Trends in Testing and Self-Reported Diagnoses of Sexually Transmitted Infections in Gay and Bisexual Men in Australia, 2017 to 2021: Analysis of National Behavioral Surveillance Surveys

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Background: Gay, bisexual, and other men who have sex with men (GBM) are overrepresented in diagnoses of sexually transmitted infections (STIs) relative to their population size. This study assessed trends in STI testing and diagnoses among GBM in Australia.

Methods: The Gay Community Periodic Surveys are repeated cross-sectional behavioral surveillance surveys of GBM. Participants reported the number of anal swabs, throat swabs, urine samples, and blood tests for syphilis they undertook in the last year. "Frequent comprehensive testing" was defined as ≥3 of each test in the previous year. Participants reported STI diagnoses of chlamydia, gonorrhea, syphilis, and other STIs in the last year. Trends in testing and diagnoses from 2017 to 2020 and 2020 to 2021 were assessed with logistic regression models.

Results: We analyzed 24,488 survey responses from participants reporting casual sex in the last 6 months. Between 2017 and 2020, frequent comprehensive STI testing decreased among HIV-negative GBM on preexposure prophylaxis (PrEP) from 71.7% to 68.9% and declined further to 58.6% in 2021. Frequent comprehensive STI testing was stable during 2017–2020 among HIV-negative/untested GBM not on PrEP (17.4%–14.6%) and HIV-positive GBM (30.4%–35.1%) but declined in 2021 to 7.5% among non-PrEP-users and 25.7% among HIV-positive participants. There were minimal changes in STI diagnoses during 2017–2020, but diagnoses declined in 2021.

Conclusions: Many GBM do not meet Australian STI testing guidelines that recommend quarterly testing. Further evaluation of whether this recommendation is realistic or necessary to reduce STIs among GBM is recommended.

Diagnoses of sexually transmitted infections (STIs) including chlamydia, gonorrhea, and syphilis have increased internationally over the last 10 years among gay, bisexual, and other men who have sex with men (GBM).[1–6] Current Australian guidelines, introduced in 2019, recommend STI screening every 3 months for sexually active GBM and at least annually for GBM in monogamous relationships and those who are not sexually active.[7] This recommendation includes an anal swab, throat swab, and urine sample for chlamydia and gonorrhea, and blood tests for HIV and syphilis. It is important to note that the previous iteration of these guidelines in 2014 recommended quarterly testing only for asymptomatic GBM who met risk-based criteria that considered condom use, number of sexual partners, drug use, and HIV status,[8] although it is not clear whether this change to universal screening for all sexually active GBM has led to greater testing frequency.[9]

There has been significant uptake of HIV preexposure prophylaxis (PrEP) among GBM in Australia,[10] leading to concerns about increasing STI diagnoses due to reduced condom use. Evidence is mixed on whether PrEP use leads to higher STI rates, but Australian data show no significant increase in STI diagnoses among GBM after PrEP initiation.[11,12] Users of PrEP in Australia are recommended to test for STIs when obtaining a new prescription, and previous STI infection was often used as a criterion for PrEP eligibility,[13,14] potentially causing detection bias, as evidence from both Australia and internationally suggests that PrEP users test more frequently than non-PrEP users.[15,16] Furthermore, those who initiate PrEP may already engage in sexual activity that increases their risk of STIs.[12] Although HIV testing has increased among GBM in Australia, it has been concentrated among PrEP users.[17,18] In a 2018 study, 63.5% of HIV-negative participants not on PrEP had tested for HIV in the previous year compared with 98.6% of HIV-negative PrEP users.[17] There is evidence that even PrEP users are not meeting the recommended testing frequency,[19] and considering the impact of COVID-19 on testing patterns and health care access,[20] this raises questions about the feasibility of higher-frequency testing guidelines. Further analysis of behavioral trends concerning STI testing among GBM is needed to assess whether GBM are meeting STI testing recommendations in the context of PrEP and COVID-19.

This analysis assessed trends in self-reported STI testing and diagnoses among GBM who had casual sex (in line with recommended testing guidelines for sexually active GBM). This was done through repeated behavioral surveillance data collected between 2017 and 2021, a period during which PrEP use was

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increasing in Australia and the COVID-19 pandemic emerged, disrupting sexual health–related behavior.[20,21] We aimed to assess whether trends in testing and STI diagnoses were different between 3 GBM subgroups: (1) HIV-negative PrEP users, (2) HIV-negative/untested non-PrEP users, and (3) people living with HIV. We separated trends in testing and diagnoses by the periods leading up to (2017–20) and after COVID-19 (2020–21). We assessed factors associated with having received 3 or more STI tests and STI diagnoses in the most recent round of the survey.

METHODS

Design

We used data from the Gay Community Periodic Surveys (GCPS), which are repeated, anonymous, cross-sectional HIV behavioral surveillance surveys of GBM in 7 states/territories in Australia. The methods of the GCPS have been described.[20,22] Briefly, the GCPS is conducted either annually or biennially in each jurisdiction. The survey is typically conducted face-to-face at venues and events, supplemented by online recruitment. In states where the study was conducted in early 2020 before COVID-19 restrictions (New South Wales and Victoria), recruitment remained the same as previous years. COVID-19 restrictions were introduced in March 2020, affecting recruitment in Queensland, South Australia, and Tasmania in 2020 and all jurisdictions thereafter. Recruitment was conducted completely online for some jurisdictions (Queensland and Tasmania in 2020; New South Wales, Victoria, and the Australian Capital Territory in 2021), whereas the others had some face-to-face recruitment but were largely conducted online (South Australia in 2020, Western Australia and Queensland in 2021).[20] Participants are eligible to participate in the GCPS if they are at least 18 years of age for face-to-face recruitment or at least 16 years for online recruitment, identify as a man (inclusive of cisgender and transgender men), have had sex with a man in the past 5 years, and/or identify as gay, bisexual, or queer. The GCPS have approval from the UNSW Sydney Human Research Ethics Committee (ref. HC180903), and the research ethics committees of the community organizations ACON (201,901) and Thorne Harbour Health (THH/CREP/19/006).

Measures

The measures collected in the GCPS have been described elsewhere.[22] Between 2017 and 2020, STI testing was assessed separately for anal swabs, throat swabs, urine samples, and blood tests for syphilis with the question, "Which of these sexual health tests have you had in the last 12 months?" with the response options "None," "Once," "Twice," and "3 or more." In 2021, these options changed to "None," "One," "Two," "3," and "4+." To assess trends, the latter 2 categories were collapsed to remain consistent with previous years (e.g., "3 or more"). Participants were classified as having had a comprehensive STI screen in the last 12 months if they had received at least 1 anal swab, throat swab, urine sample, and blood test for syphilis in that period, consistent with our previous publications.[23] The number of comprehensive screens would be the lowest frequency among all the types of tests. For example, if a participant reported having 2 anal swabs and throat swabs but 3 or more urine samples and blood tests for syphilis in the last year, they were considered to have had 2 comprehensive screens. HIV testing frequency was assessed with the question, "How many HIV tests have you had in the last 12 months?" As with STI testing, the response options in 2017 to 2020 were "None (no tests)," "One test," "Two tests," "3–4 tests," and "5 or more tests," and in 2021, the latter categories were changed to "3 tests" and "4 or more tests." Frequent comprehensive HIV/STI testing was defined as having both 3 or more comprehensive STI tests and also 3 or more HIV tests in the last 12 months.

Diagnoses of STI were assessed with the question, "Which sexually transmitted infection(s) other than HIV were you diagnosed with in the last 12 months?" with response options "Chlamydia," "Gonorrhoea," "Syphilis," "Other," and "Not been diagnosed with an STI in the last 12 months." Participants reported their HIV status ("Based on the results of your HIV tests, what is your HIV status?") and among HIV-negative and untested participants, PrEP use was measured with the question, "In the last 6 months, did you take PrEP to protect yourself from HIV?" Those who reported any PrEP use in the previous 6 months were categorized as PrEP users.

Demographic characteristics used in this analysis included age, country of birth, sexual identity, highest level of education attained, employment, relationship status, postcode of residence, HIV status, and PrEP use. Age was included as a continuous variable. Participants self-reported their sexual identity and were categorized into "gay," "bisexual," or "other sexual identity." Other demographic variables were dichotomized to simplify analyses and reporting. Participants were dichotomized into groups based on whether they were born in Australia or not, had a university degree or not, and were in full-time employment or not. Gay social engagement was measured by a 2-item scale, with scores ranging from 0 to 7 based on their number of gay male friends and free time spent with those friends.[24] The proportion of gay residents living in the participants' postcodes was estimated using an established method.[25] Postcodes were categorized as "<5%," "5–< 10%," and "≥10%" gay male residents.

Variables about sexual behavior with male partners in the previous 6 months included the number of partners (dichotomized to "10 or fewer" or "11 or more"), engaging in any condomless anal intercourse with casual partners (CLAIC) or regular partners (CLAIR) or not, and group sex with 2 or more partners or not. Participants were also dichotomized into whether they had injected drugs in the previous 6 months or not.

Analyses

Analyses were restricted to participants who reported having casual sex in the previous 6 months. In this analysis, we use the term "frequent" to mean ≥3 instances of each test in the last 12 months. "Frequent comprehensive STI testing" was defined as having ≥3 of all 4 STI tests in the last 12 months. Participants were dichotomized into 2 groups, one reporting ≥3 of each STI test in the last year (frequent comprehensive STI testing) and the other reporting fewer or no tests. The number and proportion of participants who had frequent comprehensive STI testing and had ≥3 HIV tests in the last 12 months ("Frequent comprehensive HIV/STI testing") were also reported. Participants who received any diagnoses of chlamydia, gonorrhea, syphilis, or other STI in the previous 12 months were classified as having been diagnosed with "Any STI." Because PrEP guidelines in Australia recommend 3-monthly clinic visits at which HIV/STI testing is conducted, results were stratified for 3 participant groups: "HIV-negative on PrEP," "HIV-negative/untested not on PrEP," and "HIV-positive."

Analyses were conducted in Stata 14.2 (StataCorp, College Station, TX). Because of disruptions caused by COVID-19 restrictions, trend analyses on STI testing and STI diagnoses were conducted on survey responses between 2017 and 2020, and then again for 2020 to 2021. These trends were assessed using bivariate logistic regression with year as the independent continuous variable and testing or diagnoses as the dependent variable where the odds ratio represents the mean change in odds of the outcome (testing or diagnoses) per year. Trends in HIV testing were

restricted to HIV-negative and untested participants. Bivariate and multivariate logistic regression models were performed using a cross-sectional sample comprising the most recent available survey round from each jurisdiction (2020 for SA and TAS, and 2021 for the ACT, NSW, QLD, VIC, and WA) on demographics and behavioral factors associated with 2 outcomes: frequent comprehensive STI testing (≥3 screens vs. ≤2 screens) and any STI diagnosis in the previous 12 months (yes/no). Statistical significance was set at $P = 0.05$.

RESULTS

Trends in Frequent STI and HIV Testing From 2017 to 2020 and From 2020 to 2021

Between 2017 and 2021, 42,772 completed surveys were received. For surveys collected in 2020 (n = 8479), 6309 (74.4%) were from either New South Wales or Victoria, which were collected before the commencement of any COVID-19 from March 2020. Of the 42,772 completed surveys, 24,488 participants (59.9%) reported casual sex in the 6 months before the survey and were included in these analyses. Of this sample, 1570 (6.1%) were recruited in sexual health clinics. Among participants included in analyses, 8187 HIV-negative participants reported PrEP use in the last 6 months; the proportion of all included participants who were HIV-negative and reported PrEP use increased from 29.3% in 2017 to 41.8% in 2021 with a peak of 45.0% in 2020. Among PrEP users, the proportion who reported frequent comprehensive STI testing decreased from 71.7% in 2017 to 68.9% in 2020 and decreased to 58.6% in 2021. Frequent HIV testing decreased from 89.6% in 2017 to 80.7% in 2020 and decreased to 72.2% in 2021. Frequent comprehensive HIV/STI testing decreased from 70.6% in 2017 to 66.9% in 2020 and decreased to 56.7% in 2021 (Table 1).

There were 13,964 HIV-negative or untested participants who had not used PrEP in the last 6 months, decreasing from 60.6% of all included participants in 2017 to 48.1% in 2021, with a low of 45.9% in 2019. The proportion of participants who reported frequent comprehensive STI testing was stable between 2017 (17.4%) and 2020 (14.6%), but this decreased to 7.5% in 2021. Frequent HIV testing decreased from 29.4% to 22.6% and decreased to 11.5% in 2021. Frequent comprehensive HIV/STI testing was stable from 2017 (15.6%) to 2020 (12.4%) but decreased to 6.2% in 2021 (Table 1).

There were 2337 HIV-positive participants, and the proportion who reported frequent comprehensive STI testing was stable between 2017 (30.4%) and 2020 (35.1%), but this decreased to 25.7% in 2021 (Table 1).

Trends in the individual tests (anal swabs, throat swabs, urine samples, blood tests for syphilis) are reported in Supplementary Table 1, http://links.lww.com/OLQ/A985.

Trends in STI Diagnoses From 2017 to 2021

Among HIV-negative men on PrEP, the proportion diagnosed with chlamydia in the previous 12 months was stable between 2017 (34.5%) and 2020 (36.1%), but chlamydia diagnoses decreased to 26.3% in 2021. The proportion diagnosed with gonorrhea was stable between 2017 (31.9%) and 2020 (33.9%), but this decreased to 19.5% in 2021. The proportion diagnosed with syphilis increased from 8.8% in 2017 to 11.2% in 2020, and this was sustained in 2021 at 10.5%. The proportion diagnosed with another STI was stable from 4.3% in 2017 to 5.8% in 2020 and in 2021 (5.4%). The proportion who reported any STI diagnosis in the last 12 months decreased from 56.1% in 2017 to 52.6% in 2020 and decreased further to 38.5% in 2021 (Table 2).

Among HIV-negative/untested men not on PrEP, the proportions diagnosed with chlamydia, gonorrhea, syphilis, or another STI in the last 12 months between 2017 and 2020 was stable (Table 2). From 2020 to 2021, there were decreases in the proportions diagnosed with chlamydia from 9.8% to 7.2% and gonorrhea from 9.8% to 4.7%. The proportions diagnosed with syphilis or another STI was stable between 2020 and 2021. The proportion who reported any STI diagnosis in the last 12 months remained stable between 2017 (21.9%) and 2020 (18.8%), but this decreased to 12.9% in 2021 (Table 2)

Among HIV-positive men, the proportion diagnosed with chlamydia was stable between 2017 (31.9%) and 2020 (36.3%), but decreased to 26.0% in 2021. The proportion diagnosed with gonorrhea increased from 27.6% in 2017 to 35.5% in 2020 but

TABLE 1. Number and Proportion of Participants Who Had Frequent STI and HIV Tests in the Last 12 Months by HIV Status and PrEP Use in 2017 to 2021

	≥3 Tests in Last 12 mo	2017	2018	2019	2020	2021	2017–2020, OR (95% CI)	2020–2021, OR (95% CI)
HIV negative on PrEP (n = 8187)	Comprehensive STI tests	790 (71.7)	1047 (77.0)	1447 (69.5)	1449 (68.9)	902 (58.6)	0.91 (0.87–0.96)*	0.64 (0.56–0.73)*
	HIV tests	986 (89.6)	1243 (91.5)	1723 (82.8)	1693 (80.7)	1109 (72.2)	0.74 (0.69–0.79)*	0.62 (0.53–0.72)*
	Comprehensive HIV/STI tests	778 (70.6)	1037 (76.3)	1426 (68.5)	1408 (66.9)	872 (56.7)	0.90 (0.86–0.95) *	0.65 (0.56–0.74)*
	Total	**1102**	**1359**	**2083**	**2104**	**1539**		
HIV negative/ untested not on PrEP (n = 13,964)	Comprehensive STI tests	658 (17.4)	538 (16.9)	557 (19.2)	338 (14.6)	134 (7.5)	0.97 (0.93–1.01)	0.47 (0.38–0.59)*
	HIV tests	1100 (29.8)	863 (27.7)	818 (28.7)	509 (22.6)	205 (11.5)	0.91 (0.88–0.94)*	0.45 (0.38–0.53)*
	Comprehensive HIV/STI tests	591 (15.6)	494 (15.5)	517 (17.9)	287 (12.4)	110 (6.2)	0.96 (0.92–1.00)	0.46 (0.37–0.58)*
	Total	**3793**	**3182**	**2897**	**2310**	**1782**		
HIV positive (n = 2337)	Comprehensive STI tests	166 (30.4)	159 (31.2)	170 (32.7)	136 (35.1)	96 (25.7)	1.07 (0.98–1.17)	0.64 (0.47–0.87)†
	Total	**547**	**510**	**520**	**387**	**373**		

Comprehensive STI tests includes anal swabs, throat swabs, urine samples, and blood tests for syphilis.

*Significant at $P < 0.001$.

†Significant at $P < 0.01$.

TABLE 2. Number and Proportion of Participants Who Received an STI Diagnosis in the Previous 12 Months by HIV Status and PrEP Use in 2017 to 2021

		2017	2018	2019	2020	2021	2017–2020, OR (95% CI)	2020–2021, OR (95% CI)
HIV negative on PrEP (n = 8187)	Chlamydia	374 (34.5)	521 (38.8)	707 (34.6)	727 (36.1)	392 (26.3)	1.00 (0.95–1.04)	0.63 (0.55–0.73)*
	Gonorrhea	345 (31.9)	476 (35.4)	714 (34.9)	683 (33.9)	291 (19.5)	1.02 (0.97–1.07)	0.47 (0.40–0.55)*
	Syphilis	95 (8.8)	116 (8.6)	189 (9.2)	226 (11.2)	156 (10.5)	1.11 (1.02–1.20)†	0.92 (0.74–1.15)
	Other STI	47 (4.3)	80 (6.0)	94 (4.6)	116 (5.8)	80 (5.4)	1.06 (0.95–1.17)	0.93 (0.69–1.24)
	Any STI	607 (56.1)	760 (56.6)	1087 (53.2)	1060 (52.6)	575 (38.5)	0.94 (0.90–0.99)†	0.56 (0.49–0.65)*
	Total	**1102**	**1359**	**2083**	**2104**	**1539**		
HIV negative/untested not on PrEP (n = 13,964)	Chlamydia	396 (10.8)	325 (10.7)	374 (13.3)	209 (9.8)	123 (7.2)	1.01 (0.96–1.06)	0.72 (0.57–0.91)‡
	Gonorrhea	375 (10.3)	338 (11.1)	324 (11.5)	210 (9.8)	81 (4.7)	1.00 (0.95–1.06)	0.45 (0.35–0.59)*
	Syphilis	127 (3.5)	128 (4.2)	134 (4.8)	83 (3.9)	63 (3.7)	1.06 (0.98–1.16)	0.94 (0.67–1.30)
	Other STI	93 (2.6)	109 (3.6)	87 (3.1)	76 (3.6)	54 (3.1)	1.09 (1.00–1.20)	0.88 (0.61–1.25)
	Any STI	799 (21.9)	652 (21.5)	643 (22.9)	402 (18.8)	222 (12.9)	0.96 (0.93–1.00)	0.64 (0.53–0.76)*
	Total	**3793**	**3182**	**2897**	**2310**	**1782**		
HIV positive (n = 2337)	Chlamydia	170 (31.9)	146 (29.9)	162 (32.0)	134 (36.3)	94 (26.0)	1.06 (0.97–1.16)	0.62 (0.45–0.85)‡
	Gonorrhea	147 (27.6)	163 (33.3)	157 (31.0)	131 (35.5)	82 (22.7)	1.10 (1.01–1.21)†	0.53 (0.39–0.74)*
	Syphilis	87 (16.3)	77 (15.8)	101 (20.0)	84 (22.8)	66 (18.3)	1.16 (1.05–1.29)‡	0.76 (0.53–1.09)
	Other STI	23 (4.3)	29 (5.9)	38 (7.5)	25 (6.8)	26 (7.2)	1.19 (1.00–1.41)	1.07 (0.60–1.89)
	Any STI	264 (49.5)	243 (49.7)	255 (50.4)	197 (53.4)	137 (38.0)	1.05 (0.96–1.14)	0.53 (0.40–0.72)*
	Total	**547**	**510**	**520**	**387**	**373**		

*Significant at $P < 0.001$.
†Significant at $P < 0.01$.
‡Significant at $P < 0.05$.

decreased to 22.7% in 2021. The proportion diagnosed with syphilis increased from 16.3% in 2017 to 22.8% in 2020 and was sustained at 18.3% in 2021. The proportion diagnosed with another STI increased slightly from 4.3% in 2017 to 6.8% in 2020 and was sustained at 7.2% in 2021. The proportion who reported any STI diagnosis in the last 12 months was stable between 2017 (49.5%) and 2020 (53.4%) but decreased to 38.0% in 2021 (Table 2).

Factors Associated With Frequent Comprehensive STI Testing and Diagnosis of Any STI in the Cross-Sectional Sample

In the cross-sectional sample of the most recent surveys from each state/territory, 4425 GBM reported casual sex in the previous 6 months. In this sample, 1233 (29.8%) reported frequent comprehensive STI testing in the previous year. Factors independently associated with frequent comprehensive STI testing included the following: having a university degree (adjusted odds ratio [aOR], 1.26; 95% confidence interval [CI], 1.01–1.56), being more socially engaged with gay men (aOR, 1.09; 95% CI, 1.02–1.17), having 11 or more male sexual partners in the last 6 months (aOR, 2.08; 95% CI, 1.64–2.62), engaging in CLAIC in the last 6 months (aOR, 1.33; 95% CI, 1.02–1.73), engaging in group sex in the last 6 months (aOR, 1.28; 95% CI, 1.02–1.61), living in a postcode with higher proportions of gay men (compared with <5% postcodes; 5%–9% postcodes: aOR, 1.30 [95% CI, 1.00–1.69]; ≥10% postcodes: aOR, 1.67 [95% CI, 1.20–2.32]), and being HIV negative on PrEP (aOR, 11.72; 95% CI, 9.02–15.23) or HIV positive (aOR, 3.91; 95% CI, 2.62–5.82; Table 3). Age, sexual identity, being born in Australia, being in full-time employment, relationship status, engaging in CLAIR in the last 6 months, and injecting drug use were not associated with having frequent comprehensive STI testing.

Of the 4425 participants in the cross-sectional sample, 1020 (23.1%) had an STI diagnosis in the previous 12 months. Factors positively associated with an STI diagnosis in the previous 12 months included the following: being more socially engaged with gay men (aOR, 1.06; 95% CI, 1.00–1.12), having 11 or more male sexual partners in the last 6 months (aOR, 1.85; 95% CI, 1.53–2.24), engaging in CLAIC in the last 6 months (aOR, 2.21; 95% CI, 1.74–2.81), engaging in group sex (aOR, 1.57; 95% CI, 1.30–1.90) and injecting drug use (aOR, 2.50; 95% CI, 1.80–3.48) in the last 6 months, and having received 3 or more comprehensive STI screens in the last year (aOR, 2.56; 95% CI, 2.10–3.11; Table 4). Compared with those living in postcodes with less than 5% gay men, participants were more likely to have received an STI diagnosis if they lived in postcodes with ≥10% gay men (aOR, 1.39; 95% CI, 1.07–1.81). Compared with HIV-negative/untested participants not on PrEP, participants were more likely to have received an STI diagnosis if they were HIV negative and on PrEP (aOR, 1.66; 95% CI, 1.33–2.07) or were HIV positive (aOR, 2.02; 95% CI, 1.47–2.76). Having an STI diagnosis in the previous 12 months was negatively associated with age (aOR, 0.98; 95% CI, 0.97–0.98; Table 4). Diagnosis of STI was not independently associated with sexual identity, being born in Australia, education, employment, relationship status, or engaging in CLAIR in the last 6 months.

DISCUSSION

Among a large nonclinical sample of GBM between 2017 and 2021, we found that frequent comprehensive STI testing was consistently higher among HIV-negative GBM on PrEP, followed by HIV-positive GBM, then HIV-negative/untested GBM not PrEP. Among HIV-negative GBM on PrEP, frequent comprehensive testing decreased between 2017 and 2020, with little change in the other 2 groups. As we asked about their testing behaviors from the previous 12 months, and many of the 2020 surveys were conducted early in the year, the decline observed in 2021 but not in 2020 may reflect a lag between the emergence of COVID-19 and the HIV/STI testing period captured in our survey. However, frequent comprehensive testing remained 4 times more likely to be reported by PrEP users than HIV-negative/untested men not on PrEP (and this gap widened in 2021). Frequent comprehensive testing decreased among all groups in 2021, likely due to

TABLE 3. Predictors of Frequent Comprehensive STI Testing in the Previous 12 Months in the Last Available Round in 2020/2021

	≤2 Tests	≥3 Tests	OR (95% CI)	aOR (95% CI)
Age, mean (SD)	41.2 (14.8)	40.0 (12.5)	0.99 (0.99–1.00)*	0.99 (0.98–1.00)
Sexual identity				
Gay	2278 (67.6)	1093 (32.4)	REF	REF
Bisexual	510 (83.3)	102 (16.7)	0.42 (0.33–0.52) †	0.74 (0.52–1.05)
Other identity	114 (75.5)	37 (24.5)	0.68 (0.46–0.99)‡	0.66 (0.36–1.23)
Born in Australia	2128 (71.5)	849 (28.5)	0.81 (0.70–0.94)*	0.83 (0.66–1.04)
University educated	1480 (65.3)	787 (34.7)	1.70 (1.48–1.95) †	1.26 (1.01–1.56)‡
Full-time employment	1659 (66.3)	845 (33.8)	2.34 (1.65–3.31) †	1.06 (0.68–1.65)
Relationship status				
Monogamous	195 (79.6)	50 (20.4)	REF	REF
Open relationship	986 (68.3)	458 (31.7)	1.81 (1.30–2.52) †	1.35 (0.85–2.15)
Casual sex only	1625 (70.0)	698 (30.1)	1.68 (1.21–2.31)‡	1.40 (0.88–2.22)
Not currently having sex with men	34 (87.2)	5 (12.8)	0.57 (0.21–1.54)	1.31 (0.41–4.22)
Gay social engagement, mean (SD)	5.5 (2.7)	6.3 (1.5)	1.34 (1.28–1.40) †	1.09 (1.02–1.17)‡
Gay postcode				
<5%	2178 (74.5)	744 (25.5)	REF	REF
5%–<10%	460 (62.7)	274 (37.3)	1.74 (1.47–2.07) †	1.30 (1.00–1.69)
≥10%	209 (50.2)	207 (49.8)	2.90 (2.35–3.57) †	1.67 (1.20–2.32)*
11 or more male sexual partners§	522 (47.8)	570 (52.2)	3.93 (3.39–4.55) †	2.08 (1.64–2.62) †
CLAIC§	1660 (61.6)	1033 (38.4)	3.88 (3.28–4.59)†	1.33 (1.02–1.73)‡
CLAIR§	1456 (63.8)	828 (36.3)	2.04 (1.77–2.34)†	1.23 (0.97–1.55)
Engaged in group sex§	1090 (58.6)	770 (41.4)	2.63 (2.29–3.02)†	1.28 (1.02–1.61)‡
Engaged in injecting drug use§	174 (71.0)	71 (29.0)	0.95 (0.72–1.27)	
HIV status and PrEP use				
HIV negative/untested not on PrEP	1905 (92.6)	153 (7.4)	REF	REF
HIV negative on PrEP	704 (41.8)	980 (58.2)	17.32 (14.30–20.99)†	11.72 (9.02–15.23)†
HIV positive	298 (74.9)	100 (25.1)	4.22 (3.18–5.58)†	3.91 (2.62–5.82)†
Total	2907	1233		

*Significant at $P < 0.001$.
†Significant at $P < 0.01$.
‡Significant at $P < 0.05$.
§In the previous 6 months.

COVID-19. Diagnoses of STI were higher among PrEP users and HIV-positive GBM compared with those not on PrEP. Although the trends for specific STIs between 2017 and 2020 varied according to subgroup, in 2021 there were consistent decreases in the proportions reporting chlamydia, gonorrhea, and any STI diagnosis in the previous 12 months.

Users of PrEP were much more likely to report frequent comprehensive STI testing than non-PrEP users, consistent with previous evidence.[15,16] However, those on PrEP still fell short of the recommended STI testing frequency,[19] and despite quarterly testing also being recommended for PrEP prescriptions.[26] There are several potential explanations for why frequent testing decreased in PrEP users. Firstly, those who initiated PrEP in later years may be testing less frequently than early adopters of PrEP who could be more motivated and proactive about their sexual health behaviors. Since 2018 was when PrEP became government subsidized and publicly available, many new PrEP users that initiated PrEP after 2018 may not have been previously part of a PrEP demonstration project, which required regular follow-up testing[14,27] and therefore may not have been testing frequently before PrEP initiation. Second, another potential reason is increasing use of event-driven PrEP, also known as on-demand PrEP, where PrEP is taken around the time of sex.[28] Gay, bisexual, and other men who have sex with men who take event-driven PrEP are likely to take PrEP less frequently than daily PrEP users and therefore may require fewer prescriptions and fewer visits to sexual health clinics per year. Future work that assesses HIV/STI testing frequency among PrEP users should capture information about how they took PrEP and stratify PrEP users by their dosing regimens to further explore how taking daily or event-driven PrEP affects testing behaviors.

Preexposure prophylaxis users and HIV-positive participants were consistently more likely to both test for and be diagnosed with STIs compared with HIV-negative/untested participants not on PrEP. Because a history of rectal STIs is an indicator for PrEP suitability,[26] and clinicians may actively promote PrEP to those with an STI diagnosis, it is not surprising that PrEP users are more likely to have an STI compared with non-PrEP users. There is mixed evidence as to whether or not PrEP initiation leads to increased STI incidence,[11,12,29] but we showed a modest decrease in self-reported 12-month period prevalence of any STI in our sample of PrEP users. However, period prevalence of chlamydia and gonorrhea separately did not decrease. The increasing trend in syphilis among PrEP users and HIV-positive participants is a concern, and potential interventions to address this should be considered. Further monitoring of STI diagnoses by PrEP use and HIV status is important in tailoring health promotion to the needs of specific subpopulations of GBM. Other interventions, such as doxycycline for postexposure prophylaxis for STIs[30] or use of syphilis self-testing kits, may be appropriate for some subpopulations of GBM based on their STI history.

Several factors were associated with frequent comprehensive testing and STI diagnoses. Those who were more socially engaged with gay men and who lived in areas with high concentrations of gay men were more likely to test frequently or receive an STI diagnosis. These results are consistent with previous evidence showing that connection to gay community has been linked to protective sexual health behaviors, such as HIV testing and PrEP

TABLE 4. Predictors of Any STI Diagnoses in the Previous 12 Months in the Last Available Round in 2020/2021

	No STI Diagnosis	Any STI Diagnosis	OR (95% CI)	aOR (95% CI)
Age, mean (SD)	41.2 (14.6)	38.7 (12.1)	0.99 (0.98–0.99)*	0.98 (0.97–0.98)*
Sexual identity				
Gay	2297 (72.6)	868 (27.4)	REF	REF
Bisexual	461 (82.0)	101 (18.0)	0.58 (0.46–0.72)*	0.92 (0.70–1.21)
Other sexual identity	97 (67.8)	46 (32.2)	1.25 (0.88–1.80)	1.04 (0.66–1.63)
Born in Australia	2094 (75.1)	696 (25.0)	0.78 (0.67–0.92)†	0.83 (0.69–1.00)
University educated	1568 (72.9)	582 (27.1)	1.09 (0.94–1.26)	
Full-time employment	1704 (71.9)	667 (28.1)	1.32 (0.90–1.94)	
Relationship status				
Monogamous	185 (79.4)	48 (20.6)	REF	REF
Open relationship	971 (72.8)	362 (27.2)	1.44 (1.02–2.02)‡	1.03 (0.69–1.52)
Casual sex only	1624 (73.7)	580 (26.3)	1.38 (0.99–1.92)	1.06 (0.72–1.56)
Not currently having sex with men	28 (84.9)	5 (15.2)	0.69 (0.25–1.88)	0.84 (0.26–2.74)
Gay social engagement, mean (SD	5.6 (1.6)	6.2 (1.7)	1.25 (1.20–1.31)*	1.06 (1.00–1.12)
Gay postcode				
<5%	2091 (77.3)	615 (22.7)	REF	REF
5%–<10%	491 (69.2)	219 (30.9)	1.52 (1.26–1.82)*	1.13 (0.91–1.40)
≥10%	231 (57.9)	168 (42.1)	1.52 (1.26–1.82)*	1.39 (1.07–1.81)‡
11 or more male sexual partners§	523 (51.3)	496 (48.7)	4.22 (3.62–4.93)*	1.85 (1.53–2.24)*
CLAIC§	1674 (65.6)	879 (34.4)	4.41 (3.63–5.34)*	2.21 (1.74–2.81)*
CLAIR§	1489 (68.8)	676 (31.2)	1.80 (1.55–2.09)*	1.02 (0.84–1.23)
Engaged in group sex§	1077 (61.8)	665 (38.2)	3.00 (2.57–3.48)*	1.57 (1.30–1.90)*
Engaged in injecting drug use§	108 (47.0)	122 (53.0)	3.47 (2.65–4.55)*	2.50 (1.80–3.48)‡
HIV status and PrEP use				
HIV negative not on PrEP	1656 (86.9)	250 (13.1)	REF	REF
HIV negative on PrEP	966 (60.6)	628 (39.4)	4.31 (3.65–5.09)*	1.66 (1.33–2.07)†
HIV positive	234 (62.2)	142 (37.8)	4.02 (3.14–5.15)*	2.02 (1.47–2.76)*
3 or more comprehensive STI tests in last year	605 (51.3)	569 (48.7)	4.69 (4.03–5.47) *	2.56 (2.10–3.11) *
Total	2856	1020		

*Significant at $P < 0.001$.
†Significant at $P < 0.01$.
‡Significant at $P < 0.05$.
§In the previous 6 months.

use,[17,31] as well as behaviors that increase STI risk such as having a higher number of sexual partners and condomless anal intercourse.[24,32] Our results showed that those who are most sexually active are indeed more likely to engage with STI testing.

Our results demonstrated that substantial proportion GBM are not testing at our lower threshold of ≥3 tests per year compared with the quarterly testing guidelines. This raises an important question: will promoting STI testing to meet current guidelines reduce STI prevalence? Undoubtedly, STI testing is important among GBM to reduce time between infection and treatment, and to disrupt chains of transmission. Conversely, it has been argued that frequent universal screening of GBM may not be feasible or cost-effective for clinics, and even in context with increased STI testing among GBM, STI prevalence did not necessarily decrease at the population level.[9,33] In particular, Williams et al.[34] argued that reducing asymptomatic screening for chlamydia and gonorrhea may have potential benefits to address growing antimicrobial resistance and burden on health care services, but should also be considered against potential harms from reduced screening. They call for future research on acceptability and cost-effectiveness of reducing testing frequency, as well as modeling and monitoring on infection and resistance.[34] Further evaluation is needed on whether recommendations for quarterly testing frequency for GBM are realistic or necessary to reduce STI prevalence.

There are several limitations in these analyses. The data were self-reported. Participants susceptible to desirability bias or recall bias may have overreported the number of STI (and HIV) tests they had in the previous year, whereas others may have forgotten when they were tested. Participants recruited face-to-face may also be more susceptible to desirability bias due to the presence of a recruiter, which may have impacted how they responded to the survey compared with those who completed the survey online. This could also have affected the trends as online recruitment was used more during COVID-19–affected rounds. A small proportion of participants were recruited in sexual health clinics, which may have inflated STI testing frequency. Participants were asked about PrEP use in the previous 6 months and HIV/STI testing in the previous year, so a participant who initiated PrEP recently (e.g., in the last 3 months) may have appeared to report less frequent STI testing than is recommended, but still testing in line with the guidelines. Although we asked about the anatomical site of the tests (anal swab, throat swab, urine sample, and blood test for syphilis) and also asked which STIs they have been diagnosed with in the last year, we do not have information on which STIs were tested for at each site. Conversely, we do not have information on which site their previous STI diagnoses were located. Despite these limitations, a major strength of this analysis compared with clinical samples is that STI testing behaviors among GBM who do not attend sexual health services can be assessed.

CONCLUSIONS

Among a large nonclinical sample of Australian GBM, most GBM fell short of the recommendation for GBM to test for HIV and STIs quarterly, and testing frequency fell markedly during 2020–2021, coincident with COVID-19. The fall in testing was particularly pronounced in HIV-negative/untested participants not on PrEP who tested very infrequently. Our findings indicate a

need for further debate on the practical implications of promoting highly frequent STI testing to all sexually active GBM regardless of risk.

REFERENCES

1. Wilkinson A, El-Hayek C, Fairley CK, et al. Incidence and risk factors associated with chlamydia in men who have sex with men: A cohort analysis of Victorian Primary Care Network for Sentinel Surveillance data. Sex Transm Infect 2012; 88(5):319–324.
2. Callander D, Guy R, Fairley CK, et al. Gonorrhoea gone wild: Rising incidence of gonorrhoea and associated risk factors among gay and bisexual men attending Australian sexual health clinics. Sex Health 2019; 16(5):457–463.
3. Chow EPF, Grulich AE, Fairley CK. Epidemiology and prevention of sexually transmitted infections in men who have sex with men at risk of HIV. Lancet HIV 2019; 6(6):e396–e405.
4. Read P, Fairley CK, Chow EP. Increasing trends of syphilis among men who have sex with men in high income countries. Sex Health 2015; 12 (2):155–163.
5. Williamson DA, Chen MY. Emerging and reemerging sexually transmitted infections. N Engl J Med 2020; 382(21):2023–2032.
6. Kirby Institute. HIV, Viral Hepatitis and Sexually Transmissible Infections in Australia: Annual Surveillance Report 2018. Sydney, Australia: Kirby Institute, 2018.
7. Sexually Transmissible Infections in Gay Men Action Group. Australian Sexually Transmitted Infection & HIV Testing Guidelines 2019 for asymptomatic men who have sex with men. Sydney Australia: NSW Sexually Transmissible Infections Program Unit; 2019. Available at: https://stipu.nsw.gov.au/wp-content/uploads/STIGMA_Guidelines2019_Final-1.pdf. Accessed June 16, 2023.
8. Sexually Transmissible Infections in Gay Men Action Group. Australian Sexually Transmitted Infection & HIV Testing Guidelines 2014 for asymptomatic men who have sex with men. Sydney Australia: NSW Sexually Transmissible Infections Program Unit; 2014. Available at: https://www.health.nsw.gov.au/sexualhealth/Documents/STIGMA-testing-guidelines-finalv5.pdf. Accessed August 23, 2023.
9. Traeger MW, Stoove M. Why risk matters for STI control: Who are those at greatest risk and how are they identified? Sex Health 2022.
10. Holt M, Broady TR, Mao L, et al. Increasing preexposure prophylaxis use and 'net prevention coverage' in behavioural surveillance of Australian gay and bisexual men. AIDS 2021; 35(5):835–840.
11. Traeger MW, Cornelisse VJ, Asselin J, et al. Association of HIV preexposure prophylaxis with incidence of sexually transmitted infections among individuals at high risk of HIV infection. JAMA 2019; 321(14):1380–1390.
12. Ong JJ, Baggaley RC, Wi TE, et al. Global epidemiologic characteristics of sexually transmitted infections among individuals using preexposure prophylaxis for the prevention of HIV infection: A systematic review and meta-analysis. JAMA Netw Open 2019; 2(12):e1917134.
13. Zablotska IB, Selvey C, Guy R, et al. Expanded HIV pre-exposure prophylaxis (PrEP) implementation in communities in New South Wales, Australia (EPIC-NSW): Design of an open label, single arm implementation trial. BMC Public Health 2018; 18(1):210.
14. Ryan KE, Mak A, Stoove M, et al. Protocol for an HIV pre-exposure prophylaxis (PrEP) population level intervention study in Victoria Australia: The PrEPX study. Front Public Health 2018; 6:151.
15. Jansen K, Steffen G, Potthoff A, et al. STI in times of PrEP: High prevalence of chlamydia, gonorrhea, and mycoplasma at different anatomic sites in men who have sex with men in Germany. BMC Infect Dis 2020; 20(1):110.
16. Menza TW, Lipira L, Bhattarai A, et al. Self-reported screening for rectal sexually transmitted infections among men who have sex with men. Sex Transm Dis 2019; 46(10):683–688.
17. Bavinton BR, Grulich AE, Broady T, et al. Increases in HIV testing frequency in Australian gay and bisexual men are concentrated among PrEP users: An analysis of Australian Behavioural Surveillance Data, 2013–2018. AIDS Behav 2020; 24(9):2691–2702.
18. Patel PG, Keen P, McManus H, et al. Increased targeted HIV testing and reduced undiagnosed HIV infections among gay and bisexual men. HIV Med 2021; 22(7):605–616.
19. Schumacher C, Wu L, Chandran A, et al. Sexually transmitted infection screening among gay, bisexual, and other men who have sex with men prescribed pre-exposure prophylaxis in Baltimore City, Maryland. Clin Infect Dis 2020; 71(10):2637–2644.
20. Holt M, Chan C, Broady TR, et al. Adjusting behavioural surveillance and assessing disparities in the impact of COVID-19 on gay and bisexual men's HIV-related behaviour in Australia. AIDS Behav 2022.
21. Hammoud MA, Maher L, Holt M, et al. Physical distancing due to COVID-19 disrupts sexual behaviors among gay and bisexual men in Australia: Implications for trends in HIV and other sexually transmissible infections. J Acquir Immune Defic Syndr 2020; 85(3):309–315.
22. Holt M, Lea T, Mao L, et al. Adapting behavioural surveillance to antiretroviral-based HIV prevention: Reviewing and anticipating trends in the Australian Gay Community Periodic Surveys. Sex Health 2017; 14(1):72–79.
23. Holt M, Hull P, Lea T, et al. Comprehensive testing for, and diagnosis of, sexually transmissible infections among Australian gay and bisexual men: Findings from repeated, cross-sectional behavioural surveillance, 2003–2012. Sex Transm Infect 2014; 90(3):208–215.
24. Chan C, Bavinton BR, Prestage GE, et al. Changing levels of social engagement with gay men is associated with HIV related outcomes and behaviors: Trends in Australian behavioral surveillance 1998–2020. Arch Sex Behav 2022; 51(5):2509–2521.
25. Callander D, Mooney-Somers J, Keen P, et al. Australian 'gayborhoods' and 'lesborhoods': A new method for estimating the number and prevalence of adult gay men and lesbian women living in each Australian postcode. Int J Geogr Inform Sci 2020; 34(11):2160–2176.
26. The Australasian Society for HIV, Viral Hepatitis and Sexual Health Medicine (ASHM). National PrEP Guidelines Update. Prevent HIV by Prescribing PrEP. Sydney, 2021. Available at: https://prepguidelines.com.au/wp-content/uploads/2021/11/ASHM-National-PrEP-Guidelines.pdf. Accessed October 10, 2023.
27. Grulich AE, Guy R, Amin J, et al. Population-level effectiveness of rapid, targeted, high-coverage roll-out of HIV pre-exposure prophylaxis in men who have sex with men: The EPIC-NSW prospective cohort study. Lancet HIV 2018; 5(11):e629–e637.
28. Molina JM, Capitant C, Spire B, et al. On-demand preexposure prophylaxis in men at high risk for HIV-1 infection. N Engl J Med 2015; 373(23):2237–2246.
29. Montano MA, Dombrowski JC, Dasgupta S, et al. Changes in sexual behavior and STI diagnoses among MSM initiating PrEP in a clinic setting. AIDS Behav 2019; 23(2):548–555.
30. Traeger MW, Mayer KH, Krakower DS, et al. Potential impact of doxycycline post-exposure prophylaxis prescribing strategies on incidence of bacterial sexually transmitted infections. Clin Infect Dis 2023; ciad488.
31. Keen P, Hammoud MA, Bourne A, et al. Use of HIV pre-exposure prophylaxis (PrEP) associated with lower HIV anxiety among gay and bisexual men in Australia who are at high risk of HIV infection: Results from the flux study. J Acquir Immune Defic Syndr 2020; 83(2): 119–125.
32. Foster-Gimbel O, Doyle DM, Engeln R. The gay community involvement index: An exploratory factor analysis and initial validation of a new measure of gay community involvement. Arch Sex Behav 2020; 49(1):233–247.
33. Kenyon C, Vanbaelen T, Van Dijck C. Recent insights suggest the need for the STI field to embrace a more eco-social conceptual framework: A viewpoint. Int J STD AIDS 2022; 9564624211064133.
34. Williams E, Williamson DA, Hocking JS. Frequent screening for asymptomatic chlamydia and gonorrhoea infections in men who have sex with men: Time to re-evaluate? Lancet Infect Dis 2023; S1473-3099(23)00356.