

“Seek, Test, Treat” Lessons From Australia: A Study of HIV Testing Patterns From a Cohort of Men Who Have Sex With Men

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Objective: HIV diagnoses are increasing in Australia, mostly among men who have sex with men (MSM). Similar to many countries, Australia’s HIV prevention strategies emphasize a “seek, test, treat” approach including enhancing HIV testing frequency. We describe HIV testing among MSM and correlates of returning for testing within 12 months in the context of new HIV prevention paradigms.

Methods: Testing and behavioral data (2007–2013) contributed by MSM aged ≥ 16 years were included. Total HIV tests by calendar year and repeat tests within 12 months were described, alongside negative binomial regression for trend. A 2-level mixed-effects logistic regression model examined correlates of testing within 12 months. Median (days) between HIV tests was compared between MSM diagnosed with HIV and persistently HIV-negative MSM.

Results: The study included 46,060 tests from 17,904 MSM. There was an increase in annual tests ($P < 0.01$), repeat tests within 12 months ($P < 0.01$), and the proportion of tests within 12 months of an index test ($P < 0.01$), although only to 53.3% in 2013. Return rates were higher in MSM aged 16–29 years (adjusted odds ratio 1.30, 95% confidence interval: 1.1 to 1.5) and those reporting higher numbers of partners (adjusted odds ratio 3.5, 95% confidence interval: 3.0 to 4.0). Median time between tests among MSM

diagnosed with HIV (233 days) was greater than for HIV-negative MSM (189 days) ($P = 0.03$).

Conclusions: Although testing has increased, testing frequency among many MSM remains suboptimal. To optimize “seek, test, treat”-based HIV prevention strategies, new approaches to increase testing uptake and early HIV detection among MSM are needed.

Key Words: HIV, men who have sex with men, prevention

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INTRODUCTION

Notifications of HIV in Australia have continued to increase since the late 1990s, with the largest increase in the state of Victoria, the second most populous state in Australia. The majority of HIV diagnoses in Australia occur among men who have sex with men (MSM).¹ Increases in HIV diagnoses among MSM have occurred alongside substantial increases in other sexually transmissible infections (STIs), including chlamydia, syphilis, and gonorrhoea.² A similar re-emergence of HIV and other STIs among MSM has been seen in the United Kingdom, North America, and parts of Europe.^{3,4} To address this, considerable investments made in HIV and STI prevention in Australia over the past decade have increasingly focussed on improving rates of HIV and other STI testing among MSM. These included social marketing campaigns,⁵ trials of point-of-care testing models,⁶ novel community engagement strategies,⁷ and revisions to the National HIV Testing Policy.⁸ Such initiatives specifically aim to reduce the prevalence of undiagnosed HIV, which is understood to contribute disproportionately to onward HIV transmission.⁹ Timely diagnoses of HIV have the potential to interrupt transmission by prompting mitigation of sexual risk¹⁰ and facilitating timely commencement of treatment,^{11,12} with subsequent reductions in community viral load.¹³ Effective screening and detection of infections, particularly early infections, is fundamental to “seek, test, treat” HIV prevention strategies.^{14–18}

In Australia, annual HIV and STI testing is recommended for all sexually active MSM and 3- to 6-monthly testing is recommended for MSM engaging in high-risk sexual practices.¹⁹ There is some evidence of recent local increases in the total number of HIV tests conducted among

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MSM,²⁰ and self-reported rates of HIV testing among gay men in Australia are high, at approximately 60% for annual testing.²¹ However, objective clinic-level data among MSM in Australia have shown suboptimal HIV testing frequency²² and there is evidence of pools of MSM who have never tested for HIV.²³ Increased HIV testing has also been reported internationally with substantial proportions of undiagnosed MSM, and persistent HIV incidence and infrequent HIV testing remain a key issue.^{24–26} Models outlining the potential impact of “seek, test, treat” approaches to HIV prevention emphasize the importance of increasing test frequency among those at highest risk of acquiring HIV and transmitting it to others.^{27,28} UNAIDS has also endorsed ambitious global targets aimed at ensuring 90% of people living with HIV are diagnosed (alongside 90% retained on treatment and 90% achieving viral suppression).²⁹ To evaluate the potential HIV prevention benefits of strategies focussed on enhancing HIV testing and detection, it is important to measure HIV testing frequency (beyond simply recording overall tests conducted), alongside trajectories in HIV incidence and notifications. It is also important to describe the characteristics of those testing more or less frequently to inform refinements to prevention strategies including targeted and tailored interventions.

Victoria (the Australian state with the highest per population HIV diagnosis rate) maintains one of the few HIV surveillance systems internationally that prospectively link individuals’ HIV and STI tests alongside basic data on sexual risk behavior at the time of testing. This system provides an opportunity to monitor HIV testing among MSM, evaluate efforts to enhance HIV testing, and detect changes in HIV incidence among those presenting for testing. We scrutinized HIV testing and behavioral data from MSM presenting at sentinel surveillance clinics with the aim of describing HIV testing patterns over time and correlates of returning for testing within 12 months.

METHODS

Setting

The Victorian Primary Care Network for Sentinel Surveillance (VPCNSS) on blood-borne viruses and sexually transmissible infections was established in April 2006 and is managed by the Burnet Institute. The VPCNSS has been described in detail previously³⁰ but in brief, it consists of 12 participating primary health care sites and their corresponding laboratories, with 4 disease networks: HIV, chlamydia, syphilis, and gonorrhoea. The HIV network includes 2 metropolitan sexual health centers and 2 General Practice (GP) clinics specializing in gay men’s health that see a high caseload of MSM for HIV and STI testing. These HIV network clinical sites have high HIV coverage in Victoria, accounting for 50% of HIV diagnoses in Victoria between 2007 and 2010.²⁰

Data Collection

HIV test outcome data from laboratories are uniquely identified and linked to corresponding responses from a brief surveillance questionnaire self-completed by patients at the

time of testing. One sexual health center undertaking a relatively small number of HIV tests does not collect behavioral data and was therefore excluded from this analysis as MSM status could not be assigned (n = 324 HIV tests). Data collection differs between 1 metropolitan sexual health center and the 2 GP clinic sites.

At the latter, the doctor completes basic demographics, reason for HIV test, presence of symptoms, previous HIV testing history at the clinic, history of injecting drug use, engagement in sex work and, if male, history of sex with another man. The patient then completes the questionnaire items including numbers of recent oral and anal sex partners (categorical), HIV status of regular sex partner, recent condom use with regular and casual sex partners, and locations where patients met sex partners. These questions have a 6-month recall period. At 1 metropolitan sexual health center; a 12-month recall period for number of partners (continuous) and condom use with any anal sex partner (compared with differentiation between oral or anal, and casual or regular partner at other sites). HIV status of partner and location of meeting partners was not asked at this sexual health center.

For the purpose of this analysis, responses were combined into categories of number of partners with the final categories being 1 male partner in 6 or 12 months; 2 to 5 in 6 months or 2 to 10 in 12 months; 6 to 10 in 6 months or 11 to 20 in 12 months; and more than 10 in 6 months or more than 20 in 12 months. Response categories for condom use for anal sex with any sex partner were the same across all sites [always, usually (>50%), sometimes (<50%), and never]. Categories were combined into a binary variable for recent condom use with categories of consistent condom use (always) and inconsistent (sometimes, usually, never) with any anal sex partner. Clinical guidelines¹⁹ were considered when deriving meaningful categories for variables for number of partners and condom use.

Participants

Data from all HIV tests recorded for sexually active HIV-negative MSM aged ≥ 16 years between 2007 and 2013 were used in this study, and participants could have multiple tests. Analysis excluded MSM reporting no male sex partners in the previous 6 or 12 months because annual testing is not recommended for MSM not sexually active in the previous year.¹⁹ For consistency with recent literature,²⁶ tests within 30 days of a previous test were considered as the same testing episode and therefore excluded. MSM status was assigned by patient or clinician identification on the laboratory form, questionnaire data on male sexual partners, or screening for rectal STIs alongside HIV testing. HIV diagnosis was by antibody detection using enzyme immunoassay (EIA) and follow-up confirmatory Western blot performed at a reference laboratory. Tests performed as part of ongoing nonoccupational postexposure prophylaxis follow-up, as indicated by clinicians, were excluded from the analysis (n = 359).

Analysis

Individual records were organized as panels, with the outcome of “test within 12 months” as binary and assigned at

every record within an individual's panel of data. Each record (test performed) was considered an index, and "test within 12 months" was assigned "yes" to an index if the subsequent test was <12 months (365 days) of the index test date. For example, if an individual had 4 HIV tests between May 2012 and June 2013, 3 months apart, each test would be counted and each test would count as a test within 12 months. Continuing the example, the index tests in 2012 that had subsequent tests within 12 months, but in 2013, were reported as "test within 12 months" for the calendar year 2012.

Total number of HIV tests and number and percentage of tests within 12 months of an index test were described overall and by demographics, sexual risk behavior, and type of clinic. Returning for testing within 13 months (396 days) and 14 months (426 days) was also examined to assess the sensitivity of the 12-month (365 days) cutoff in the descriptive analysis of returning for testing.

To assess trends by calendar year, the proportion of tests with a return test was reported. A 2-sample *z* test was used to test for a difference in proportion of tests with a subsequent test within 12 months between 2007 and 2012.³¹

Trends in testing and returning for testing were examined using a negative binomial regression. The outcome variable (tests) was count data and was found to be over-dispersed; therefore, negative binomial approach was used to assess trends. A likelihood ratio test was used to confirm the negative binomial regression as returning the better fit of the observed data compared with a Poisson regression.

Logistic regression was used to analyze predictors of returning for testing as a binary event variable. A mixed-effect multilevel model was used to assess predictors of returning for testing within 12 months where demographics, sexual risk behavior, and type of clinic attended were included as fixed effects and participant's unique record identifier was incorporated as a random effect. Our mixed-effects regression was modeled over 2 levels with repeated tests (level 1) contributed by MSM (level 2) over time. The 2-level model was chosen to account for the unobserved confounding within MSM, such as an established testing pattern any individual may have. The final logistic regression model included adjustment for all variables and was selected with consideration of information criteria alongside the clinical and public health applicability of the model, which provided estimates of individual level predictors of returning

that could be used to identify subpopulations of MSM who did not return for testing.^{32,33}

Of those MSM diagnosed with HIV with a testing history in the VPCNSS, the time between tests was calculated in days and reported as a median. The Wilcoxon rank-sum test was used to test for a difference in time between tests for HIV-positive MSM and persistently negative MSM. For all analysis, *P* < 0.05 was considered statistically significant, and analysis was conducted using Stata, Release 13.

RESULTS

Description of HIV Testing

A total of 46,060 HIV tests from 17,904 sexually active MSM between 2007 and 2013 were included in the analyses. The total number of tests increased by more than 100% over the follow-up period from 4431 in 2007 to 9336 in 2013 (*P* < 0.01). There was no increase in the median number of annual tests per individual (*P* = 0.65) (Table 1). A description of HIV testing and returning for testing by demographic characteristics and sexual risk behavior is available as supplemental digital content (see Table S1, <http://links.lww.com/QAI/A665>).

Returning for Repeat HIV Testing

Half (50.1%) of all HIV tests between 2007 and 2012 were accompanied by a subsequent test at the same clinic within 12 months. The number and proportion of tests performed within 12 months of an index test increased annually between 2007 and 2012 (*P* < 0.01). This represents an increase of 115% in the number of return tests, but only an 8.5% increase in the proportion of tests with a return test within 12 months (Table 1). Assessment of the sensitivity of the 12-month cutoff showed similar proportions of MSM returning for testing when using 13 and 14 months as a cutoff (data not shown).

We observed higher rates of return tests within 12 months among younger MSM [adjusted odds ratio (aOR) 1.30, 95% confidence interval (CI): 1.1 to 1.5] and MSM born in a country other than Australia (aOR 1.1, 95% CI: 1.0 to 1.2). Compared with MSM reporting 1 male partner, higher number of partners cumulatively increased the odds of returning for testing, with the strongest association found

TABLE 1. Description of HIV Tests and Returning for Testing Within 12 Months Among Sexually Active MSM (n = 46,060), January 2007 to December 2013

Year	Total	2007	2008	2009	2010	2011	2012	2013	<i>P</i> *
Individuals	17,904	1928	2042	2095	2241	2376	3170	4052	
HIV tests	46,060	4431	5231	5732	6483	6816	8031	9336	<0.01
Return tests within 12 mo (n)	18,398	1985	2444	2891	3279	3519	4280	—	<0.01
Return tests within 12 mo (%)	50.1%	44.8	46.7	50.4	50.6	51.6	53.3	—	<0.01†
Median tests per individual	2.0	1.0	2.0	2.0	2.0	2.0	2.0	1.0	0.65‡

Data from 2014 not available to calculate returning for testing after 2013 tests.

**P*-value for negative binomial regression for trend.

†*P*-value for 2-sample *z* test (2007–2012).

‡*P*-value for Wilcoxon rank-sum test for equality of medians (2007–2013).

Return tests within 12m (%) denominator is tests from 2007–2012 (n = 36,724).

for those reporting >10 partners in 6 months or >20 partners in 12 months (aOR 3.5, 95% CI: 3.0 to 4.0) (Table 2).

HIV Testing Before Testing Positive

There were 455 new positive HIV tests at the participating clinics between 2007 and 2013. Approximately 58% of MSM diagnosed in this period were diagnosed on their first VPCNSS test recorded. Among MSM diagnosed with HIV between 2007 and 2013 with a previous test record at a participating clinic (n = 188), a longer median time between tests (233 days; interquartile range = 125–467) was observed compared with persistently HIV-negative MSM (n = 9089; 189 days; interquartile range = 105–357; P = 0.03).

DISCUSSION

This study used 7 years of linked surveillance data to describe HIV testing patterns among MSM attending the major primary care HIV clinics in Melbourne. The relatively consistent proportional increase in total tests (increased by 110%) and 12-month return tests (increased by 115%) indicates that most of the increase in HIV testing was driven by MSM testing for HIV at participating clinics for the first time. The contribution of return testing to the increases in overall tests was relatively modest; the proportion of tests occurring within 12 months of an index test increased by only 8.5%, and the median number of tests per patient in a given

calendar year remained relatively stable. Despite guidelines recommending at least 12-monthly HIV testing for all MSM included in this analysis, approximately half of the tests conducted among MSM in 2012 were not followed by a subsequent test at the same clinic in the ensuing 12 months. Of particular concern, less frequent testing was seen among MSM subsequently diagnosed with HIV compared with those who were persistently HIV negative. Although the data are limited to individuals returning to the same clinic, the trends suggest in-roads in increasing overall HIV testing but little meaningful increase in HIV testing frequency in Australia's key HIV risk population.

These data correspond with post-highly active antiretroviral therapy (HAART) era highs in Victorian annual HIV diagnoses, with a steady increase in diagnoses seen over the past 5 years.³⁴ These patterns broadly reflect Australian HIV surveillance data that also include little change in the proportion of HIV notifications classified at late diagnoses (~30% diagnosed with CD4 <350 cells per microliter).¹ Suboptimal testing frequency demonstrated in this study limit treatment-based prevention strategies that are reliant on early diagnosis and timely consideration of treatment alongside opportunities to modify risk behaviors to interrupt transmission.³⁵ Australian HIV prevention targets include increased testing,³⁶ with local modelling suggesting a reduction in infections would require a 30% decrease in the time MSM are undiagnosed alongside a 70% increase in treatment uptake among those diagnosed.³⁷ It is therefore vital to monitor HIV testing frequency (alongside trends in overall testing) among those at risk.

However, it remains unclear how much overall HIV testing and testing frequency needs to increase, and among whom, to impact the local epidemic. Comparable countries in Europe^{24,38} and North America^{25,39,40} have also reported increased HIV testing alongside sustained HIV endemicity, late diagnosis, and longer intervals between tests for those subsequently diagnosed. Recent estimates in Australia suggest that approximately 86% of people living with HIV know their status, 77% of those diagnosed with HIV are on antiretroviral treatment (ART) (66% of all people with HIV), and 85% of people on ART have undetectable viral load.¹ Although these estimates suggest that Australia has a relatively small gap in achieving the UNAIDS “90 90 90”²⁹ goal (linked to a 90% reduction in HIV incidence by 2030), rates of undiagnosed infection may be unevenly distributed and remain a potential key driver of infection in Australia,²⁷ especially if clustered within higher risk-taking MSM. Local data from MSM recruited through bars, clubs, and sex-on-premises-venues in 2008 showed that 31.1% of the sample's HIV-positive MSM were unaware of their HIV status.⁴¹ Although relative changes in undiagnosed infection among MSM remain unknown, our data showing little proportional change in 12-monthly HIV testing, a large proportion of MSM (~50%) diagnosed on their first test at a specific VPCNSS clinic and diagnosed MSM with longer intervals between tests are concerning.

MSM reporting high numbers of sexual partners in adjusted analysis were associated with return testing within 12 months. Frequent testing among MSM with high partner turnover is encouraging and demonstrates some individual insight into personal risk. Local campaigns promoting HIV

TABLE 2. Predictors of Returning for Testing Among Sexually Active MSM (n = 17,904), January 2007 to December 2012

	OR (95% CI)	aOR (95% CI)
Age groups, yrs		
16–29	1.5 (1.4 to 1.7)	1.3 (1.1 to 1.5)
30–39	1.3 (1.2 to 1.5)	1.1 (1.0 to 1.3)
40–49	1.0 (0.9 to 1.2)	0.9 (0.8 to 1.1)
50+	Reference	—
Country of birth		
Australia	Reference	—
Other	1.1 (1.1 to 1.2)	1.1 (1.0 to 1.2)
Number of male partners*		
One	Reference	—
2–5 in 6 mo or 2–10 in 12 mo	2.0 (1.8 to 2.1)	1.9 (1.7 to 2.1)
6–10 in 6 mo or 11–20 in 12 mo	2.9 (2.6 to 3.2)	2.9 (2.5 to 3.2)
>10 in 6 mo or >20 in 12 mo	3.3 (2.9 to 3.7)	3.5 (3.0 to 4.0)
Recent condom use†		
Consistent	Reference	—
Inconsistent	1.0 (0.9 to 1.1)	1.0 (0.9 to 1.1)
Type of clinic		
Sexual health centers	Reference	—
GP specializing in gay men's health	0.8 (0.8 to 0.9)	1.0 (1.0 to 1.1)

Excludes 2013 as data not available from 2014 to calculate returning for testing. Adjusted analysis includes all variables.

*Combined variable using recall periods of 12 months (sexual health center) and 6 months (other sites).

†Combined variable using recall periods of 12 months and condoms' use with any partner (sexual health center), and 6 months and specific nomination of with casual or regular partner/s (other sites).

testing among MSM, which have shown some success previously, may have also contributed to frequent testing among those MSM with higher partner turnover.⁵ However, condom use largely dictates HIV risk among MSM; MSM reporting condomless sex are recommended to test for HIV in Australia up to 4 times a year¹⁹; yet in this study, these MSM had the same likelihood of 12-month return testing as those consistently using condoms. MSM reporting condomless sex increased over the follow-up period, consistent with trends seen in surveys of gay men in Australia,²¹ and establishing frequent testing among these MSM is integral to HIV prevention. Modelling of the UK HIV epidemic among MSM demonstrated that increasing rates of diagnosis through increasing testing coverage and frequency and ART initiation may impact the epidemic. However, primary prevention was considered equally essential to reducing incidence.⁴² The extent to which HIV testing as a prevention strategy is capable of offsetting sexual risk behavior is an important question in Australia, and comparable countries that are moving to implement “seek, test, treat” prevention strategies may also be asking the same question.

There are some limitations to the VPCNSS that warrant some caution in the interpretation of the results. First, the inclusion of sexual health centers and specialist gay men’s GP clinics may have resulted in selection bias toward higher-risk MSM; the proportion of MSM reporting condomless sex in our data is higher than in community-based surveys.²¹ MSM may test at different clinics within the VPCNSS or have intermediate tests at clinics outside the network, and these tests cannot be linked, resulting in missed HIV tests or diagnoses among MSM. It is unknown what number of tests may be missed or what proportion of MSM changed clinics during the follow-up period. The data are therefore not able to indicate the actual number of MSM who tested within 12 months; however, the data are likely to provide indications of testing trends.

Our study also has significant strengths. The VPCNSS has high coverage of those at risk of HIV, as demonstrated by the proportion of all jurisdictional HIV notifications captured (50%).²⁰ In addition, the VPCNSS provides intraclinic testing frequency data free from the self-report bias and is the only ongoing linked surveillance system monitoring HIV testing in Australia. Although previous analysis has been conducted from VPCNSS on returning for testing, which provided important insights,²² this article extends from the previous analysis that was restricted by a calendar year approach to monitoring return tests. We offer additional data, examination of trends over time, a rolling cohort, and greater analysis flexibility through panel data.

These findings demonstrate infrequent HIV testing and ongoing condomless sex among MSM returning to the same clinic in the context of increased HIV notifications. The extent to which HIV testing needs to increase further to impact the HIV epidemic is unknown, but insights from this study can provide comparison indicators for other countries to interrogate HIV testing data as part of an overall prevention strategy. We also provide important local data from which to evaluate interventions designed to enhance HIV testing frequency in Australia, including ongoing social marketing,⁵ optimization of clinic-based strategies,³⁵ and innovative

testing models (eg, rapid-point-of-care tests,⁶ community-based testing,⁴³ home-based testing).⁴⁴ This article highlights the reliance of treatment-based prevention strategies on frequency of testing. Future research should aim to use individual longitudinal data to monitor temporal patterns for the entire HIV care cascade to better understand the relative potential prevention gains elicited by frequent testing versus the other aspects of the cascade such as time between diagnosis and treatment. Objective empirical data are also necessary to inform mathematical models from which tailored and targeted strategies for HIV prevention can be identified.

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