



## Differences in HIV testing among sexual orientation subgroups in the United States: A national cross-sectional study

Holly Gurnik<sup>a,b</sup>, Curtiss W. Engstrom<sup>a,c</sup>, Sean Esteban McCabe<sup>a,d,e,f,g,h</sup>, Rebecca J. Evans-Polce<sup>a,g,\*</sup>

<sup>a</sup> Center for the Study of Drugs, Alcohol, Smoking and Health, Department of Health Behavior and Biological Sciences, University of Michigan School of Nursing, Ann Arbor, MI 48109, USA

<sup>b</sup> School of Public Health, University of Michigan, Ann Arbor, MI 48109, USA

<sup>c</sup> Program in Survey and Data Science, Institute for Social Research, University of Michigan, Ann Arbor, MI 48104, USA

<sup>d</sup> Institute for Research on Women and Gender, University of Michigan, Ann Arbor, MI 48109, USA

<sup>e</sup> Center for Sexuality and Health Disparities, Department of Health Behavior and Biological Sciences, University of Michigan School of Nursing, Ann Arbor, MI 48109, USA

<sup>f</sup> Institute for Healthcare Policy and Innovation, University of Michigan, Ann Arbor, MI 48109, USA

<sup>g</sup> Survey Research Center, Institute for Social Research, University of Michigan, Ann Arbor, MI 48104, USA

<sup>h</sup> Rogel Cancer Center, University of Michigan, Ann Arbor, MI 48109, USA

### ARTICLE INFO

#### Keywords:

HIV testing  
Sexual orientation  
Health disparities  
Cross-sectional  
United States

### ABSTRACT

Understanding differences in HIV testing among US adults is a crucial step for HIV prevention. This study used cross-sectional data to assess whether HIV testing varies across sexual orientation subgroups and by important psychosocial factors. Data were from the National Epidemiological Survey on Alcohol and Related Conditions-III (NESARC-III;  $n = 36\,309$ , response rate = 60.1%), a nationally representative survey of the US non-institutionalized adult population. Using logistic regression, we examined HIV testing among heterosexual concordant, heterosexual discordant, gay/lesbian, and bisexual adults. Psychosocial correlates included adverse childhood experiences (ACEs), discrimination, educational attainment, social support, and substance use disorders (SUDs). Bisexual (77.0%) and gay/lesbian (65.4%) women had a greater prevalence of HIV testing than concordant heterosexual women (51.6%), and bisexual women had a significantly higher testing prevalence than discordant heterosexual women (54.8%). Gay (84.0%) and bisexual (72.1%) men also had a significantly higher testing prevalence than discordant (48.2%) and concordant (49.4%) heterosexual men. In multivariable models, bisexual men and women (AOR = 1.8; 95% CI = 1.3–2.4) and gay men (AOR = 4.7; 95% CI = 3.2–7.1) had significantly greater odds of HIV testing than heterosexual concordant adults. A higher number of ACEs, greater social support, history of SUDs, and higher educational attainment were positively associated with HIV testing. HIV testing prevalence varied across sexual orientation subgroups; discordant heterosexual men had the lowest prevalence. Health care providers should consider a person's sexual orientation, ACEs, educational attainment, social support, and history of SUDs when evaluating HIV testing needs in the US.

### 1. Introduction

Human immunodeficiency virus (HIV) remains a global health crisis and sexual minorities continue to carry a disproportionate burden of HIV infection and mortality (CDC, 2021). Despite growing awareness of the necessity for HIV testing, 13% of individuals who are HIV positive are unaware of their status (CDC, 2021; CDC, 2022a; U.S. Statistics,

2021). The Centers for Disease Control and Prevention (CDC) recommends individuals aged 13–64 test for HIV at least once as part of routine healthcare (CDC, 2022a). However, for people who are considered higher risk such as men who have sex with men (MSM), people with multiple sex partners, or people who share drug injection equipment, the CDC recommends getting tested once a year (CDC, 2022a). Many people in the United States (US) do not meet CDC recommendations as only

\* Corresponding author at: Department of Health Behavior and Biological Sciences, University of Michigan School of Nursing, 400 North Ingalls Building, Ann Arbor, MI 48109-5482, USA.

E-mail address: [bjevans@umich.edu](mailto:bjevans@umich.edu) (R.J. Evans-Polce).

<https://doi.org/10.1016/j.pmedr.2023.102230>

Received 7 December 2022; Received in revised form 26 April 2023; Accepted 7 May 2023

Available online 15 May 2023

2211-3355/© 2023 The Author(s). Published by Elsevier Inc. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

about 40% of people have ever received a test in their lifetime (DiNenno, 2022; CDC, 2022a). Testing services are not equally accessible in the US by all sociodemographic groups, potentially contributing to HIV-related health disparities.

Sexual minority-identifying men and women are considered a high risk group for HIV. Multiple studies found higher odds of HIV testing among sexual minorities (Agénor et al., 2019; Blanco et al., 2018; Blossnich et al., 2014; Conron et al., 2010). However, testing prevalence varies by sexual minority subgroups. For example, bisexual and gay men on average test more than heterosexual men, yet bisexual men are 60% less likely to have ever been tested than gay men (Blossnich et al., 2014).

Beyond sexual identity, HIV testing behavior may vary by other dimensions of sexual orientation including sexual behavior and attraction (Hsieh & Shuster, 2021; Laumann et al., 2000; McCabe et al., 2005). However, many national studies examining HIV testing do not include dimensions of sexual orientation (Everett, 2013; Fu et al., 2019). Terms like MSM groups people together and limits knowledge on individuals who identify as heterosexual but have same-sex sexual behavior or attraction (Abdallah et al., 2020; Everett, 2013; Hsieh & Shuster, 2021; Mayer et al., 2008). For sexual behavior, it may be useful to consider past-year and lifetime sexual activity; however, relying solely on behavior can misrepresent sexually transmitted infection risks and disparities, so all three dimensions of sexual orientation should be considered (McCabe et al., 2005).

Of the 20 million people in the US who meet criteria for a past-year substance use disorder (SUD), a disproportionate number are sexual minorities (Conron et al., 2010; Evans-Polce et al., 2020; Helminen et al., 2022; McCabe et al., 2005; Pantalone et al., 2020; SAMHSA Release, n.d.). One avenue for testing among people who meet criteria for a SUD is offering HIV testing in SUD treatment facilities (Blanco et al., 2018; McCabe et al., 2009; Simeone et al., 2017). People receiving treatment are more likely to be active participants in the health care system, so receiving an HIV test as part of their treatment can ensure linkage to care for SUD and HIV (Cummings et al., 2021; Simeone et al., 2017). Whether those who engage in SUD treatment are more likely to test for HIV is not known but would further inform the role SUD treatment facilities may play in increasing testing prevalence.

Health care decisions are based on psychosocial factors that must be considered when implementing effective strategies for HIV testing. For instance, people with greater educational attainment and stronger social networks are more likely to make protective health decisions (Blanco et al., 2018; Chesney & Smith, 1999; Kahle et al., 2020; Phillips et al., 2020). People with general life and minority-specific stressors may be at higher risk of avoiding health care (Evans-Polce et al., 2020; McCabe et al., 2010; Meyer, 1995, 2003). These stressors include adverse childhood experiences (ACEs) and stressors in adulthood. ACEs are associated with higher odds of community testing and lower odds of self-testing among young adult MSM (McCabe et al., 2020; Schnarrs et al., 2022). However, there is little research using a national sample of US adults to suggest ACEs and stressors are associated with HIV testing. In addition, minority-specific stressors such as discrimination are under-explored factors that may be associated with lower HIV testing for sexual minority populations (Bernstein et al., 2008; Chesney & Smith, 1999; Meyer, 2003).

The purpose of this research was to use a nationally representative sample of US adults to assess whether HIV testing varies among sexual orientation subgroups, and to examine the associations of psychosocial factors and HIV testing.

## 2. Methods

### 2.1. Study design and population

We analyzed cross-sectional data from the National Epidemiologic Survey on Alcohol and Related Conditions (NESARC-III), an in-person household interview among noninstitutionalized individuals aged 18

and up who lived in the contiguous US, Alaska, and Hawaii from April 2012 through June 2013. The overall sample size was 36 309. An estimated 56.3% of participants were female. All participants were asked, "Are you of Hispanic or Latino origin?", and 19.4% of all participants identified as Hispanic or Latino.

Approximately 69.5% of participants were White, 22.1% were Black, 4.4% were Asian, 0.6% were Native Hawaiian/Pacific Islander, 1.7% were American Indian/Alaska Native, and 1.7% were multiple races. Interviews were conducted in-person, and the household, individual, and overall response rates were 72%, 84%, and 60.1%, respectively. The survey oversampled Black, Hispanic, and Asian respondents to ensure reliable estimates for these populations (Grant et al., 2015).

The NESARC-III used the Alcohol Use Disorder and Associated Disabilities Interview Schedule-5 (AUDADIS-5), a valid and reliable structured diagnostic interview of mental health, substance use, and other health conditions based on the diagnostic symptom criteria listed in the *Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition* (DSM-5) (Ruan et al., 2008). Intraclass Correlation Coefficient (ICC) values for this questionnaire to show that it has good reliability properties. Validity of the AUDADIS-5 has also been demonstrated (Hasin et al., 2015). Further information about the methodological features of the NESARC-III can be found elsewhere (Grant et al., 2015).

## 3. Measures

### 3.1. Sexual orientation

The NESARC-III assessed three dimensions of sexual orientation: sexual identity, sexual attraction, and sexual behavior. Sexual identity was assessed by asking which category best describes respondents: heterosexual, gay or lesbian, bisexual, or not sure. Sexual attraction was assessed by asking, "People are different in their sexual attraction to other people. Which best describes your feelings: (1) only attracted to females, (2) mostly attracted to females, (3) equally attracted to females and males, (4) mostly attracted to males, and (5) only attracted to males?" Sexual behavior was determined by asking, "Have you had sex in the last 12 months?" (1) yes or (2) no. If a participant had sex in the past year, they were asked if they had sex with only males, only females, or both males and females. Based on their responses, participants were coded into five categories of sexual orientation: gay/lesbian ( $n = 586$ ), bisexual ( $n = 566$ ), concordant heterosexual (heterosexual identity and only opposite-sex attraction and opposite-sex behavior;  $n = 32\ 073$ ), discordant heterosexual (heterosexual identity and same-sex attraction or same-sex behavior,  $n = 2\ 076$ ), or not sure ( $n = 199$ ).

### 3.2. HIV testing

HIV testing was assessed by asking participants if they had ever been tested for HIV in their lifetime.

### 3.3. Adverse childhood experiences

Adverse childhood experiences were measured from a validated 18 question scale which asked participants about their life experiences before the age of 18 (Ruan et al., 2008). The scale has ICC values that range from good to excellent, suggesting good reliability. Questions include the frequency of psychological abuse, physical abuse, physical neglect, emotional neglect, childhood sexual abuse, and parental/care-giver interpersonal violence. Responses were summed to create a scale from 0 to 18 with a higher score signifying more ACEs.

### 3.4. Adult stressful life experiences

The validated stressful life events scale included 14 questions asking if participants experienced specific stressful events (e.g. death of a friend/family member, financial crisis, and unemployment) in the past

year (Ruan et al., 2008). The scale ranges from 0 to 14 indicating the number of stressful life events experienced, and has an ICC of 0.94, showing strong test–retest reliability.

### 3.5. Discrimination

Participants who identified as gay/lesbian, bisexual, or heterosexual with discordant sexual behavior or attraction were asked about their experiences with sexual orientation discrimination. The Experiences of Discrimination scale includes six items assessed on a four-point scale regarding the frequency of types of discrimination (i.e. discrimination in obtaining health care or health insurance coverage, discrimination in health care treatment, in public settings, verbal harassment, and physical assault or threats of harm) (Krieger et al., 2005; Ruan et al., 2008). Responses were summed to create a scale from 0 to 24.

### 3.6. Social support

Social support was defined using the Interpersonal Support Evaluation List-12 (ISEL-12), six positive statements and six negative statements about a participant's perception of their social support (Cohen et al., 1985). An example of a positive statement is "if I were stranded 10 miles from home, someone I know would come and get me," and an example of a negative statement is "if a family crisis arose, it would be difficult to find someone who could give me good advice about how to handle it." Participants responded using a four-point scale from 0 to 3 and negative statements were reverse coded. Items were summed to create a score ranging from 0 to 36, with higher scores indicating greater social support.

### 3.7. Lifetime substance use disorders

Using the AUDADIS-5 and consistent with the DSM-5, individuals meeting at least 2 of the 11 criteria within the same 12-month period were considered to meet criteria for a SUD. The SUDs considered were DSM-5 alcohol use disorder (AUD) (lifetime), DSM-5 tobacco use disorder (TUD) (lifetime), and DSM-5 other drug use disorder (ODUD) (i.e. cocaine, heroin, marijuana, hallucinogens, opioids; lifetime).

### 3.8. Treatment for AUD and ODUD

Participants who had a history of alcohol or drug use reported whether they had ever received any treatment for alcohol or drug use. This included Alcoholics or Narcotics Anonymous, halfway houses, family or other social services, employee assistance programs, private therapist, crisis centers, rehabilitation center, detoxification facility, outpatient treatment, inpatient treatment, methadone maintenance program, halfway house or other therapeutic community, or emergency room visits.

### 3.9. Other correlates of HIV testing

The correlates examined included sexual activity (past-year), DSM-5 anxiety disorder (i.e. generalized anxiety disorder, obsessive–compulsive disorder, panic disorder, post-traumatic stress disorder; lifetime), DSM-5 mood disorder (i.e. bipolar, dysthymia, major depressive disorder; lifetime), religion/spirituality importance (very important, somewhat important, not very important, and not important at all), income (< \$25 000, \$25 000–\$64 999, and ≥ \$65 000), lifetime unprotected sex, race/ethnicity (White non-Hispanic, Black non-Hispanic, Asian non-Hispanic, and Hispanic), educational attainment (college graduate, some college, high school graduate, and less than high school), US Census region (Northeast, Midwest, South, and West), urbanicity (urban/rural), and health insurance status (health insurance vs not).

### 3.10. Data analysis

For all analyses, we used StataCorp's (Stata version 17, StataCorp LLC, College Station, Texas, USA) "svy" package to account for the NESARC-III's sampling weights and complex survey features (stratification and primary sampling units). For variance estimation, we used Taylor series linearization to account for account weighting and complex sampling features (stratification, cluster sampling) (Heeringa et al., 2017).

We conducted descriptive analysis by calculating the weighted estimates of the population distributions of the three dimensions of sexual orientation—identity, attraction, and behavior—separately for males and females (See Supplementary Table A).

Next, we estimated HIV testing distributions by sexual orientation (gay/lesbian, bisexual, not sure, discordant heterosexual, and concordant heterosexual). We examined the differences in testing prevalence across subgroups for males and females separately using design-adjusted Wald *F*-tests. Associations were considered significant at *P* values at or below 0.001.

We conducted multivariable logistic regression analyses to examine the associations of sexual orientation and other covariates with HIV testing. Control variables in the multivariable models included any lifetime mood disorder, any lifetime anxiety disorder, religiosity, social support, income, unprotected sex, race, education, region, urbanicity, and health insurance status variables in the analysis. Participants were stratified by their reported sex (male or female) and past-year sexual activity. Ninety-five percent confidence intervals (CI) were calculated using design-adjusted standard errors. We then examined correlates of HIV testing separately for heterosexual concordant individuals and sexual minority individuals. Among sexual minorities, correlates of testing were examined with and without the inclusion of sexual orientation discrimination in the model. Finally, among individuals who met criteria for AUD and/or ODUD, we examined associations of receiving lifetime AUD or ODUD treatment with HIV testing, whilst controlling for the previous factors. All analyses employed casewise deletion of missing data, meaning if a respondent was missing a response on one variable, they were removed from that specific analysis. The authors' University Institutional Review Board exempted this research from further oversight. This manuscript followed the STROBE statement guidelines.

## 4. Results

Table 1 presents estimated prevalence of ever having received an HIV test by sexual orientation subgroup. 20 098 participants reported ever having received an HIV test. Bisexual (77.0%) and gay/lesbian (65.4%) women had a greater prevalence of HIV testing than concordant heterosexual women (51.6%), and bisexual women (77.0%) had a significantly higher testing prevalence than discordant heterosexual women (54.8%). Gay men (84.0%) also had a significantly higher testing prevalence than discordant (48.2%) and concordant heterosexual (49.4%) men.

Table 2 presents results from multivariable logistic regression models examining the associations of potential correlates with HIV testing, overall and stratified by sex and past-year sexual activity. Gay men who were sexually active had higher odds of getting tested than heterosexual concordant men (adjusted odds ratio [AOR] = 6.1; 95% CI = 3.5–10.7). People with an AUD (AOR = 1.2; 95% CI = 1.1–1.3) and with a TUD (AOR = 1.5; 95% CI = 1.4–1.6) had higher odds of getting tested. Overall, people with any ODUD had higher odds of getting tested (AOR = 1.3; 95% CI = 1.1–1.4); however, people who had ODUD and were not sexually active had a particularly high odds of receiving an HIV test (AOR = 2.3; 95% CI = 1.7–2.9). There were also higher odds of HIV testing among people with more ACEs (AOR = 1.1; 95% CI = 1.1–1.1) and a greater number of adult stressful life experiences (AOR = 1.1; 95% CI = 1.1–1.2). Additionally, people who reported greater social support (AOR = 1.0; 95% CI = 1.0–1.0) and people with higher educational

**Table 1**  
HIV testing prevalence by sex and sexual orientation.

HIV testing (ever been tested)	Females					Males				
	Lesbian	Bisexual	Not sure	Discordant <sup>a</sup> heterosexual	Concordant <sup>b</sup> heterosexual	Gay	Bisexual	Not sure	Discordant <sup>a</sup> heterosexual	Concordant <sup>b</sup> heterosexual
	(n = 265)	(n = 422)	(n = 130)	(n = 1294)	(n = 17 845)	(n = 321)	(n = 144)	(n = 69)	(n = 782)	(n = 14 228)
	% (SE)	% (SE)	% (SE)	% (SE)	% (SE)	% (SE)	% (SE)	% (SE)	% (SE)	% (SE)
Overall sample	65.4 (3.7) <sup>c</sup>	77.0 (3.0) <sup>cd</sup>	53.5 (6.3) <sup>ce</sup>	54.8 (1.6) <sup>cef</sup>	51.6 (0.7) <sup>ef</sup>	84.0 (2.6) <sup>c</sup>	72.1 (4.8) <sup>cd</sup>	49.4 (8.1) <sup>de</sup>	48.2 (2.3) <sup>ef</sup>	49.4 (0.7) <sup>ef</sup>
Sexually active - past-year	70.0 (4.0) <sup>c</sup>	82.1 (2.9) <sup>cd</sup>	70.0 (7.7) <sup>cde</sup>	62.8 (1.9) <sup>cef</sup>	60.0 (0.7) <sup>cef</sup>	88.7 (2.8) <sup>c</sup>	72.3 (6.0) <sup>cd</sup>	63.6 (9.8) <sup>cde</sup>	53.4 (2.8) <sup>def</sup>	53.6 (0.7) <sup>def</sup>
Sexually active - life	66.5 (3.8) <sup>c</sup>	79.4 (3.0) <sup>cd</sup>	56.6 (6.4) <sup>cde</sup>	56.0 (1.6) <sup>cef</sup>	52.8 (0.7) <sup>ef</sup>	85.3 (2.7) <sup>c</sup>	72.8 (5.0) <sup>cd</sup>	53.4 (9.1) <sup>cde</sup>	49.6 (2.4) <sup>ef</sup>	50.5 (0.7) <sup>ef</sup>

Abbreviations: SE = standard error.

<sup>a</sup> Discordant heterosexual refers to individuals who identified as heterosexual with same-sex attraction or same-sex behavior.

<sup>b</sup> Concordant heterosexual refers to individuals who identified as heterosexual without any same-sex attraction or same-sex behavior.

<sup>c,d,e,f</sup> By sex, if two values have the same superscript, then they are insignificantly different from one another at a  $P < 0.001$  level (a strong barrier due to the number of tests performed). If values do not contain the same superscript, then they are significantly different from one another at a  $P < 0.001$  level following an  $F$ -distribution based on the adjusted Wald  $F$ -test. If a value has no superscripts, then they are significantly different from all other categories within that sex.

attainment (AOR = 1.5; 95% CI = 1.3–1.7) had higher odds of getting tested.

Table 3 shows the correlates of HIV testing separately for heterosexual concordant and for sexual minority people. Among heterosexual concordant individuals, those with an AUD (AOR = 1.2; 95% CI = 1.1–1.3) or mood disorder (AOR = 1.2; 95% CI = 1.1–1.3) had higher odds of getting tested; however, these were not predictors of testing for sexual minorities. Both heterosexual concordant and sexual minority people who experienced greater ACEs (AOR = 1.1, 95% CI = 1.1–1.1; AOR = 1.1, 95% CI = 1.0–1.2) and stressful life experiences (AOR = 1.1, 95% CI = 1.1–1.2; AOR = 1.1, 95% CI = 1.0–1.2) had higher odds of getting tested. When lifetime sexual orientation discrimination was included in the model for sexual minorities, discrimination was not a significant predictor of HIV testing.

Finally, in Table 4 we examined whether AUD and ODUD treatment was associated with HIV testing among those who met criteria for an AUD or ODUD. Those who had received any AUD or ODUD treatment had greater odds of receiving an HIV test (AOR = 1.6; 95% CI = 1.4–1.9) compared to people who did not receive treatment.

## 5. Discussion

Our findings offer new evidence highlighting the importance of heterogeneity in sexual orientation subgroups when it comes to HIV testing. The pitfall of treating all sexual minority subgroups as a homogenous group based on a single dimension of sexual orientation is some high-risk subgroups are missed, potentially creating an inaccurate picture of who is being reached with HIV testing services and public health messaging (Compton & Jones, 2021). It is also important to recognize that rates of HIV testing for all reported groups still falls below the CDC guidelines that everyone should get tested at least once during routine healthcare visits; however, certain subgroups were less likely to meet these guidelines than others and work must be done to close that gap (CDC, 2022a). For instance, we found heterosexual discordant men may benefit from additional HIV testing outreach and messaging. These findings point to the continued need for targeted policies to improve testing rates for subgroups who may have previously gone ignored in current public health practices for HIV testing.

Using this nationally representative sample, people with more ACEs had greater odds of getting tested and this association was equally important for heterosexual concordant and sexual minority individuals. Past research has also shown people with a history of experiencing childhood sexual abuse had a higher prevalence of HIV testing, which is consistent with our finding that people with more ACEs had higher odds of testing (Blanco et al., 2018; Schnarrs et al., 2022). People with higher

educational attainment also had greater odds of HIV testing. Individuals who may lack access to relevant HIV education in settings like school health classes or through primary care may benefit from targeted educational campaigns designed to increase knowledge on HIV risk factors and the importance of testing. We also found social support increased the odds of receiving an HIV test for heterosexual concordant and sexual minority individuals. A greater number of social connections may provide support or encouragement for people who are at risk to test (Kim et al., 2019; Lelutiu-Weinberger et al., 2020; Stein & Nyamathi, 2000).

People with a history of a DSM-5 AUD, TUD, or ODUD had a higher prevalence of testing, showing messaging around the importance of testing has generally reached individuals with SUD (Compton & Jones, 2021). However, work to increase HIV testing among those with a SUD is still needed. For example, over 45% of people who inject drugs have not received an HIV test in the past year (CDC, 2022b). We found individuals with a SUD who had a history of receiving treatment had an even higher likelihood of getting tested for HIV; however, accessing treatment for a SUD remains low across all sexual orientation subgroups. The majority of people with a SUD never receive any type of treatment (McCabe et al., 2013). As people are more likely to receive an HIV test if they are already involved in the health care system, increasing SUD treatment access may be one avenue to increase testing among those with a SUD (Gustafson et al., 2020; Kim et al., 2012).

Our analysis showed sexual orientation discrimination was not associated with HIV testing; however, this deserves further research as different forms of discrimination or testing location may play a role. For instance, past research shows MSM are more likely to disclose their sexual identity or behavior to providers in clinics with lesbian/gay/bisexual/transgender-friendly signs, who are then able to recommend appropriate care such as HIV testing (Qiao et al., 2018). Creative solutions could also decrease experiences of sexual orientation discrimination, such as using digital interventions to reach individuals who lack access to a safe space or primary care (Garett & Young, 2022). These interventions can increase self-testing, which generally has high acceptance (Garett & Young, 2022).

Our findings indicate HIV testing prevalence varies across sexual orientation subgroups. Understanding who gets tested for HIV from this nationally representative sample can inform further practice and research efforts. For instance, public health messaging strategies to reach heterosexual discordant individuals should be considered (McCree et al., 2017). Health care providers should consider the multiple facets of a person's sexual orientation, and their history of ACEs, substance use history, education, and social support when evaluating HIV testing needs in the US because these factors all impact a person's likelihood of seeking out testing.

**Table 2**  
Predictors of HIV testing among US adult males and females.

Predictors of HIV testing	Overall			Males			Females		
	Overall	Sexually active	Not sexually active	Overall	Sexually active	Not sexually active	Overall	Sexually active	Not sexually active
	(n = 33 433)	(n = 24 447)	(n = 9006)	(n = 14 623)	(n = 11 533)	(n = 3100)	(n = 18 810)	(n = 12 914)	(n = 5986)
AOR (95% CI)	AOR (95% CI)	AOR (95% CI)	AOR (95% CI)	AOR (95% CI)	AOR (95% CI)	AOR (95% CI)	AOR (95% CI)	AOR (95% CI)	
Sex									
Male	REF	REF	REF	n/a	n/a	n/a	n/a	n/a	n/a
Female	1.3 (1.3–1.4)***	1.4 (1.4–1.5)***	1.0 (0.9–1.1)	n/a	n/a	n/a	n/a	n/a	n/a
Sexually active - past-year	2.3 (2.1–2.5)***	n/a	n/a	1.9 (1.7–2.1)***	n/a	n/a	2.6 (2.3–2.9)***	n/a	n/a
Sexual orientation									
Heterosexual concordant	REF	REF	REF	REF	REF	REF	REF	REF	REF
Heterosexual discordant	0.9 (0.7–1.2)	0.9 (0.7–1.2)	1.0 (0.8–1.3)	1.0 (0.8–1.2)	1.0 (0.8–1.3)	1.1 (0.7–1.6)	0.9 (0.7–1.0)	0.8 (0.7–1.0)	1.0 (0.7–1.3)
Gay/Lesbian	2.4 (1.8–3.1)***	2.6 (1.9–3.6)***	1.9 (1.1–3.1)*	4.7 (3.1–7.0)***	6.1 (3.5–10.7)***	2.9 (1.5–5.7)**	1.0 (0.6–1.4)	1.0 (0.7–1.5)	1.0 (0.5–2.1)
Bisexual	1.8 (1.3–2.4)***	1.7 (1.2–2.4)**	1.9 (1.1–3.3)*	1.9 (1.2–3.3)*	1.6 (0.9–2.8)	3.8 (1.6–9.0)**	1.6 (1.1–2.2)*	1.7 (1.1–2.6)*	1.2 (0.6–2.2)
Not sure	0.9 (0.6–1.4)	1.1 (0.6–2.2)	0.6 (0.3–1.1)	1.2 (0.6–2.3)	1.7 (0.7–3.9)	0.6 (0.2–2.1)	0.7 (0.4–1.3)	0.8 (0.3–2.1)	0.6 (0.3–1.1)
Alcohol use disorder - life	1.2 (1.1–1.3)***	1.2 (1.1–1.3)***	1.3 (1.1–1.5)**	1.1 (1.0–1.2)*	1.1 (0.9–1.2)	1.2 (0.9–1.6)	1.4 (1.2–1.6)***	1.5 (1.3–1.7)***	1.4 (1.1–1.7)**
Tobacco use disorder - life	1.5 (1.4–1.6)***	1.5 (1.4–1.7)***	1.5 (1.3–1.7)***	1.4 (1.3–1.6)***	1.4 (1.3–1.6)***	1.6 (1.3–2.0)***	1.6 (1.4–1.8)***	1.8 (1.6–2.1)***	1.4 (1.2–1.7)**
Other drug use disorder - life	1.3 (1.1–1.4)***	1.1 (1.0–1.3)*	2.3 (1.7–2.9)***	1.2 (1.0–1.4)*	1.1 (0.9–1.3)	2.3 (1.7–3.2)***	1.4 (1.2–1.7)**	0.9 (0.7–1.3)	2.4 (1.6–3.4)***
Anxiety disorder - life	0.9 (0.9–1.0)	1.0 (0.9–1.0)	0.9 (0.8–1.1)	1.0 (0.9–1.1)	1.0 (0.9–1.2)	0.9 (0.7–1.3)	0.9 (0.8–1.0)*	0.9 (0.8–1.0)	0.9 (0.7–1.1)
Mood disorder - life	1.2 (1.1–1.3)***	1.2 (1.1–1.3)***	1.3 (1.1–1.5)***	1.2 (1.0–1.3)*	1.2 (1.0–1.4)	1.2 (0.9–1.6)	1.2 (1.1–1.3)***	1.2 (1.1–1.3)**	1.3 (1.1–1.6)**
Importance of religion/spirituality									
Very important	0.8 (0.7–0.9)**	0.8 (0.7–0.9)**	0.9 (0.7–1.2)	0.9 (0.7–1.0)	0.9 (0.7–1.0)	0.9 (0.6–1.2)	0.8 (0.6–1.0)*	0.7 (0.6–0.9)*	0.9 (0.6–1.3)
Somewhat important	1.0 (0.9–1.1)	0.9 (0.8–1.1)	1.1 (0.8–1.4)	0.8 (0.8–1.1)	0.9 (0.8–1.1)	1.1 (0.7–1.6)	1.0 (0.8–1.2)	0.9 (0.7–1.2)	1.1 (0.7–1.5)
Not very important	1.0 (0.8–1.1)	0.9 (0.8–1.1)	1.1 (0.8–1.5)	0.9 (0.8–1.1)	0.9 (0.8–1.1)	0.9 (0.6–1.4)	1.0 (0.8–1.3)	0.9 (0.7–1.2)	1.4 (0.9–2.2)
Not important at all	REF	REF	REF	REF	REF	REF	REF	REF	REF
Social support (0–36)	1.0 (1.0–1.0)***	1.0 (1.0–1.0)***	1.0 (1.0–1.0)	1.0 (1.0–1.0)*	1.0 (1.0–1.0)	1.0 (1.0–1.0)	1.0 (1.0–1.0)***	1.0 (1.0–1.0)***	1.0 (1.0–1.0)
Adverse childhood experiences (0–10)	1.1 (1.1–1.1)***	1.1 (1.1–1.1)***	1.1 (1.1–1.1)***	1.1 (1.1–1.1)***	1.1 (1.1–1.1)***	1.1 (1.0–1.1)**	1.1 (1.1–1.1)***	1.1 (1.1–1.1)***	1.1 (1.1–1.2)***
Adult stressful life experiences (0–16)	1.1 (1.1–1.2)***	1.1 (1.1–1.2)***	1.1 (1.1–1.2)***	1.1 (1.1–1.1)***	1.1 (1.0–1.1)***	1.1 (1.0–1.4)	1.2 (1.1–1.2)***	1.2 (1.1–1.2)***	1.2 (1.1–1.2)***
Income									
≥ \$65 000	REF	REF	REF	REF	REF	REF	REF	REF	REF
\$25 000–\$64 999	1.0 (1.0–1.1)	1.0 (0.9–1.1)	1.1 (0.9–1.2)	1.0 (0.9–1.1)	0.9 (0.8–1.1)	1.3 (1.0–1.8)*	1.1 (1.0–1.2)	1.1 (1.0–1.3)*	1.0 (0.8–1.2)
< \$25 000	1.1 (1.0–1.2)*	1.1 (1.0–1.2)	1.2 (1.0–1.4)*	1.1 (1.0–1.2)	1.0 (0.9–1.2)	1.1 (0.9–1.5)	1.1 (1.0–1.2)	1.1 (0.9–1.2)	1.1 (0.9–1.3)
Unprotected sex	1.6 (1.5–1.7)***	1.5 (1.4–1.7)***	n/a	1.6 (1.5–1.8)***	1.6 (1.4–1.8)***	n/a	1.5 (1.4–1.7)***	1.4 (1.2–1.6)***	n/a

(continued on next page)

Table 2 (continued)

Predictors of HIV testing	Overall			Males			Females		
	Overall	Sexually active	Not sexually active	Overall	Sexually active	Not sexually active	Overall	Sexually active	Not sexually active
	(n = 33 433)	(n = 24 447)	(n = 9006)	(n = 14 623)	(n = 11 533)	(n = 3100)	(n = 18 810)	(n = 12 914)	(n = 5986)
AOR (95% CI)	AOR (95% CI)	AOR (95% CI)	AOR (95% CI)	AOR (95% CI)	AOR (95% CI)	AOR (95% CI)	AOR (95% CI)	AOR (95% CI)	
Race/Ethnicity									
White, non-Hispanic	REF	REF	REF	REF	REF	REF	REF	REF	REF
Black, non-Hispanic	2.9 (2.5–3.3)***	3.2 (2.7–3.7)***	2.4 (2.0–2.8)***	2.7 (2.3–3.1)***	2.8 (2.4–3.3)***	2.1 (1.6–2.8)***	3.1 (2.7–3.7)***	3.6 (3.0–4.4)***	2.6 (2.2–3.2)***
Asian, non-Hispanic	0.8 (0.7–0.9)**	0.8 (0.7–1.0)*	0.69 (0.5–0.9)**	0.8 (0.6–0.9)**	0.8 (0.6–1.0)	0.6 (0.4–1.0)	0.9 (0.7–1.0)	0.9 (0.7–1.1)	0.8 (0.6–1.0)
Hispanic	1.8 (1.6–2.0)***	1.8 (1.6–2.0)***	1.7 (1.4–2.1)***	1.6 (1.4–1.8)***	1.6 (1.4–1.9)***	1.5 (1.1–1.9)**	2.0 (1.7–2.3)***	2.0 (1.7–2.3)***	1.9 (0.5–2.4)***
Education									
College graduate	1.5 (1.3–1.7)***	1.4 (1.2–1.6)***	1.7 (1.4–2.0)***	1.5 (1.3–1.8)***	1.5 (1.3–1.9)***	1.6 (1.2–2.1)**	1.4 (1.2–1.6)***	1.2 (1.0–1.5)	1.7 (1.4–2.2)***
Some college	1.2 (1.1–1.4)***	1.2 (1.1–1.4)**	1.2 (1.0–1.5)*	1.4 (1.2–1.6)***	1.5 (1.2–1.8)***	1.3 (0.9–1.7)	1.1 (0.9–1.3)	1.0 (0.8–1.2)	1.2 (1.0–1.6)
High school graduate	1.0 (0.9–1.1)	1.0 (0.7–1.1)	1.0 (0.9–1.3)	1.1 (1.0–1.3)	1.2 (1.0–1.4)	1.6 (1.2–2.1)**	0.9 (0.8–1.1)	0.8 (0.7–1.0)*	1.1 (0.9–1.3)
Less than high school	REF	REF	REF	REF	REF	REF	REF	REF	REF
US geographic region									
Northeast	REF	REF	REF	REF	REF	REF	REF	REF	REF
Midwest	0.7 (0.6–0.8)***	0.7 (0.6–0.8)***	0.9 (0.7–1.2)	0.7 (0.6–0.9)**	0.6 (0.5–0.8)***	1.0 (0.7–1.3)	0.7 (0.6–0.8)***	0.7 (0.6–0.8)***	0.8 (0.6–1.1)
South	1.0 (0.9–1.1)	1.0 (0.8–1.1)	1.1 (0.9–1.5)	1.0 (0.9–1.2)	1.0 (0.8–1.2)	1.3 (1.0–1.8)*	1.0 (0.9–1.1)	1.0 (0.8–1.1)	1.1 (0.8–1.4)
West	0.8 (0.7–0.9)**	0.8 (0.7–0.9)***	0.9 (0.7–1.1)	0.8 (0.6–0.9)*	0.8 (0.6–0.9)	0.8 (0.6–1.1)	0.9 (0.7–1.0)	0.8 (0.7–1.0)*	0.9 (0.7–1.3)
Metropolitan area									
Urban	REF	REF	REF	REF	REF	REF	REF	REF	REF
Rural	0.8 (0.7–0.9)***	0.8 (0.7–0.9)***	0.9 (0.8–1.1)	0.8 (0.7–1.0)**	0.8 (0.7–0.9)***	1.1 (0.9–1.4)	0.8 (0.7–0.9)**	0.8 (0.7–1.0)*	0.8 (0.7–0.9)**
Health insurance status									
No health insurance	REF	REF	REF	REF	REF	REF	REF	REF	REF
Health insurance	1.0 (0.9–1.0)	1.0 (0.9–1.1)	0.9 (0.8–1.0)	0.9 (0.8–1.0)	0.9 (0.8–1.0)	0.9 (0.7–1.2)	1.0 (0.9–1.1)	1.0 (0.9–1.2)	0.8 (0.7–1.0)*

Abbreviations: AOR = adjusted odds ratio; CI = confidence interval; REF = reference; n/a = not applicable; \$ = USD.

\*P < 0.05, \*\*P < 0.01, \*\*\*P < 0.001.

One limitation of this study is the cross-sectional design, preventing causal inferences. HIV testing was self-reported; however, previous research shows high sensitivity of self-reporting HIV testing (Xia et al., 2021). In addition, the NESARC-III study does not ask about a broader range of sexual or gender identities (e.g. pansexual) that could be associated with HIV testing. Furthermore, non-response was 39.9% and the NESARC-III excludes some subgroups like incarcerated individuals who experience a high prevalence of HIV which could have led to underestimation of HIV and HIV testing prevalence in the US population. A major strength of the NESARC-III is the large national sample size of sexual minority adults and valid measures of ACEs, SUDs, and anxiety and mood disorders.

In conclusion, HIV testing varies among sexual orientation subgroups in the US and HIV testing rates are impacted by psychosocial factors like ACEs and substance use. When recommending an HIV test, health care providers should evaluate a person’s individual experiences with life stressors and social support and should consider further dimensions of

sexual orientation beyond sexual identity. People who identify as a sexual minority are not a monolith, so health care programming and public health messaging must be representative of different subgroups who otherwise have not been included in comprehensive HIV education and testing initiatives.

## 6. Role of the sponsors

The funders had no role in the design and conduct of the study; collection, management, analysis, and interpretation of the data; preparation, review, or approval of the manuscript; and decision to submit the manuscript for publication. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institute on Alcohol Abuse and Alcoholism, National Cancer Institute, National Institute on Drug Abuse, National Institute of Mental Health, the National Institutes of Health, or the U.S. Government.

**Table 3**  
Predictors of HIV testing among heterosexual concordant and sexual minority US adults.

Predictors of HIV testing	Model 1	Model 2	Model 3
	Heterosexual concordant	Sexual minorities	Sexual minorities
	(n = 30 247)	(n = 3186)	(n = 2792)
	AOR (95% CI)	AOR (95% CI)	AOR (95% CI)
Lifetime sexual orientation discrimination (0–48)	n/a	n/a	1.1 (1.0–1.2)
Sex			
Male	REF	REF	REF
Female	1.4 (1.3–1.5)***	1.0 (0.8–1.2)	1.0 (0.8–1.3)
Sexually active - past-year	2.3 (2.1–2.5)***	2.2 (1.7–2.7)***	2.2 (1.7–2.9)***
Sexual orientation			
Heterosexual discordant	n/a	REF	REF
Gay/Lesbian	n/a	2.4 (1.8–3.1)***	2.3 (1.7–3.0)***
Bisexual	n/a	2.0 (1.4–2.8)***	1.9 (1.4–2.7)***
Not sure	n/a	1.0 (0.6–1.7)	1.1 (0.6–1.7)
Alcohol use disorder - life	1.2 (1.1–1.3)***	1.1 (0.9–1.5)	1.1 (0.8–1.5)
Tobacco use disorder - life	1.5 (1.4–1.7)***	1.4 (1.1–1.8)**	1.4 (1.1–1.9)*
Other drug use disorder - life	1.2 (1.1–1.4)**	1.5 (1.1–2.0)*	1.5 (1.1–2.1)**
Anxiety disorder - life	0.9 (0.9–1.0)	1.0 (0.8–1.3)	1.0 (0.7–1.2)
Mood disorder - life	1.2 (1.1–1.3)***	1.0 (0.8–1.3)	1.1 (0.8–1.4)
Importance of religion/spirituality			
Very important	0.8 (0.7–0.9)**	0.8 (0.6–1.1)	0.9 (0.6–1.2)
Somewhat important	1.0 (0.9–1.1)	1.0 (0.6–1.4)	1.1 (0.7–1.7)
Not very important	1.0 (0.9–1.1)	0.8 (0.5–1.1)	0.9 (0.6–1.4)
Not important at all	REF	REF	REF
Social support (0–36)	1.0 (1.0–1.0)***	1.0 (1.0–1.0)*	1.0 (1.0–1.0)
Adverse childhood experiences (0–10)	1.1 (1.1–1.1)***	1.1 (1.0–1.2)***	1.1 (1.0–1.1)**
Adult stressful life experiences (0–16)	1.1 (1.1–1.2)***	1.1 (1.0–1.2)**	1.1 (1.0–1.2)**
Income			
≥ \$65 000	REF	REF	REF
\$25 000–\$64 999	1.0 (0.9–1.1)	1.1 (0.9–1.5)	1.1 (0.9–1.5)
< \$25 000	1.1 (1.0–1.2)	1.1 (0.8–1.5)	1.1 (0.8–1.5)
Unprotected sex	1.6 (1.4–1.7)***	1.7 (1.3–2.1)***	1.8 (1.4–2.3)***
Race/Ethnicity			
White, non-Hispanic	REF	REF	REF
Black, non-Hispanic	2.9 (2.6–3.3)***	2.6 (1.9–3.6)***	2.6 (1.9–3.7)***
Asian, non-Hispanic	0.8 (0.7–0.9)**	0.7 (0.5–1.1)	0.8 (0.5–1.2)
Hispanic	1.8 (1.6–2.0)***	1.4 (1.1–1.9)**	1.4 (1.0–1.8)**
Education			
College graduate	1.5 (1.3–1.6)***	1.6 (1.2–2.2)**	1.6 (1.1–2.2)**
Some college	1.2 (1.1–1.4)***	1.2 (0.9–1.7)	1.3 (0.9–1.8)
High school graduate	1.0 (0.9–1.2)	0.8 (0.6–1.1)	0.7 (0.5–1.1)
Less than high school	REF	REF	REF
US geographic region			
Northeast	REF	REF	REF
Midwest	0.7 (0.6–0.8)***	0.8 (0.6–1.2)	0.9 (0.6–1.2)
South	1.0 (0.9–1.1)	1.0 (0.8–1.4)	1.0 (0.7–1.3)
West	0.8 (0.7–0.9)**	0.7 (0.5–1.0)	0.8 (0.6–1.1)
Metropolitan area			
Urban	REF	REF	REF
Rural	0.8 (0.7–0.9)**	0.8 (0.6–1.1)	0.8 (0.5–1.1)
Health insurance status			
No health insurance	REF	REF	REF
Health insurance	1.0 (0.9–1.1)	0.9 (0.7–1.2)	0.9 (0.7–1.3)

Abbreviations: AOR = adjusted odds ratio; CI = confidence interval; n/a = not applicable; REF = reference; \$ = USD.

**7. Data availability statement**

This manuscript was prepared using a limited access NESARC-III dataset obtained from the National Institute on Alcohol Abuse and

Alcoholism. As noted above, this manuscript has not been reviewed or endorsed by the National Institute on Alcohol Abuse and Alcoholism and does not necessarily represent the opinions of the National Institute on Alcohol Abuse and Alcoholism, who is not responsible for the contents.

**Table 4**

Predictors of HIV testing among those with lifetime alcohol (AUD) and/or other drug use disorders (ODUD), including treatment for AUD and/or ODUD.

Predictors of HIV testing	Overall	Males	Females
	(n = 10 177)	(n = 5647)	(n = 4530)
	AOR (95% CI)	AOR (95% CI)	AOR (95% CI)
Sex			
Male	REF	REF	REF
Female	1.7 (1.5–1.9)***	n/a	n/a
Sexually active (past year)	2.0 (1.8–2.3)***	1.6 (1.4–2.0)***	2.7 (2.2–3.2)***
Sexual orientation			
Heterosexual concordant	REF	REF	REF
Heterosexual discordant	1.0 (0.8–1.2)***	1.1 (0.8–1.6)	0.9 (0.6–1.2)
Gay/Lesbian	2.2 (1.5–3.4)***	5.0 (2.4–10.5)***	1.0 (0.5–1.5)
Bisexual	1.7 (1.1–2.6)	1.7 (0.8–3.8)	1.7 (1.0–2.9)
Not sure	0.5 (0.3–1.1)	0.5 (0.2–1.4)	0.5 (0.2–1.5)
Treatment for AUD/ODUD - life	1.6 (1.4–1.9)***	1.7 (1.4–2.0)***	1.4 (1.1–1.8)**

Abbreviations: AOR = adjusted odds ratio; CI = confidence interval; REF = reference; n/a = not applicable.

Note: Controls include any lifetime mood disorder, any lifetime anxiety disorders, religiosity, social support, income, unprotected sex, race, education, region, urbanicity, and health insurance status.

\* $P < 0.05$ , \*\* $P < 0.01$ , \*\*\* $P < 0.001$ .

For access to the limited access NESARC-III dataset please refer to the limited access data policy: <https://www.niaaa.nih.gov/research/nesarc-iii/nesarc-iii-data-access>.

### Funding

This work was supported by the National Institutes of Health [grant numbers R21DA051388, R01AA025684, R01AA030243 and R01CA212517]. The Student Opportunities for AIDS/HIV Research (SOAR) program is supported by the National Institute of Mental Health and the Office of Behavioral and Social Sciences Research of the National Institutes of Health under Award Number [R25MH126703]. This manuscript was prepared using a limited access dataset obtained from the National Institute on Alcohol Abuse and Alcoholism.

### CRediT authorship contribution statement

**Holly Gurnik:** Conceptualization, Visualization, Writing – original draft, Writing – review & editing. **Curtiss W. Engstrom:** Methodology, Formal analysis, Visualization, Writing – review & editing. **Sean Esteban McCabe:** Conceptualization, Methodology, Writing – review & editing, Supervision, Funding acquisition. **Rebecca J. Evans-Polce:** Conceptualization, Methodology, Writing – review & editing, Supervision, Funding acquisition.

### Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

### Data availability

The authors do not have permission to share data.

### Acknowledgements

The authors would like to thank Mr. Mahmoud Abdulkarim and Mrs. Kathryn Lundquist, for their assistance with proofreading and formatting the manuscript. Mr. Abdulkarim and Mrs. Lundquist are both affiliated with the University of Michigan Center for the Study of Drugs, Alcohol, Smoking and Health and have no conflicts of interest to report. We also would like to acknowledge the anonymous reviewers for their constructive feedback and respondents for their participation in the study.

### Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.pmedr.2023.102230>.

### References

- Abdallah, I., Conserve, D., Burgess, T.L., Adegbite, A.H., Oraka, E., 2020. Correlates of HIV-related risk behaviors among self-identified heterosexual men who have sex with men (HMSM): national survey of family growth (2002, 2006–2010, and 2011–2017). *AIDS Care* 32 (12), 1529–1537.
- Agénor, M., Pérez, A.E., Koma, J.W., Abrams, J.A., McGregor, A.J., Ojikutu, B.O., 2019. Sexual Orientation Identity, Race/Ethnicity, and Lifetime HIV Testing in a National Probability Sample of U.S. Women and Men: An Intersectional Approach. *LGBT Health* 6 (6), 306–318. <https://doi.org/10.1089/lgbt.2019.0001>.
- Bernstein, K.T., Liu, K.-L., Begier, E.M., Koblin, B., Karpati, A., Murrill, C., 2008. Same-Sex Attraction Disclosure to Health Care Providers Among New York City Men Who Have Sex With Men: Implications for HIV Testing Approaches. *Arch. Intern. Med.* 168 (13), 1458–1464. <https://doi.org/10.1001/archinte.168.13.1458>.
- Blanco, C., Wall, M.M., Compton, W.M., Kahana, S., Feng, T., Saha, T., Elliott, J.C., Hall, H.I., Grant, B.F., 2018. Prevalence and correlates of HIV testing and HIV-positive status in the US: Results from the National Epidemiological Survey on Alcohol and Related Conditions III (NESARC-III). *J. Psychiatr. Res.* 105, 1–8. <https://doi.org/10.1016/j.jpsychires.2018.08.007>.
- Blosnich, J.R., Farmer, G.W., Lee, J.G.L., Silenzio, V.M.B., Bowen, D.J., 2014. Health Inequalities Among Sexual Minority Adults. *Am. J. Prev. Med.* 46 (4), 337–349.
- Centers for Disease Control and Prevention. (2021). *CDC's HIV Prevention Priorities: Mobilizing to End the Epidemic*. Retrieved from <https://www.cdc.gov/hiv/policies/stategic-priorities/mobilizing/prevention-priorities.html>.
- Centers for Disease Control and Prevention. (2022). *HIV by Group: HIV Among People Who Inject Drugs*. Retrieved from <https://www.cdc.gov/hiv/group/hiv-idu.html>.
- Centers for Disease Control and Prevention. (2022). *HIV Testing*. Retrieved from <https://www.cdc.gov/hiv/testing/index.html>.
- Chesney, M. A., & Smith, A. W. (1999). Critical Delays in HIV Testing and Care: The Potential Role of Stigma. *American Behavioral Scientist*, 42(7), 1162–1174. <https://doi.org/10.1177/00027649921954822>.
- Cohen, S., Mermelstein, R., Kamarck, T., & Hoberman, H. M. (1985). Measuring the Functional Components of Social Support. In I. G. Sarason & B. R. Sarason (Eds.), *Social Support: Theory, Research and Applications* (pp. 73–94). Springer Netherlands. [https://doi.org/10.1007/978-94-009-5115-0\\_5](https://doi.org/10.1007/978-94-009-5115-0_5).
- Compton, W. M., & Jones, C. M. (2021). Substance Use among Men Who Have Sex with Men. *The New England Journal of Medicine*, 385(4), 352–356. <https://doi.org/10.1056/NEJMra2033007>.
- Conron, K.J., Mimiaga, M.J., Landers, S.J., 2010. A Population-Based Study of Sexual Orientation Identity and Gender Differences in Adult Health. *Am. J. Public Health* 100 (10), 1953–1960. <https://doi.org/10.2105/AJPH.2009.174169>.
- Cummings, B., Lucas, W., Burgess, J., Dada, S., Parry, C.D.H., Harker, N., 2021. Correlates of Self-Reported HIV Testing Among Patients in Specialized Substance Abuse Treatment Centers in South Africa. *AIDS Behav.* 25 (9), 2755–2766.
- DiNenno, E.A., Delaney, K.P., Pitasi, M.A., MacGowan, R., Miles, G., Dailey, A., Courtenay-Quirk, C., Byrd, K., Thomas, D., Brooks, J.T., Daskalakis, D., Collins, N., 2022. HIV Testing Before and During the COVID-19 Pandemic—United States, 2019–2020. *MMWR Morb. Mortal. Wkly Rep.* 71 (25), 820–824.
- Evans-Polce, R.J., Kcomt, L., Veliz, P.T., Boyd, C.J., McCabe, S.E., 2020. Alcohol, Tobacco, and Comorbid Psychiatric Disorders and Associations With Sexual Identity



- and Stress-Related Correlates. *Am. J. Psychiatry* 177 (11), 1073–1081. <https://doi.org/10.1176/appi.ajp.2020.20010005>.
- Everett, B.G., 2013. Sexual Orientation Disparities in Sexually Transmitted Infections: Examining the Intersection Between Sexual Identity and Sexual Behavior. *Arch. Sex. Behav.* 42 (2), 225–236. <https://doi.org/10.1007/s10508-012-9902-1>.
- Fu, T., Herbenick, D., Dodge, B., Owens, C., Sanders, S.A., Reece, M., Fortenberry, J.D., 2019. Relationships Among Sexual Identity, Sexual Attraction, and Sexual Behavior: Results from a Nationally Representative Probability Sample of Adults in the United States. *Arch. Sex. Behav.* 48 (5), 1483–1493. <https://doi.org/10.1007/s10508-018-1319-z>.
- Garett, R., Young, S.D., 2022. Potential application of conversational agents in HIV testing uptake among high-risk populations. *J. Public Health.* <https://doi.org/10.1093/pubmed/fdac020>.
- Grant, B., Chu, A., Sigman, R., Amsbary, M., Kali, J., Sugawara, Y., Jiao, R., Ren, W., & Goldstein, R. (2015). *National Epidemiologic Survey on Alcohol and Related Conditions-III (NESARC-III): Source and Accuracy Statement*. National Institute on Alcohol Abuse and Alcoholism.
- Gustafson, R., Demlow, S.E., Nathoo, A., McKee, G., MacDonald, L.E., Chu, T., Sandhu, J., Grafstein, E., Hull, M., Chittock, D., Carere, R., Krajdén, M., Sherlock, C. H., Harrison, S., Buchner, C.S., Montaner, J.S.G., Daly, P., 2020. Routine HIV testing in acute care hospitals: Changing practice to curb a local HIV epidemic in Vancouver, BC. *Prevent. Med.* 137, 106132 <https://doi.org/10.1016/j.ypmed.2020.106132>.
- Hasin, D.S., Greenstein, E., Aivadyan, C., Stohl, M., Aharonovich, E., Saha, T., Goldstein, R., Nunes, E.V., Jung, J., Zhang, H., Grant, B.F., 2015. The Alcohol Use Disorder and Associated Disabilities Interview Schedule-5 (AUDADIS-5): Procedural Validity of Substance Use Disorders Modules Through Clinical Re-appraisal in a General Population Sample. *Drug Alcohol Depend.* 148, 40–46. <https://doi.org/10.1016/j.drugalcdep.2014.12.011>.
- Heeringa, S.G., West, B.T., Berglund, P.A., 2017. In: *Applied Survey Data Analysis*. Chapman and Hall/CRC. <https://doi.org/10.1201/9781315153278>.
- Helminen, E.C., Cascalheira, C.J., Shaw, T.J., Zollweg, S., Hughes, T.L., Scheer, J.R., 2022. A latent class analysis of tailored substance use treatment programs: Implications for treating syndemic conditions facing sexual and gender minority populations. *Drug Alcohol Depend.* 238, 109550 <https://doi.org/10.1016/j.drugalcdep.2022.109550>.
- Hsieh, N., Shuster, S.M., 2021. Health and Health Care of Sexual and Gender Minorities. *J. Health Soc. Behav.* 62 (3), 318–333. <https://doi.org/10.1177/00221465211016436>.
- Kable, E.M., Veliz, P., McCabe, S.E., Boyd, C.J., 2020. Functional and structural social support, substance use and sexual orientation from a nationally representative sample of US adults. *Addiction* 115 (3), 546–558. <https://doi.org/10.1111/add.14819>.
- Kim, Y.K., Small, E., Okumu, M., 2019. School-based HIV/AIDS education, risky sexual behaviors, and HIV testing among high school students in the United States. *Soc. Work Health Care* 58 (3), 258–273. <https://doi.org/10.1080/00981389.2018.1558163>.
- Kim, E.K., Thorpe, L., Myers, J.E., Nash, D., 2012. Healthcare-related correlates of recent HIV testing in New York City. *Prev. Med.* 54 (6), 440–443. <https://doi.org/10.1016/j.ypmed.2012.03.006>.
- Krieger, N., Smith, K., Naishadham, D., Hartman, C., Barbeau, E.M., 2005. Experiences of discrimination: Validity and reliability of a self-report measure for population health research on racism and health. *Soc Sci Med* 61 (7), 1576–1596.
- Laumann, E.O., Gagnon, J.H., Michael, R.T., Michaels, S., 2000. *The Social Organization of Sexuality: Sexual Practices in the United States*. University of Chicago Press.
- Leluti-Weinberger, C., Wilton, L., Koblin, B.A., Hoover, D.R., Hirshfield, S., Chiasson, M. A., Nandi, V., Usher, D., Frye, V., 2020. The Role of Social Support in HIV Testing and PrEP Awareness among Young Black Men and Transgender Women Who Have Sex with Men or Transgender Women. *J. Urban Health* 97 (5), 715–727. <https://doi.org/10.1007/s11524-019-00396-8>.
- Mayer, K.H., Bradford, J.B., Makadon, H.J., Stall, R., Goldhammer, H., Landers, S., 2008. Sexual and Gender Minority Health: What We Know and What Needs to Be Done. *Am. J. Public Health* 98 (6), 989–995. <https://doi.org/10.2105/AJPH.2007.127811>.
- McCabe, S.E., Hughes, T.L., Bostwick, W., Boyd, C.J., 2005. Assessment of difference in dimensions of sexual orientation: Implications for substance use research in a college-age population. *J. Stud. Alcohol* 66 (5), 620–629. <https://doi.org/10.15288/jsa.2005.66.620>.
- McCabe, S.E., Hughes, T.L., Bostwick, W.B., West, B.T., Boyd, C.J., 2009. Sexual orientation, substance use behaviors and substance dependence in the United States. *Addiction* 104 (8), 1333–1345. <https://doi.org/10.1111/j.1360-0443.2009.02596.x>.
- McCabe, S.E., Bostwick, W.B., Hughes, T.L., West, B.T., Boyd, C.J., 2010. The Relationship Between Discrimination and Substance Use Disorders Among Lesbian, Gay, and Bisexual Adults in the United States. *Am. J. Public Health* 100 (10), 1946–1952. <https://doi.org/10.2105/AJPH.2009.163147>.
- McCabe, S.E., West, B.T., Hughes, T.L., Boyd, C.J., 2013. Sexual orientation and substance abuse treatment utilization in the United States: results from a national survey. *J. Subst. Abuse Treat.* 44 (1), 4–12. <https://doi.org/10.1016/j.jsat.2012.01.007>.
- McCabe, S.E., Hughes, T.L., West, B.T., Evans-Polce, R.J., Veliz, P.T., Dickinson, K., McCabe, V.V., Boyd, C.J., 2020. Sexual Orientation, Adverse Childhood Experiences, and Comorbid DSM-5 Substance Use and Mental Health Disorders. *J. Clin. Psychiatry* 81 (6). <https://doi.org/10.4088/JCP.20m13291>.
- McCree, D.H., Oster, A.M., Jeffries, W.L., Denson, D.J., Lima, A.C., Whitman, H., Ivy, W., Henny, K.D., 2017. HIV acquisition and transmission among men who have sex with men and women: What we know and how to prevent it. *Prev. Med.* 100, 132–134. <https://doi.org/10.1016/j.ypmed.2017.04.024>.
- Meyer, I.H., 1995. Minority Stress and Mental Health in Gay Men. *J. Health Soc. Behav.* 36 (1), 38–56. <https://doi.org/10.2307/2137286>.
- Meyer, I.H., 2003. Prejudice, social stress, and mental health in lesbian, gay, and bisexual populations: Conceptual issues and research evidence. *Psychol. Bull.* 129 (5), 674–697. <https://doi.org/10.1037/0033-2909.129.5.674>.
- Pantalone, D.W., Nelson, K.M., Batchelder, A.W., Chiu, C., Gunn, H.A., Horvath, K.J., 2020. A Systematic Review and Meta-Analysis of Combination Behavioral Interventions Co-Targeting Psychosocial Syndemics and HIV-Related Health Behaviors for Sexual Minority Men. *J. Sex Res.* 57 (6), 681–708. <https://doi.org/10.1080/00224499.2020.1728514>.
- Phillips, G., McCuskey, D.J., Felt, D., Curry, C.W., Ruprecht, M.M., Wang, X., Beach, L.B., 2020. Association of HIV Education with HIV Testing and Sexual Risk Behaviors Among US Youth, 2009–2017: Disparities Between Sexual Minority and Sexual Majority Youth. *Prevent. Sci.: Off. J. Soc. Prevent. Res.* 21 (7), 898–907. <https://doi.org/10.1007/s11121-020-01153-z>.
- Qiao, S., Zhou, G., Li, X., 2018. Disclosure of Same-Sex Behaviors to Health-care Providers and Uptake of HIV Testing for Men Who Have Sex With Men: A Systematic Review. *Am. J. Men's Health* 12 (5), 1197–1214. <https://doi.org/10.1177/1557988318784149>.
- Ruan, W.J., Goldstein, R.B., Chou, S.P., Smith, S.M., Saha, T.D., Pickering, R.P., Dawson, D.A., Huang, B., Stinson, F.S., Grant, B.F., 2008. The Alcohol Use Disorder and Associated Disabilities Interview Schedule-IV (AUDADIS-IV): Reliability of new psychiatric diagnostic modules and risk factors in a general population sample. *Drug Alcohol Depend.* 92 (1), 27–36. <https://doi.org/10.1016/j.drugalcdep.2007.06.001>.
- SAMHSA releases 2020 National Survey on Drug Use and Health. (n.d.). Retrieved July 8, 2022, from <https://www.samhsa.gov/newsroom/press-announcements/202110260320>.
- Schnarrs, P.W., Bond, M., Stone, A.L., Salcido, R., Young, L., Dean, J., Grigsby, T.J., 2022. The Relationship Between Adverse Childhood Experiences and Utilization of Different HIV Testing Strategies Among Young Men Who Have Sex with Men in Texas. *AIDS Behav.* 26 (11), 3642–3653.
- Someone, C.A., Seal, S.M., Savage, C., 2017. Implementing HIV Testing in Substance Use Treatment Programs: A Systematic Review. *HIV, Mental Health and Substance Abuse* 28 (2), 199–215. <https://doi.org/10.1016/j.jana.2015.11.006>.
- Stein, J.A., Nyamathi, A., 2000. Gender differences in behavioural and psychosocial predictors of HIV testing and return for test results in a high-risk population. *AIDS Care* 12 (3), 343–356. <https://doi.org/10.1080/09540120050043007>.
- U.S. Statistics: HIV gov. (2021, June 2). HIV.Gov. <https://www.hiv.gov/hiv-basics/overview/data-and-trends/statistics>.
- Xia, Y., Milwid, R.M., Godin, A., Boily, M.C., Johnson, L.F., Marsh, K., Eaton, J.W., Maheu-Giroux, M., 2021. Accuracy of Self-Reported HIV-Testing History and Awareness of HIV-Positive Status in Four Sub-Saharan African Countries. *AIDS (London, England)* 35 (3), 503–510. <https://doi.org/10.1097/QAD.0000000000002759>.