses of HPV vaccine rose from 19.8% in 2013 to 37.8% in 2018.[21] In late 2019, the Advisory Committee on Immunization Practices (ACIP) harmonized HPV vaccination recommendations for everyone through age 26 years including MSM. ACIP also recommended shared clinical decision-making regarding potential HPV vaccination for some persons aged 27 through 45 years who might be at risk for new HPV infection and might benefit from vaccination; however, the public health benefit of vaccinating adults in this age range is not clear.[19]

The objective of this paper is to assess factors associated with prevalent anal HPV, including HPV vaccination, by sexual positioning practices (i.e., insertive versus receptive anal sex) among certain young adult sexual and gender minorities (i.e., MSM and transgender women) in a major U.S. city. We hypothesized that persons engaging in insertive anal sex exclusively would be less likely to have detectable anal HPV compared to persons engaging in receptive anal sex. In addition, we expected that receipt of HPV vaccination would be protective against vaccine-type anal HPV infections.

Methods

The Vaccine Impact in Men (VIM) study assessed one-time HPV prevalence among a sample of MSM and transgender women aged 18–26 years in the Chicago metropolitan area who also participated in the RADAR study, an ongoing longitudinal cohort study of a syndemic of health issues associated with HIV among young sexual and gender minorities

assigned male sex at birth.[22] Diverse methods for participant enrollment into RADAR were used in order to achieve a multiple cohort, accelerated longitudinal design using modified snowball sampling methods.[23] To achieve this accelerated study design, a subset of participants from two previous cohorts of young MSM, Project Q2 and Crew 450, were enrolled in RADAR. In 2015, a third cohort of young MSM was enrolled. At the time of enrollment into RADAR, all participants were aged 16–29 years, assigned male sex at birth, spoke English, and had sex with a man in the previous year or identified as gay, bisexual or transgender. All cohort members completed follow-up visits at six-month intervals and provided informed consent.

Enrollment in the VIM study subsequently occurred during February 2016 through September 2018. Participants already enrolled in RADAR were assessed at their study visit for eligibility for VIM and were eligible if they provided written informed consent and met the following criteria: (1) aged 18 through 26 years; (2) assigned male sex at birth; and (3) ever had sex (oral or anal) with a male partner, and/or identified as gay or bisexual. Enrollment of eligible individuals continued until the desired sample size was achieved. VIM study methods have been described in further detail previously. Participants received gift card compensation. The study was reviewed and approved by institutional review boards at Northwestern University and at CDC.

The analyses conducted here include longitudinal behavioral data from all RADAR study visits up through the date of VIM study enrollment and participation, when anal specimens were collected for HPV testing (e.g., if HPV specimens were collected at the RADAR 24-month follow-up visit, then data included were from the baseline visit, and follow-up visits at 6, 12, 18, and 24 months). VIM study enrollment (N=666) occurred at the following RADAR visits: baseline (n=5), 6-month follow-up (n=177), 12-month follow-up (n=136), 18-month follow-up (n=121), 24-month follow-up (n=91), 30-month follow-up (n=69), and 36-month follow-up (n=67). The analytic sample included multiple RADAR study visits to assess longitudinal patterns of sexual behavior, and only a single, cross-sectional VIM study visit.

Demographics.

Participants self-reported demographic information including age, sex, race, ethnicity, and sexual orientation. Participants reporting Hispanic/Latino ethnicity were coded as such, regardless of their racial identity. Participants also self-reported information on their current health insurance status (i.e., currently insured versus none).

HPV vaccination.

HPV vaccination was operationalized as a binary variable indicating having received either no HPV vaccination by self-report, or self-reported receipt of ≥1 dose of any HPV vaccine (i.e., 4vHPV or 9vHPV).

Anal HPV.

Each participant submitted a self-collected anal swab specimen. Detailed methods have been reported previously.[24] Specimens were shipped to CDC for HPV testing using a research use

only L1-consensus PCR assay (Roche Linear Array) to detect any of 37 HPV types[25] (types 6, 11, 16, 18, 26, 31, 33, 35, 39, 40, 42, 45, 51, 52, 53, 54, 55, 56, 58, 59, 61, 62, 64, 66, 67, 68, 69, 70, 71, 72, 73, 81, 82, 83, 84, 89, and IS39). 4vHPV types were HPV 6, 11, 16, and 18. Variables were operationalized dichotomously as having any detectable HPV or none, and as having at least one detectable 4vHPV type or none.

Sexual positioning.

Sexual positioning practices during anal sex were determined using longitudinal data and included all prior study visits up to and including the visit at which anal specimens were obtained for HPV testing (e.g., for an anal specimen collected at a 12-month follow-up visit, sexual positioning data for that participant was included from baseline, 6-month, and 12-month visits). Sexual positioning practices were defined as behavior in the six-month period prior to each study visit; behaviors were operationalized as a categorical variable as reporting engaging in insertive anal sex exclusively, engaging in receptive anal sex exclusively, or engaging in both practices.

HIV status and sex behaviors.

Fingerstick blood samples were collected every six months as part of each participant's RADAR study visit. Each participant's HIV infection status was determined using the Alere™ Determine™ HIV1/2 Ab/Ag Combo 4th generation point-of-care test. Those who tested positive on the point-of-care HIV tests received confirmatory HIV antigen and antibody immunoassay testing following current CDC HIV testing guidelines. Condomless anal sex with male partners was assessed using the HIV Risk Assessment of Sexual Partnerships Survey and was reported by participants on a partner-by-partner basis as the number of instances of condomless anal sex in the past six months.[26,27] It was operationalized as having either no instances of condomless sex or having at least one instance of condomless sex. Number of insertive or receptive anal sex acts was reported at each study visit as the total number of acts with the participant's last four partners. Total number of sex partners over the study period was considered in sensitivity analyses.

Statistical analyses.

Participant characteristics were described using means and standard deviations (SD), or proportions, as appropriate. A series of multivariable logistic regression models were used to examine whether sexual positioning was associated with detection of 1) any HPV type and 2) 4vHPV types and, within each of these, to separately consider persons engaging in either any insertive anal sex versus none or any receptive anal sex versus none. All models were adjusted for demographic characteristics. All covariates identified as statistically significant at the $p \leq 0.05$ level in bivariate analyses using the Wald test statistic, or known confounders (i.e., insurance status, condomless anal sex, number of sex acts, HIV status) were included in the multivariable regression model. Sensitivity analyses considered: 1) total number of sex partners, either condomed or condomless, in place of number of sex acts; and 2) treating both condomless anal sex and receipt of vaccination as effect modifiers of sexual positioning. All analyses were performed in RStudio v1.1353 and R v3.5.2.[28]

Results

This analysis included 666 participants with anal HPV results (Table 1). All were aged 18–26 years; mean age was 21.6 years (SD 2.4). All participants were assigned male sex at birth; current gender identity was 605 (90.8%) male and 61 (9.2%) transgender or other gender identity. Participants self-reported their race and ethnicity as 174 (26.1%) non-Hispanic white, 214 (32.1%) non-Hispanic black, 211 (31.7%) Hispanic/Latino, and 67 (10.1%) other or multiracial. Regarding sexual orientation, 474 (71.2%) identified as gay, 105 (15.8%) as bisexual, and 87 (13.1%) as another sexual orientation. In addition, 548 (85.6%) participants reported having health insurance, 242 (45.1%) reported receipt of ≥1 HPV vaccine dose, and 352 (53.7%) had at least one instance of condomless sex during the study period. Overall, 113 (17.0%) tested positive for HIV. By self-report, 73 (11.0%) engaged exclusively in insertive anal sex, 87 (13.1%) engaged exclusively in receptive anal sex, 475 (71.3%) engaged in both insertive and receptive anal sex, and 31 (4.7%) engaged in neither in the time frame of the study. Regarding HPV vaccination status, 242 (45.1%) total reported receiving ≥1 dose, including 18 (29.5%) of those engaging exclusively in insertive anal sex, 36 (52.2%) of those engaging exclusively in receptive anal sex, and 177 (46.3%) of those engaging in either insertive or receptive anal sex. Any HPV type was detected in anal specimens from 400 (60.1%) participants, and a 4vHPV type was detected in 146 (21.9%).

The first model considered factors associated with anal infection with any HPV type as the outcome and sexual positioning practice as the primary independent variable (Table 2). In this model, there was a significant increase in odds of any HPV among participants engaging exclusively in receptive anal sex compared with engaging exclusively in insertive anal sex (adjusted odds ratio [aOR] = 5.90, 95% confidence interval [CI]: 2.52–13.78). Similarly, a significant increase was observed among participants engaging in both insertive and receptive anal sex, compared to those engaging exclusively in insertive anal sex (aOR = 3.31; 95% CI: 1.71–6.44). Additionally, participants engaging in condomless anal sex (aOR = 1.97, 95% CI: 1.28–3.04;), and HIV-positive participants (aOR = 6.41, 95% CI: 2.81–14.60) each had significantly higher odds of having any HPV compared to participants consistently using condoms and HIV-negative participants, respectively. The odds of having any HPV also increased with each year of age (aOR = 1.18, 95% CI: 1.07–1.30). No significant differences in any HPV were observed with regard to race/ethnicity, sexual orientation, insurance status, HPV vaccination receipt, or total number of insertive/receptive anal sex acts during the study period.

The second model considered factors associated with anal infection with a 4vHPV type as the outcome and sexual positioning practice as the primary independent variable (Table 2). In this model, there was no significant increase in odds of 4vHPV type and sexual positioning practices. A key finding was that among participants who received ≥1 dose of HPV vaccine, compared with participants who received none, there was a reduced odds of anal infection with a 4vHPV type, (aOR = 0.56; 95% CI: 0.34–0.92). Similar to the previous model, older participants (aOR = 1.28, 95% CI: 1.15–1.43), those engaging in condomless anal sex (aOR = 1.93, 95% CI: 1.15–3.24), and those diagnosed with HIV (aOR = 3.30, 95% CI: 1.80 −6.05) each had significantly higher odds of infection with a 4vHPV type compared to younger participants, those consistently using condoms, and HIV-negative participants,

respectively. No significant differences in 4vHPV-types were observed with regard to race/ethnicity, sexual orientation, insurance status, or total number of anal sex acts during the study period.

In sensitivity analyses of both models, interaction terms were considered between sexual positioning practices and both condomless anal sex and self-reported HPV vaccination status. For neither term was significant effect modification present in either of the models. A second set of sensitivity analyses considered total number of sex partners in place of total number of sex acts, no differences in the models were observed.

Discussion

Using data from a large diverse sample of young MSM and transgender women in Chicago to evaluate associations between sexual positioning practices and anal HPV infection, we observed no significant association between HPV vaccination and having any HPV infection, even after adjusting for differences in sexual positioning practices, suggesting that vaccinated and unvaccinated participants were similarly exposed to HPV. The finding that vaccination was associated with lower odds of 4vHPV types in anal specimens provides evidence of vaccine effectiveness for prevention of vaccine-type HPV among young MSM and transgender women regardless of sexual positioning. Consistent with existing literature on known risk factors for HPV infection, we observed that older individuals, those engaging in any condomless anal sex during the study period, and those diagnosed with HIV were more likely to have a detectable 4vHPV type and any HPV type in their anal specimen. Factors not associated with anal HPV infection in this analysis included race/ethnicity, health insurance status, or number of insertive/receptive anal sex acts during the study period.

Persons engaging in receptive anal sex were more likely to have detectable anal HPV compared to those engaging in insertive anal sex in our data. Odds of any anal HPV were highest among participants engaging exclusively in receptive anal sex, followed by the odds among participants engaging in both insertive and receptive anal sex. Although participants engaging in receptive anal sex at any point during the study period had a greater point prevalence of any anal HPV, they were not more likely to have 4vHPV vaccine-type HPV, likely due to the protective effect of prior HPV vaccination. No association was observed between sexual positioning practices and odds of anal infection with 4vHPV types.

Sexual positioning practices might affect the chance of acquiring a new HPV infection. Previously published work in this area has noted that men engaging in receptive sexual positioning are more likely to acquire HPV-infection as well as to develop HPV-associated precancer lesions.[8,29] Our study builds on this past work by reporting key findings related to HPV vaccination status, namely that vaccination was associated with lower odds of 4vHPV vaccine-type HPV. Additionally, we observed that participants who had engaged exclusively in receptive anal sex during the study period were more likely to have any detectable HPV compared to other participants. MSM may have long lifetime periods of acquiring new sex partners,[30] and sexual positioning practices may change over time.[11] Given an association between older age and HPV infection, these sexual behavior practices

suggest that some MSM might remain susceptible to new HPV infections later in life.[11] We noted that nearly half of both exclusive receptive partners and versatile partners lacked even a single dose of HPV vaccine, suggesting missed opportunities for vaccination in this population. Future research should explore the impacts on all adults, including MSM and transgender women, of increasing HPV vaccination rates and cancer screening practices in the broader population.

This analysis is subject to several limitations. First, HPV vaccination history was self-reported, and some participants could have misreported their vaccination status; age at vaccination and number of doses could not be assessed. Second, factors associated with genital/penile HPV could not be assessed as only anal specimens were collected in this study. Third, although sexual positioning data were obtained prior to HPV sample collection, we cannot definitely establish timing of the initial HPV infection relative to sexual behavior. Fourth, this study used a community sample rather than a probability sample and may have been subject to enrollment cohort effects; as such, findings may not be generalizable to the larger population of young men who have sex with men, particularly those outside an urban environment. Fifth, condom use and sexual encounters were treated as dichotomous variables in this analysis; and chances of HPV exposure were not further quantified.

These findings suggest that young MSM who engage in receptive anal sex have a particularly high prevalence of anal infection with any HPV type. Encouragingly, those who received HPV vaccination had significantly reduced likelihood of infection with 4vHPV types, a finding that supports current national HPV vaccination recommendations to vaccinate everyone including all MSM through age 26 years. Routine vaccination of all adolescents is expected to reduce HPV-related disease incidence among adult MSM and transgender women as vaccinated cohorts age. Because HPV vaccination is prophylactic and most effective when given before exposure, we expect that anal HPV infections, and subsequent development of HPV-related anal cancers, might be further reduced by providing HPV vaccination to MSM and transgender women before first engaging in receptive anal sex. A helpful additional step would be identification of a suite of interventions to decrease anal cancer incidence among MSM and transgender women regardless of their choice of sexual positioning.

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References

1. Satterwhite CL, Torrone E, Meites E, et al.Sexually transmitted infections among US women and men: prevalence and incidence estimates, 2008. Sex Transm Dis2013; 40(3): 187–93. [PubMed: 23403598]
2. National Cancer Institute. HPV and Cancer. 2020. https://www.cancer.gov/about-cancer/causes-prevention/risk/infectious-agents/hpv-and-cancer (accessed July 9 2020).
3. Egawa N, Egawa K, Griffin H, Doorbar J. Human Papillomaviruses; Epithelial Tropisms, and the Development of Neoplasia. Viruses2015; 7(7): 3863–90. [PubMed: 26193301]
4. Garland SM, Steben M, Sings HL, et al.Natural history of genital warts: analysis of the placebo arm of 2 randomized phase III trials of a quadrivalent human papillomavirus (types 6, 11, 16, and 18) vaccine. J Infect Dis2009; 199(6): 805–14. [PubMed: 19199546]
5. Saraiya M, Unger ER, Thompson TD, et al.US assessment of HPV types in cancers: implications for current and 9-valent HPV vaccines. J Natl Cancer Inst2015; 107(6): djv086.
6. Machalek DA, Poynten M, Jin F, et al.Anal human papillomavirus infection and associated neoplastic lesions in men who have sex with men: a systematic review and meta-analysis. Lancet Oncol2012; 13(5): 487–500. [PubMed: 22445259]
7. Schofield AM, Sadler L, Nelson L, et al.A prospective study of anal cancer screening in HIV-positive and negative MSM. AIDS2016; 30(9): 1375–83. [PubMed: 26836788]
8. Roberts JR, Siekas LL, Kaz AM. Anal intraepithelial neoplasia: A review of diagnosis and management. World J Gastrointest Oncol2017; 9(2): 50–61. [PubMed: 28255426]
9. Chin-Hong PV, Vittinghoff E, Cranston RD, et al.Age-Related Prevalence of Anal Cancer Precursors in Homosexual Men: The EXPLORE Study. JNCI: Journal of the National Cancer Institute2005; 97(12): 896–905. [PubMed: 15956651]
10. Lyons A, Pitts M, Smith G, et al.Versatility and HIV Vulnerability: Investigating the Proportion of Australian Gay Men Having Both Insertive and Receptive Anal Intercourse. The journal of sexual medicine2011; 8(8): 2164–71. [PubMed: 21269403]
11. Dangerfield DT 2nd, Smith LR, Williams J, Unger J, Bluthenthal R. Sexual Positioning Among Men Who Have Sex With Men: A Narrative Review. Archives of sexual behavior2017; 46(4): 869–84. [PubMed: 27178171]
12. Goldie SJ, Kuntz KM, Weinstein MC, Freedberg KA, Palefsky JM. Cost-effectiveness of screening for anal squamous intraepithelial lesions and anal cancer in human immunodeficiency virus-negative homosexual and bisexual men. The American journal of medicine2000; 108(8): 634–41. [PubMed: 10856411]
13. Friedman HB, Saah AJ, Sherman ME, et al.Human papillomavirus, anal squamous intraepithelial lesions, and human immunodeficiency virus in a cohort of gay men. J Infect Dis1998; 178(1): 45–52. [PubMed: 9652422]
14. Palefsky JM, Holly EA, Ralston ML, Jay N. Prevalence and risk factors for human papillomavirus infection of the anal canal in human immunodeficiency virus (HIV)-positive and HIV-negative homosexual men. J Infect Dis1998; 177(2): 361–7. [PubMed: 9466522]
15. Palefsky JM, Shiboski S, Moss A. Risk factors for anal human papillomavirus infection and anal cytologic abnormalities in HIV-positive and HIV-negative homosexual men. J Acquir Immune Defic Syndr1994; 7(6): 599–606. [PubMed: 8176644]
16. Abramowitz L, Benabderrahmane D, Ravaud P, et al.Anal squamous intraepithelial lesions and condyloma in HIV-infected heterosexual men, homosexual men and women: prevalence and associated factors. AIDS2007; 21(11): 1457–65. [PubMed: 17589192]
17. Palefsky JM, Holly EA, Ralston ML, Jay N, Berry JM, Darragh TM. High incidence of anal high-grade squamous intra-epithelial lesions among HIV-positive and HIV-negative homosexual and bisexual men. AIDS1998; 12(5): 495–503. [PubMed: 9543448]
18. Markowitz L, Dunne E, Saraiya M, et al.Human Papillomavirus Vaccination: Recommendations of the Advisory Committee on Immunization Practices (ACIP). MMWR2014; 63(RR05): 1–30.
19. Centers for Disease Control and Prevention. Human Papillomavirus Vaccination Among Adults Aged 18–26, 2013–2018. 2020. https://www.cdc.gov/nchs/products/databriefs/

db354.htm#:~:text=From%202013%20through%202018%2C%20the,from%207.7%25%20to%2027.0%25. (accessed March 2 2021).

20. Boersma P, Black LI. Human Papillomavirus Vaccination Among Adults Aged 18–26, 2013–2018. NCHS Data Brief2020; (354): 1–8.
21. Chicago Department of Public Health. HPV Vaccination. 2020. https://www.chicagohealthatlas.org/indicators/hpv-vaccination (accessed March 2 2021).
22. Mustanski B, Garofalo R, Herrick A, Donenberg G. Psychosocial health problems increase risk for HIV among urban young men who have sex with men: preliminary evidence of a syndemic in need of attention. Annals of Behavioral Medicine2007; 34(1): 37–45. [PubMed: 17688395]
23. Miyazaki Y, Raudenbush SW. Tests for linkage of multiple cohorts in an accelerated longitudinal design. Psychol Methods2000; 5(1): 44–63. [PubMed: 10937322]
24. Meites E, Gorbach PM, Gratzer B, et al.Monitoring for Human Papillomavirus Vaccine Impact Among Gay, Bisexual, and Other Men Who Have Sex With Men-United States, 2012–2014. J Infect Dis2016; 214(5): 689–96. [PubMed: 27296847]
25. de Villiers EM, Fauquet C, Broker TR, Bernard HU, zur Hausen H. Classification of papillomaviruses. Virology2004; 324(1): 17–27. [PubMed: 15183049]
26. Mustanski BS, Starks T, Newcomb M. Methods for the design and analysis of relationship and partner effects on sexual health. Archives of Sexual Behavior2014; 43(1): 21–33. [PubMed: 24243003]
27. Swann G, Newcomb ME, Mustanski B. Validation of the HIV Risk Assessment of Sexual Partnerships (H-RASP): Comparison to a 2-month prospective diary study. Arch Sex Behav2018; 47(1): 121–31. [PubMed: 28733826]
28. RStudio Team. RStudio: Integrated development for R. Boston, MA: RStudio, Inc; 2017.
29. Salati SA, Al Kadi A. Anal cancer - a review. Int J Health Sci (Qassim)2012; 6(2): 206–30. [PubMed: 23580899]
30. Glick SN, Morris M, Foxman B, et al.A comparison of sexual behavior patterns among men who have sex with men and heterosexual men and women. J Acquir Immune Defic Syndr2012; 60(1): 83–90. [PubMed: 22522237]

Table 1.

Characteristics of participating young men who have sex with men and transgender women — Chicago, 2016–2018

	Total		
Characteristic	**Mean (SD)**	**n**	**%**
Total		666	100.0
Age, mean (SD)	21.6 (2.4)	-	-
Race/ethnicity			
Non-Hispanic white	-	174	26.1
Non-Hispanic black	-	214	32.1
Hispanic/Latino	-	211	31.7
Other	-	67	10.1
Sexual orientation			
Gay	-	474	71.2
Bisexual	-	105	15.8
Other	-	87	13.1
Gender identity			
Male		605	90.8
Transgender or other identity		61	9.2
Health insurance			
Any	-	548	85.6
None	-	92	14.4
HPV vaccination, self-reported			
None	-	295	54.9
≥1 dose	-	242	45.1
Condomless anal sex (CAS) [1]			
No	-	304	46.3
Yes	-	352	53.7
Number of insertive CAS acts [1]	39.7 (393.28)	-	-
Number of receptive CAS acts [1]	27.7 (70.29)	-	-
HIV test result			
HIV-negative	-	553	83.0
HIV-positive	-	113	17.0
Sexual positioning [2]			
Insertive anal sex exclusively	-	73	11.0
Receptive anal sex exclusively	-	87	13.1
Either insertive or receptive anal sex		475	71.3
Anal HPV type/s detected			
Quadrivalent vaccine type/s[3]	-	146	21.9
Any type/s[4]	-	400	60.1

	Total		
Characteristic	**Mean (SD)**	**n**	**%**
Number of positive HPV types	2.06 (2.47)	-	-

Abbreviations: CAS, condomless anal sex; HPV, Human papillomavirus; HIV, Human immunodeficiency virus

[1] Across study visits up to and including visit at which anal swab specimens were collected

[2] Categories do not sum to 100% as not all participants report anal sex during the study period

[3] HPV types 6, 11, 16, and/or 18

[4] HPV types 6, 11, 16, 18, 26, 31, 33, 35, 39, 40, 42, 45, 51, 52, 53, 54, 55, 56, 58, 59, 61, 62, 64, 66, 67, 68, 69, 70, 71, 72, 73, 81, 82, 83, 84, 89, and/or IS39

Table 2.

Variables associated with HPV infection, either quadrivalent vaccine-type HPV or any HPV, among young men who have sex with men and transgender women— Chicago, Illinois, 2016–2018

	Quadrivalent vaccine-type HPV[1]		Any HPV[2]	
Variable	**aOR**	**95% CI**	**aOR**	**95% CI**
Sexual positioning				
Insertive anal sex exclusively	ref	-	-	-
Receptive anal sex exclusively	1.67	0.60 – 4.64	5.90***	2.52 – 13.78
Either insertive or receptive anal sex	1.82	0.77 – 4.30	3.31**	1.71 – 6.44
Age	1.28***	1.15 – 1.43	1.18***	1.07 – 1.30
Race/ethnicity				
Non-Hispanic white	ref	-	ref	-
Non-Hispanic black	0.95	0.48 – 1.89	1.15	0.64 – 2.07
Hispanic/Latino	0.57	0.29 – 1.14	0.83	0.49 – 1.42
Other	1.71	0.74 – 3.96	1.70	0.79 – 3.67
Sexual orientation				
Gay	ref	-	ref	-
Bisexual	1.06	0.55 – 2.05	0.84	0.47 – 1.48
Other	1.32	0.65 – 2.72	0.58	0.31 – 1.07
Health insurance				
Any	ref	-	ref	-
None	1.59	0.84 – 3.00	1.07	0.59 – 1.93
HPV vaccination, self-reported				
None	ref	-	ref	-
≥1 dose	0.56*	0.34 – 0.92	0.69	0.45 – 1.06
Condomless anal sex				
No	Ref	-	ref	-
Yes	1.93*	1.15 – 3.24	1.97**	1.28 – 3.04
Total number of sex acts	1.00	1.00 – 1.00	1.00	1.00 – 1.00
HIV test result				
HIV-negative	ref	-	ref	-
HIV-positive	3.30***	1.80 – 6.05	6.41***	2.81 – 14.60

Abbreviations: aOR, adjusted odds ratio; CI, confidence interval; HPV, human papillomavirus; HIV, human immunodeficiency virus

*p<0.05;

**p<0.01;

***p<0.001

[1]HPV types 6, 11, 16, and/or 18

[2]HPV types 6, 11, 16, 18, 26, 31, 33, 35, 39, 40, 42, 45, 51, 52, 53, 54, 55, 56, 58, 59, 61, 62, 64, 66, 67, 68, 69, 70, 71, 72, 73, 81, 82, 83, 84, 89, and/or IS39