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Assessment of the Density of HIV and STI Testing Providers and the Associations Between Recent Testing of Men Who Have Sex with Men in the United States

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An abstract of
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Abstract

Assessment of the Density of HIV and STI Testing Providers and the Associations Between Recent Testing of Men Who Have Sex with Men in the United States
By Juliette Berlin

Purpose: Increasing trends of bacterial sexually transmitted infections (STIs) among men who have sex with men (MSM) place MSM at greater risk of HIV acquisition. Ensuring utilization of STI and HIV testing services is critical to preventing new infections, yet geographic inequities in testing exist. No studies have examined the association between testing provider density and the prevalence of a recent HIV/STI test.
Methods: Using National Prevention Information Network (NPIN) provider locations and 2019 American Men's Internet Survey (AMIS) data, we conducted multivariate log-binomial regression to quantify the relationship between state-level testing provider density per 1000 MSM and having had an HIV/STI test within the past 12 months.
Results: Of 9189 total study participants, 61.9% (2549/4115) of MSM residing in low provider density states had recently had an HIV/STI test, and 52.4% (376/717) of MSM residing in high provider density states had a recent test. MSM residing in high provider density states were 19% (aPR = 0.81, CI = 0.72, 0.92) less likely to have been tested in the past 12 months compared to MSM residing in low provider density states.
Conclusions: We found that testing provider density and the prevalence of a recent HIV or STI test among participants had an inverse relationship, that is, MSM who lived in higher provider density states were less likely to have been tested. This relationship may suggest there are geographic and structural barriers that prevent MSM in high provider density states from accessing testing services more frequently than MSM in low provider density states.

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Introduction:

Within the United States, HIV and STI transmission continue to disproportionately affect men who have sex with men (MSM).[1] In recent years, there have been significant increases in STI diagnoses among MSM, as well as an increase in the proportion of MSM engaging in risky sexual behavior such as condom-less anal intercourse (CAI).[1] The increase in STI incidence and CAI among MSM is of particular concern because infection with a rectal bacterial STI has been shown to be associated with incident HIV.[2] A cohort study found that about 10% of HIV-negative MSM acquired rectal gonorrhea or chlamydia per year, and that black MSM had higher rates of STIs than white MSM.[2, 3]

Both racial and social disparities in HIV are apparent; prevalence among black MSM is about 3.3 times that of white MSM, and black MSM are also more likely to be living in poverty, to be homeless, and to not have health insurance.[3, 4] In addition, younger age is associated with higher rates of STIs, higher HIV incidence, and not having access to a healthcare provider.[5] Because MSM are at high risk for HIV and STI infection, consistent testing is critical, yet there are many barriers that may make it more difficult for MSM, especially those belonging to certain demographics, to access consistent healthcare and testing services.[5]

To prevent HIV, the CDC recommends that MSM be tested annually, but that more frequent screening every three to six months may be beneficial.[6] This is likely attainable among those with healthcare, however, even among those who had visited a provider, less than one-third of MSM reported being offered an HIV test.[7] Of additional concern is the fact that there are many MSM who have never been tested.[8] A cohort of MSM from 25 US cities found that 8% of tests were from MSM who had not previously tested, 71% of first-time test takers identified as an ethnic or racial minority, and 67% of first-time test takers were younger than thirty years of

age.[8] Another study highlighted geographic barriers to testing, finding that HIV prevalence among MSM in rural communities was generally high, while access to testing was low, prompting MSM to travel to more urban settings for testing.[9]

Examining whether large proportions of MSM must travel long distances to access testing is of interest because greater travel time and distance have been linked to poor health outcomes, demonstrating what is known as the distance decay association.[10] In relation to HIV care, decreasing the distance patients must travel to clinics has been positively associated with greater linkage and retention in care.[11, 12] Siegler et al. have performed extensive work on geographic PrEP disparities and travel times, demonstrating that the Southern region of the United States accounts for nearly half of all new HIV diagnoses, but only has 26% of all PrEP clinics.[13] Furthermore, one in eight PrEP eligible MSM reside in 30-minute driving deserts from PrEP clinics, with rural areas being classified as driving deserts more often.[14] Their use of national PrEP provider location data allowed them to pinpoint regions where further interventions should be developed to increase PrEP access and assessing density of HIV/STI testing may be useful to determine where disparities in testing for MSM are greatest.[14]

Determining where geographic disparities exist in HIV and STI testing is important because consistent testing is core component of prevention and may be related to other factors such race, poverty status and lack of insurance.[12-14] Our study sought to assess the density of HIV and STI testing provider locations and recent testing of MSM in the United States using location data of testing centers from a national database and a cross-sectional behavioral survey. Additionally, determining how many additional tests testing centers would need to provide to MSM may serve as a helpful metric as providers determine how to best spend resources and may be helpful in designing future interventions that aim to increase HIV/STI testing access to MSM

who previously lacked access. When assessing the relationship between testing provider density and recent HIV/STI testing among MSM, we hypothesized that location in a state with lower density of testing centers had a negative association with MSM having had an HIV/STI test within the prior year.

Methods:

Study Population

To perform this analysis, we utilized HIV/STI testing location data and behavioral cross-sectional survey data. We obtained cross-sectional data from the 2019 cycle of the American Men's Internet Survey (AMIS), an annual behavioral survey of MSM in the United States used to track HIV trends in testing services, prevention services, and risk factors with the purpose of improving HIV services and prevention.[15] AMIS generally recruits about 10,000 participants per year through convenience sampling, using online ads placed on websites and applications, as well as from emailing former participants who consented to being recontacted for future participation.[15] Participants who clicked on AMIS ads, met eligibility criteria, and provided consent and were directed to the survey. Responses and data were stored on secure servers. No compensation was provided to study participants. The AMIS study was reviewed by the Emory University Institutional Review Board and received approval prior to being conducted in compliance with federal regulations overseeing the protection of human research subjects. The AMIS-2019 surveys were conducted August to December 2019 and inclusion criteria were as follows; participants must have been at least 15 years of age, must have been residents of the US, must have had a history of oral or anal sex with a man or identify as gay or bisexual, and must have been capable of completing the survey in English.[15] The AMIS dataset provided the

covariates for analysis, and the outcome variable; whether the participant had been HIV or STI tested within the prior year.

Measures

The exposure variable for this analysis was the density of HIV/STI testing locations per 1000 MSM by state. To calculate the density of providers, we utilized estimates of MSM populations by state from Grey et al.[16] We obtained testing location data from the National Prevention Information Network (NPIN) Service Provider Information Tool.[17] Testing locations were included if they offered at least one of the following services: conventional HIV testing, rapid HIV testing, or routine testing for STIs such as chlamydia, gonorrhea, or syphilis. MSM population estimates and testing provider locations were imported into RStudio (Version 2021.9.2.382).[18] Providers in the US territories were removed, thus including only testing providers in the 50 states and the District of Colombia. Density of testing providers per 1000 MSM was then calculated by dividing the number of providers per state by the state population of MSM and multiplying by 1000.

In order to estimate how many additional tests per provider would need to be performed in each state in order to achieve 100% testing coverage of MSM, we first calculated how many MSM in each state had not been sexually active within the last year, and therefore not eligible for testing, by applying a national estimate of the proportion of men who had not had sex in the past year from prior AMIS analyses to the MSM estimate for each state.[19]A national estimate was used because state-level estimates of MSM not sexually active were not available. Then we estimated the number of MSM in each state eligible for testing by subtracting the number of participants from AMIS 2019, the number of estimated MSM who were not sexually active, and estimates of MSM living with HIV from CDC's NCHHSTP AtlasPlus tool from the total

estimate of MSM per state.[16, 19, 20] Next, we applied the proportion of MSM from AMIS who had received an HIV or STI test within the past year for each state to the estimate of MSM eligible for testing to calculate the number of expected MSM who had been tested, as well as the number of additional tests needed to achieve 100% testing coverage of the population. Finally, the average expected number of additional tests per provider was calculated by dividing the number of expected additional tests needed per state by the total number of testing providers by state. Densities of testing providers of all 50 states and the average number of additional tests per provider needed were displayed on choropleth maps.

When assessing the relationship between provider density and the prevalence of a recent HIV/STI test, we categorized provider-density as a four-level variable based on the calculated quartile of provider density per 1000 MSM because of its highly skewed distribution. Low provider density was defined as a state having between 1.04-1.74 providers per 1000 MSM, low-medium provider density was defined as 1.75-2.72 providers per MSM, medium provider density was defined as 2.73-4.91 providers per 1000 MSM, and high provider density was 4.92-14.58 providers per 1000 MSM. The outcome of interest was a reported HIV or STI test within the past 12 months, ascertained from questions from the AMIS survey. For HIV testing, participants were first asked, "Have you ever been tested for HIV?" If they responded "yes", they were asked the follow-up question, "Before your most recent test in [Month/Year], did you ever test positive for HIV?" Participants who were not sure of the month or year of their last HIV test were asked if they had been tested within the past 12 months.[15] For STI testing, participants were asked, "In the past 12 months, were you tested by a doctor or other health care provider for a sexually transmitted infection like gonorrhea, chlamydia, or syphilis?" for which the response options were "yes" or "no".[15] The outcome was a dichotomous variable and participants were coded as

having had a recent HIV or STI test if they were determined to have had an HIV test in the previous year, responded “yes” to the STI testing question, or both.

Covariates from the AMIS survey included region, age, race/ethnicity, annual household income, housing stability, number of sexual partners, and condomless anal intercourse (CAI) with a discordant partner within the last 12 months. The region was categorized as Northeast, Midwest, South, and West according to participant's’ reported state of residence and the US Census region designations[20]. Age was categorized as 15-24 years, 25-29 years, 30-39 years, and 40 years and older. Race/ethnicity was categorized as non-Hispanic White, non-Hispanic Black, Hispanic, and other or multiple races. Annual household income was categorized as $0-$19,999, $20,000-$39,999, $40,000-$74,999, and finally $75,000 or greater. Housing stability was created as a three-level categorical variable assessed by two AMIS questions; “In the past 12 months, did you double up or stay overnight with friends, relatives, or someone you didn’t know well because you didn’t have a regular, adequate, and safe place to stay at night?” and “In the past 12 months, were you ever homeless? That is, were you living on the street, in a shelter, in a Single Occupancy hotel (SRO), or in a car?"[15] Participants were classified as having stable housing if they answered “no” to both questions, irregular housing if they responded “yes” to the first question but “no” to the second, and homeless if they responded “yes” to the second question. The number of sexual partners in the past year was categorized as one or less, or greater than one, according to the number of men participants reported having oral or anal sex with. Finally, CAI with a discordant partner was defined as MSM who had anal intercourse with a partner who either had an unknown HIV status, or where one partner was HIV-negative, and the other was HIV-positive.

Analyses

The analytic dataset was restricted to only those participants who had anal or oral sex with another man in the past 12 months and who had not ever had a previous positive HIV test. CDC recommends that sexually active MSM should be screened for HIV at least once per year and bacterial STIs every 6 months.[6, 22] To assess the relationship between testing provider density and a recent HIV or STI test, we subset the 2019 AMIS dataset to only include participants who reported if they had an HIV or STI test within the past year or not and had reported their state of residence. We performed a multivariate log binomial regression, considering covariates such as region, age, race or ethnicity, annual household income, housing stability, number of male sex partners in the past 12 months, and CAI with a discordant partner in the past 12 months. Results are presented as prevalence ratios (PRs) and adjusted prevalence ratios (aPRs) with 95% confidence intervals (CIs). Data analyses were performed in SAS version 9.4 (SAS Institute, Cary, NC).[23]

Results:

There were 9476 NPIN listed testing providers in the 50 states plus Washington, DC. Density of HIV/STI testing providers per 1000 MSM ranged from 1.04 in Nevada to 14.58 in Alaska (Table 2). Mean provider density by state was 4.29 per 1000 MSM with a standard deviation of 3.66. Comparing the mean provider density of census regions, the West had the highest density with 5.59 providers per 1000 MSM, followed by the South with 4.18, the Midwest with 4.12, and the Northeast with the lowest density of 2.83. Nevada had the highest number of additional annual HIV/STI tests per provider needed to achieve 100% testing of MSM with 267 tests, while Alaska had the lowest with 14 tests per provider (Table 3). The mean number of additional annual HIV/STI tests per provider needed was 115.92 with a standard deviation of 65.46. Comparing census regions, the Northeast had the highest mean number of

additional annual HIV/STI tests per provider needed (142.08), followed by the Midwest (124.32), the West (113.91) and the South (97.68), respectively.

Of the MSM participating in the 2019 AMIS survey, 9189 reported whether they had been HIV or STI tested within the past year, reported their state of residence, had never tested positive for HIV, and had anal or oral sex with a man in the past 12 months (Table 1). Of all MSM, nearly half (44.8%) lived in a state with low testing provider density, and 58.4% reported having been tested within the past year (Table 1). Other notable characteristics of study participants included: almost half (44.8%) were in the 15–24-year-old age group, about 60% identified as non-Hispanic White, 30% reported an annual income of $75,000 or more, the vast majority (89.5%) resided in stable housing, about two-thirds (64.2%) had more than one recent sexual partner, and 22.1% had CAI with a discordant partner (Table 1).

In the crude estimates between testing provider density and a recent HIV or STI test, MSM were less likely to have been tested the higher the testing provider density state they resided in (compared low density, low-medium density: PR = 0.90, CI = 0.87, 0.94; medium density: PR = 0.82, CI = 0.75, 0.89; high density: PR = 0.74, CI = 0.65, 0.84) (Table 4). After adjusting for census region, age, race/ethnicity, annual household income, housing type, number of recent sexual partners, and recent CAI with a discordant partner, MSM residing in high provider density states were still less likely to have been tested (compared low density, low-medium density: aPR = 0.93, CI = 0.90, 0.97; medium density: aPR = 0.87, CI = 0.80, 0.94; high density: aPR = 0.81, CI = 0.72, 0.92) (Table 4).

Discussion:

Our objectives for this study were three-fold: we sought to quantify the density of testing providers per 1000 MSM at the state-level, to estimate the additional number of tests needed per

provider to achieve 100% testing of estimated MSM populations, and to assess the relationship between residency within different testing provider densities and having had an HIV or STI test within the past year. We found that the higher the testing provider density of the state of residence, the less likely participants were to have been tested recently.

Generally, states with lower estimates of MSM yielded the highest testing provider density. At the regional scale, the West had the highest density of testing providers, followed by the South, Midwest, and Northeast. Additionally, states with lower testing provider density generally had a greater expected number of additional tests per provider needed to achieve 100% testing coverage of MSM, due to their higher estimated populations of MSM. In contrast, prior studies on provider density regarding PrEP clinics and youth LGBTQ+ services have found that census divisions in the South have fewer service providers compared to other regions, and services are more likely to be concentrated in metro areas.[13, 24] While estimating testing provider density and the number of additional tests needed per provider provides an idea of how testing availability varies across the US, it does not fully answer the question of where limited access to HIV/STI testing is specifically. Access to and utilization of health services, especially for MSM, has repeatedly been shown to be dependent on urbanicity.[14, 24] Therefore, analysis of testing provider density at a more granular level such as county or ZIP code may be beneficial and will be undertaken in future analyses with this data.

Our study found that MSM who resided in high provider density states were 19% less likely to have been tested in the past 12 months compared to those residing in low provider density states after adjusting for demographic and behavioral covariates. As high provider density states generally correspond to those with sparser MSM populations, and low provider density states to those with larger MSM populations, this means that MSM in more populated

states were testing more often. Assuming these densely, more populated states are also more urban, our results reflect research suggesting that service utilization among MSM is greater in urban areas.[14, 25] These results suggest that there are likely structural barriers contributing to MSM in high provider density states being less likely to test, such as disparities around education and awareness of HIV testing guidelines, policy implications of Medicaid expansion, and access to transportation to reach testing centers. Prior research has shown that Medicaid expansions were associated with an increase in HIV diagnoses and PrEP access, particularly in low-income and rural counties where pre-Affordable Care Act uninsured rates were high.[14, 26] Therefore, MSM residing in states that elected not to expand Medicaid still likely face difficulties accessing testing and HIV care. Young MSM in Nevada reported they felt the primary barrier to HIV testing was a lack of awareness or knowledge of HIV testing guidelines, while secondarily citing access issues and lack of transportation.[27] Furthermore, in impoverished areas, car ownership or access to reliable public transportation have been found to be critical for sustained medical care, and high provider density states may lack more robust transit systems.[12] The possibility also remains that the testing provider density measure is not the best measure for more some states if smaller, community-based testing centers were not captured by NPIN's Service Finder and were a main resource for HIV and STI testing. Additionally, it is also possible that MSM in some states rely more upon mobile or mailed testing services, which were not included in our analysis.

We did not find any association between regions of residence and whether participants had an HIV/STI test in the past year, while other studies have found that MSM located in the South and Midwest were less likely to utilize health services.[13, 14, 28] Consistent with prior research, younger MSM were less likely to test than older MSM.[9] We also found that MSM engaging in riskier sexual behaviors such as having multiple recent partners or engaging in CAI

with a discordant partner were 67% and 5% more likely to have been tested than those with less partners or not having had CAI with a discordant partner, consistent with another study.[29]

Our study had several limitations. First, participants of AMIS may not be representative of the whole MSM population within in the United States, as most AMIS 2019 participants were non-Hispanic White and had high (>75k) annual household incomes. Therefore, our study was likely underrepresenting MSM from different racial/ethnic and sociodemographic backgrounds.[30] Because AMIS utilizes convenience sampling, this may have resulted in some selection bias, with MSM who are interested in health being more likely to participate. Second, while our approach of estimate testing provider density and additional tests per provider provides an idea of which states should expand testing services, it is not the ideal measure for determining access to testing services among MSM. The HIV epidemic among MSM is increasingly one among rural and non-urban MSM, due to limited access to services from both increasing poverty and policy implications, such as many rural states electing not to expand Medicaid.[13, 14] Analysis at the ZIP code level may give a more accurate depiction of access to testing services, considering both urbanicity and how transportation access affects utilization of testing services.[12] Third, we defined our outcome variable as having had either an HIV or STI test within the past year, or both. Further study should be done stratifying the two to determine how the relationship differs between testing provider density and HIV and STI testing individually.

Conclusions

Because of the recent increasing trends in bacterial STI diagnoses among MSM and the implications STIs have for HIV acquisition, it is critical that utilization of testing services be increased to prevent new infections.[1, 2] The results of our study may be helpful for HIV/STI testing facilities as they determine how to better allocate resources and expand their testing

services. States with high testing provider density and a sparser MSM population generally had less additional tests per provider needed to achieve 100% testing coverage, however MSM in such states were also less likely to have had a recent test compared to MSM in low testing provider density states. Therefore, high density states may want to focus their resources more on testing awareness and reaching vulnerable populations. Low provider density states typically had larger MSM populations and therefore more additional tests per provider were needed to achieve 100% testing coverage. These states may need to adopt a more diverse strategy to expand testing, such as holding mass testing initiatives, promoting mailed testing, and targeting particularly vulnerable MSM populations.

Geographic differences in provider density should be taken into consideration when determining strategies to increase utilization of HIV and STI testing services among MSM to prevent new HIV infections. The results of our study show that MSM residing in high provider density states were 19% less likely to have had a recent HIV/STI test compared to MSM in low provider density states. This suggests that despite having a higher density of testing providers, there may be other structural barriers in these states preventing MSM from accessing testing services.

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Figure 1. Estimated Density of HIV/STI Testing Providers, United States, 2019.

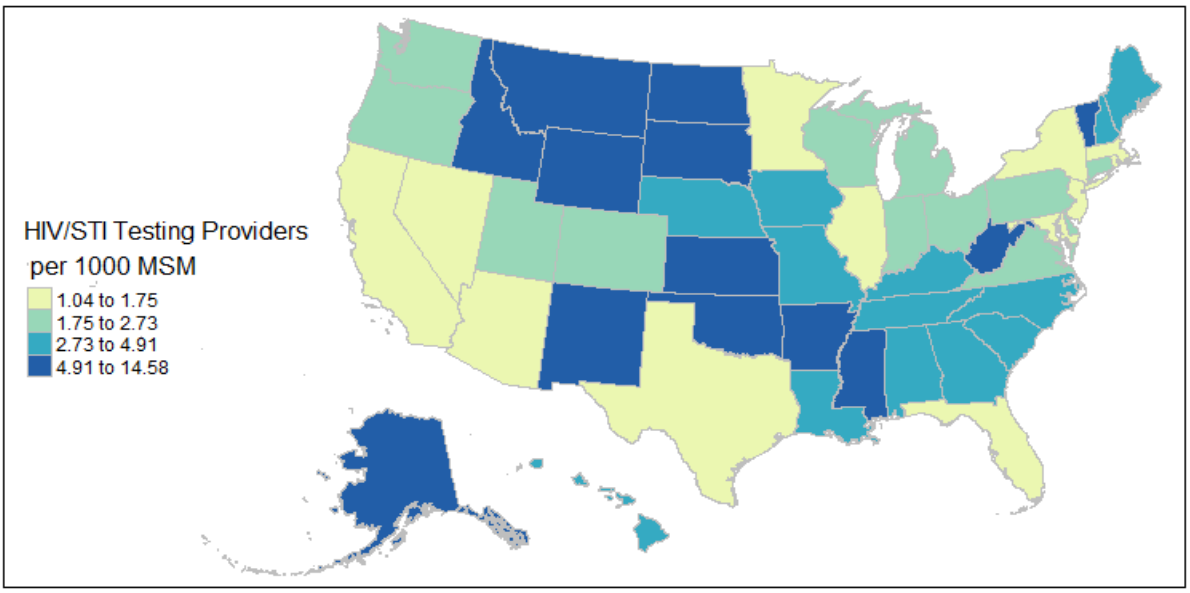

Figure 2. Estimated Additional HIV/STI Tests per Provider Needed to Achieve 100% Testing Coverage of MSM, 2019

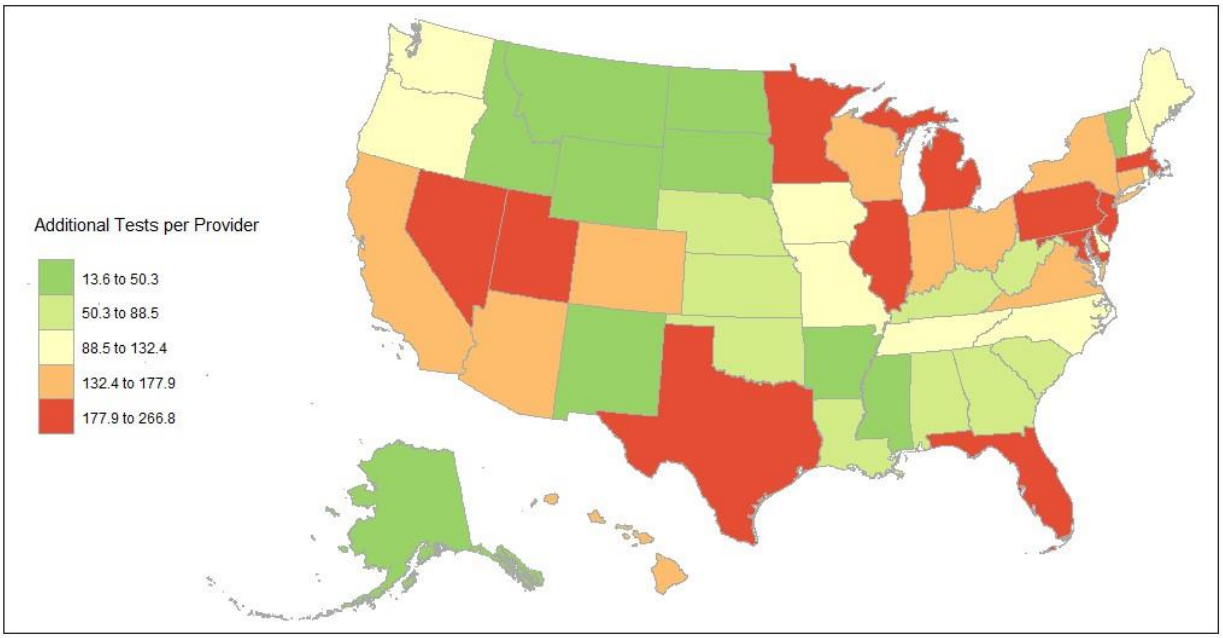

Table 1. American Men's Internet Survey 2019 Participant Characteristics Stratified by an HIV or STI Test Within the Past Year

Characteristic	Total Study Population n (%)	Recent HIV or STI Test n (%)	No Recent HIV or STI Test n (%)
Total	9189 (100)	5362 (58.4)	3827 (41.7)
Testing density			
Low	4115 (44.8)	2549 (61.9)	1566 (38.1)
Low-medium	2352 (25.6)	1318 (56.0)	1034 (44.0)
Medium	2005 (21.8)	1119 (55.8)	886 (44.2)
High	717 (7.8)	376 (52.4)	341 (47.6)
Census region			
Midwest	1894 (20.6)	1055 (55.7)	839 (44.3)
Northeast	1569 (17.1)	936 (59.7)	633 (40.3)
South	3819 (41.6)	2196 (57.5)	1623 (42.5)
West	1907 (20.8)	1175 (61.6)	732 (38.4)
Demographics			
Age (Years)			
15 - 24	4113 (44.8)	2015 (49.0)	2098 (51.0)
25 - 29	1687 (18.4)	1134 (67.2)	553 (32.8)
30 - 39	1258 (13.7)	905 (71.9)	353 (28.1)
40 +	2131 (23.19)	1308 (61.4)	823 (38.6)
Race or ethnicity			
Non-Hispanic White	5680 (61.8)	3116 (54.9)	2564 (45.1)
Non-Hispanic Black	1087 (11.8)	806 (74.2)	281 (25.9)
Hispanic	1456 (15.9)	872 (59.9)	584 (40.1)
Other or multiple races	786 (8.6)	464 (59.0)	322 (41.0)
Annual household income			
$0 - $19,999	1314 (14.3)	720 (54.8)	594 (45.2)
$20,000 - $39,999	1712 (18.6)	1044 (61.0)	668 (39.0)
$40,000 - $74,999	2324 (25.3)	1468 (63.2)	856 (36.8)
$75,000 or more	2786 (30.3)	1687 (60.6)	1099 (39.5)
Housing stability			
Homeless	285 (3.1)	182 (63.9)	103 (36.1)
Irregular housing	599 (6.5)	345 (57.6)	254 (42.4)
Stable housing	8225 (89.5)	4797 (58.3)	3428 (41.7)
Sexual Behavior			
Recent sexual partners			
One or less	3289 (35.8)	1308 (39.8)	1981 (60.2)
Greater than one	5900 (64.2)	4054 (68.7)	1846 (31.3)

CAI with discordant partner			
Yes	2026 (22.1)	1394 (68.8)	632 (31.2)
No	7163 (78.0)	3968 (55.4)	3195 (44.6)

Table 2. Estimated MSM populations in 50 states and the District of Colombia, number of testing providers per state, and estimated density of testing providers per 1000 MSM

Rank	State	MSM[1] n	Testing Providers n	Density per 1000 MSM
1	Alaska	5074	74	14.6
2	Wyoming	3225	44	13.6
3	South Dakota	5171	57	11.0
4	North Dakota	4447	49	11.0
5	Arkansas	19264	209	10.8
6	Montana	6374	69	10.8
7	Mississippi	18992	202	10.6
8	Idaho	9907	104	10.5
9	West Virginia	13063	112	8.6
10	Vermont	7069	59	8.3
11	New Mexico	17969	132	7.3
12	Oklahoma	37739	198	5.2
13	Kansas	22900	115	5.0
14	Alabama	40600	195	4.8
15	Nebraska	13199	63	4.8
16	Kentucky	47034	210	4.5
17	South Carolina	36316	152	4.2
18	Maine	15071	62	4.1
19	Iowa	20753	75	3.6
20	Louisiana	41492	138	3.3
21	New Hampshire	14122	43	3.0
22	North Carolina	103010	312	3.0
23	Georgia	131374	394	3.0
24	Tennessee	73639	207	2.8
25	Missouri	70783	196	2.8
26	Hawaii	15411	42	2.7
27	Delaware	13049	34	2.6
28	Oregon	61607	156	2.5
29	Washington	111960	277	2.5
30	Connecticut	43313	106	2.4
31	Wisconsin	59078	136	2.3
32	Indiana	70103	149	2.1
33	Virginia	112785	231	2.0
34	Utah	33294	67	2.0
35	Michigan	113860	221	1.9
36	Colorado	73357	141	1.9
37	Ohio	144367	264	1.8
38	Pennsylvania	162745	294	1.8
39	Arizona	110344	186	1.7
40	Minnesota	83027	134	1.6

41	New York	371087	571	1.5
42	Florida	340163	520	1.5
43	Illinois	199486	302	1.5
44	Massachusetts	111625	167	1.5
45	District of Colombia	36775	54	1.5
46	New Jersey	132520	186	1.4
47	California	792750	1080	1.4
48	Maryland	84465	113	1.3
49	Rhode Island	23815	31	1.3
50	Texas	371781	451	1.2
51	Nevada	51726	54	1.0

1 Estimates of MSM from each state were taken from Grey et al. 2016 “Estimating the Population Sizes of Men Who Have Sex with Men in US States and Counties Using Data from the American Community Survey”.

Table 3. Extrapolation of Additional HIV/STI Tests Needed per Provider to Achieve 100% Testing Coverage of Estimated MSM Population

State	MSM Eligible for Testing	Testing Providers	Proportion AMIS MSM With Recent Test	Expected Additional Tests Needed	Expected Additional Tests per Provider
	n	n		n	n
Nevada	35774	54	0.60	14409	267
Texas	251578	451	0.56	109864	244
New Jersey	96634	186	0.58	40264	216
Minnesota	64121	134	0.55	28894	216
Pennsylvania	120561	294	0.52	57591	196
Illinois	143936	302	0.59	58957	195
Maryland	57155	113	0.61	22025	195
Utah	25742	67	0.50	12956	193
Massachusetts	83555	167	0.63	31228	187
Michigan	84273	221	0.51	40942	185
Florida	225803	520	0.59	92488	178
California	564396	1080	0.67	186278	172
Arizona	80515	186	0.61	31068	167
Ohio	105639	264	0.58	43965	167
Indiana	51629	149	0.52	24761	166
Colorado	52268	141	0.56	22867	162
New York	250272	571	0.66	85667	150
Connecticut	32409	106	0.53	15369	145
Hawaii	11078	42	0.46	5988	143
Virginia	80630	231	0.62	30645	133
Wisconsin	45162	136	0.60	18002	132
Rhode Island	18622	31	0.79	3880	125
Washington	84206	277	0.60	33491	121
Iowa	15617	75	0.42	8985	120
Tennessee	51018	207	0.52	24528	118
Oregon	46387	156	0.61	18018	115
Missouri	50530	196	0.56	2257	114
New Hampshire[1]	11760	43	0.59	4825	112
Maine	11554	62	0.40	6932	112
Delaware	9468	34	0.65	3360	99
North Carolina	68078	312	0.59	27623	89
Kentucky	34382	210	0.46	18579	88
Louisiana	24548	138	0.55	11064	80
Oklahoma	27547	198	0.47	14600	74
Georgia	75340	394	0.64	27161	69
Alabama	25914	195	0.49	13327	68
Kansas	17093	115	0.55	7719	67
Nebraska	9664	63	0.60	3897	62

South Carolina	21155	152	0.56	9345	61
District of Colombia	23325	54	0.86	3293	61
West Virginia	9787	112	0.42	5631	50
New Mexico	12441	132	0.52	5933	45
South Dakota	4031	57	0.40	2419	42
Vermont	5446	59	0.62	2075	35
Idaho	7553	104	0.62	2905	28
Arkansas	12395	209	0.53	5768	28
Montana	4910	69	0.62	1889	27
Wyoming	2491	44	0.54	1150	26
North Dakota	3458	49	0.63	1268	26
Mississippi	10635	202	0.51	5184	26
Alaska	3825	74	0.73	1007	14

1-The number of MSM living with prevalent HIV from CDC Atlas for New Hampshire was suppressed due to a small count and was therefore not included in the calculation for MSM eligible for testing.

Table 4. Crude and Adjusted Estimates Between Correlates and an HIV/STI Test Within Past Year among MSM, 2019

Correlates	Crude PR (95% CI)	Adjusted PR (95% CI)
Testing provider density		
Low	Ref	Ref
Low-medium	0.90 (0.87-0.94)	0.93 (0.90-0.97)
Medium	0.82 (0.75-0.89)	0.87 (0.80-0.94)
High	0.74 (0.65-0.84)	0.81 (0.72-0.92)
Census region		
Midwest	1.08 (0.98-1.19)	1.07 (0.98-1.17)
South	Ref	Ref
West	1.12 (0.96-1.29)	1.11 (0.97-1.27)
Northeast	1.04 (0.99-1.09)	1.04 (0.99-1.08)
Age		
15-24	Ref	Ref
25-29	1.37 (1.31-1.44)	1.27 (1.21-1.32)
30-39	1.88 (1.72-2.06)	1.61 (1.47-1.75)
40+	2.58 (2.25-2.96)	2.04 (1.79-2.32)
Race or Ethnicity		
Non-Hispanic White	Ref	Ref
Non-Hispanic Black	1.35 (1.30-1.41)	1.13 (1.08-1.17)
Hispanic	1.83 (1.68-1.99)	1.27 (1.17-1.37)
Other or multiple races	2.47 (2.18-2.80)	1.43 (1.27-1.60)
Annual household income		
$0 - $19,999	0.90 (0.85-0.96)	0.94 (0.89-0.99)
$20,000 - $39,999	0.82 (0.73-0.92)	0.89 (0.80-0.99)
$40,000 - $74,999	0.74 (0.62-0.88)	0.83 (0.71-0.98)
$75,000 or more	Ref	Ref
Housing stability		
Homeless	0.98 (0.85-1.12)	1.08 (0.95-1.22)
Irregular housing	0.99 (0.92-1.06)	1.03 (0.97-1.10)
Stable housing	Ref	Ref
Recent sexual partners		
One or less	Ref	Ref
Greater than one	1.73 (1.65-1.81)	1.67 (1.59-1.76)
CAI with discordant partner		
Yes	1.24 (1.20-1.29)	1.05 (1.02-1.08)
No	Ref	Ref