Declining prevalence of undiagnosed HIV in Melbourne: results from community-based bio-behavioural studies of gay and bisexual men

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Abstract

Objective: To measure changes in undiagnosed HIV among gay and bisexual men (GBM) in Melbourne.

Methods: Undiagnosed HIV was compared between GBM recruited anonymously in 2008 in gay venues only and GBM anonymously or confidentially (results delivery) recruited in 2014 at gay venues and a community festival. Surveys were completed and oral fluid specimens collected for HIV testing; positive tests among GBM reporting being HIV-negative or unknown/untested were classified as undiagnosed. Tests of proportions compared serological prevalence, undiagnosed prevalence and participant characteristics.

Results: HIV prevalence was 9.5% and 7.1% among 639 and 993 GBM recruited in 2008 and 2014, respectively; undiagnosed prevalence declined significantly from 31.1% to 7.1% ($p<0.001$). Sexual risk and undiagnosed HIV was highest among venue-recruited participants in 2014 (17.6%). Fewer diagnosed GBM participated confidentially in 2014, but this did not meaningfully influence comparative undiagnosed HIV prevalence.

Conclusion: We provide the first estimates of changes in undiagnosed HIV in Australia, demonstrating a marked decline in undiagnosed HIV among GBM.

Implications for public health: Our findings are consistent with reports of increases in HIV testing among GBM. Given sustained high HIV diagnosis rates, new testing models that encourage high frequency testing are needed to control the local HIV epidemic.

Key words: undiagnosed HIV, gay and bisexual men, Australia

Undiagnosed HIV is recognised as a key driver of HIV epidemics among gay, bisexual and other men who have sex with men (GBM). Correct knowledge of one's HIV status provides the foundation for effective seroadapative HIV prevention practices,[1] and timely diagnosis allows post-diagnosis mitigation of risk behaviour,[2] and prevention of onward transmission through early treatment and subsequent reduction in HIV viral load.[3] Mathematical modelling of HIV epidemics in developed countries suggests a grossly disproportionate contribution of undiagnosed HIV to transmissions among GBM. Modelling of the Australian HIV epidemic has previously reported that the nine percent of GBM living with HIV who were estimated to be undiagnosed contributed to 30% of new infections.[4] More recent modelling in Europe suggests that undiagnosed GBM contribute up to 70% of new HIV infections.[5,6]

The putative contribution of undiagnosed HIV to onward transmission has led to the establishment of HIV prevention targets that focus on reducing undiagnosed HIV prevalence in specific risk populations.[7,8] The monitoring of such targets requires the periodic assessment of undiagnosed HIV, either through modelling or direct measurement in community-recruited samples. Models can be relatively easily revised periodically using updated surveillance data, albeit with inherent limitations associated with parameter uncertainties.[9] Only a limited number of studies have directly measured changes in undiagnosed HIV over time in community-recruited samples. Behavioural surveillance among GBM in San Francisco between 2004 and 2011 showed significant declines in undiagnosed HIV prevalence (from 21.7% to 7.5%) and non-significant declines in community viral load coinciding with increases in HIV testing.[10,11] In Baltimore, very high levels of undiagnosed HIV detected among venue-recruited GBM in 2004/2005 (58.4%) and 2008 (74.4%) were found to be related to age, race/ethnicity and health seeking behaviours.[12] Bio-behavioral surveys of GBM in the UK have shown discrepant findings. Persistent levels of undiagnosed HIV (26.3%-25.4%) were found in Glasgow

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and Edinburgh between 2008 and 2011,[13] while declines in undiagnosed HIV from 34% to 24% were detected in venue-recruited MSM in London between 2000 and 2013.[14] Surveillance of undiagnosed HIV allows for the evaluation of local HIV prevention strategies that focus on promoting HIV testing and treatment, the refinement of HIV transmission models and can help guide targeted HIV prevention strategies.

Until recently, only two direct estimates of undiagnosed HIV had been reported in Australia; among venue-recruited GBM in the city of Melbourne (2008) and state of Queensland (2007) undiagnosed HIV prevalence was found to be 31.1% and 19.5%, respectively.[15,16] In 2013-14 we undertook COUNT, the first national study of undiagnosed HIV in Australia. Based on the methods used in the study of undiagnosed HIV undertaken in Melbourne,[15] COUNT provides the first study of trends in undiagnosed HIV among GBM in Australia. Here we compare the findings from the Melbourne sample of the COUNT study with findings from the previous Melbourne study of undiagnosed HIV in GBM.

Methods

Suck It & See (SIAS)

The methods for SIAS have been described in detail elsewhere.[15] Briefly, in June 2008 trained recruitment staff approached GBM in gay community bars, clubs and sex-on-premises venues (SOPVs) and asked if they would be willing to participate in an anonymous community-based HIV prevalence study. Venues replicated those used in the Melbourne arm of the national Gay Community Periodic Survey (GCPS), an annual behavioural surveillance survey of gay men.[17,18] Inclusion criteria were being male, aged over 18 years, and reporting sex with another man in the previous five years. Individuals who consented to participate self-completed a behavioural questionnaire adapted from the GCPS and provided an oral fluid sample using the OraSure Oraquick Oral Fluid Collection Device for HIV testing at the National Reference Laboratory (NRL). SIAS participation was fully anonymous and individuals could not receive the results of the test performed on their specimen. Test results were linked to their GCPS behavioural survey via a unique identifier for analysis purposes only. The questionnaire asked about sociodemographic characteristics; relationships with men and sexual practices in the previous six months; recent HIV and sexual health testing; and drug use.[17] Specimens were tested for HIV antibodies using an anti-HIV-1 IgG antibody capture enzyme-linked immunosorbent assay,[19] with reactive and indeterminate specimens retested and confirmed by Western blot. Ethics approval for SIAS was provided by the Victorian Department of Health Human Research Ethics Committee and the Monash University Standing Committee on Ethics in Research Involving Humans.

COUNT Study

COUNT study methods were based on those used in SIAS, with the exception of offering both anonymous participation and confidential results delivery and additional recruitment from the local gay festival; COUNT methods have been described in detail elsewhere.[20] Briefly, COUNT participants were recruited through the GCPS in capital cities of six Australian jurisdictions in 2013/2014. Melbourne COUNT participants were recruited in January 2014 at the local annual gay community festival (*Midsumma*) and at community bars, clubs and sex-on-premises venues. To participate in COUNT, GCPS participants consented to also provide an oral fluid specimen for HIV testing, with surveys and specimens linked via a unique identifier. The specimen collection device and testing processes at NRL replicated those used in SIAS. Data collected from the survey instrument completed as part of the GCPS was used to characterise participants (age, country of birth, education, employment status, HIV testing history and sexual risk behaviours) and compare them with SIAS participants (where a similar survey was administered). Comparisons were also made across study participation type.

Two voluntary participation options for COUNT were offered: confidential or anonymous participation. Confidential participation involved participants providing contact details so they could receive their HIV test results via text message (SMS), by phone call or through email. No contact details were provided for anonymous participation and participants who chose this option did not receive their test result. Most confidential participants were notified of their test result by a discreet SMS (not mentioning HIV), containing a link to a secure website. For non-reactive results the website provided participants with information about the test window period and support services. Reactive results from participants whose self-reported HIV status indicated a previous diagnosis were sent by a text message that also contained a link to a secure website and a request to call the free study telephone line if they had further questions. Participants with an indeterminate or reactive result that suggested previously undiagnosed HIV were sent a text message explaining that their results were ready and asking them to call the free study telephone line. If they did not call within 48 hours, repeat calls were made until participants were contacted. Trained staff handled all calls and provided support and appropriate counselling, and also facilitated appointments for confirmatory serology at local clinics. Ethics approval for the COUNT study was provided by the Human Research Ethics Committees of the University of New South Wales, the AIDS Council of New South Wales, the Victorian AIDS Council, and the Australian Capital Territory Department of Health.

Statistical analysis

We compared differences in HIV prevalence outcomes (serological prevalence, rates of self-reported previous HIV diagnosis and proportion of undiagnosed HIV) between the SIAS and the overall COUNT samples and by COUNT participation types (anonymous vs. confidential) and COUNT participants recruited at sex and social gay venues (to compare similarly recruited samples) using two-sample tests of proportions. Proportion of undiagnosed HIV was calculated as a proportion of men with HIV-positive test results among those who indicated they were HIV-negative, untested or of unknown HIV status. Participant characteristics (age, country of birth, education, employment status, HIV testing history and sexual risk behaviours) were also compared between the overall SIAS and COUNT samples and by COUNT participation types and participants recruited through sex and social venues. Data management and analysis was conducted using Stata 13.1.[21] Statistical significance was set at $p<0.05$.

Results

The 639 SIAS participants were recruited exclusively through sex and social venues, 275 (43%) in gay bars or dance clubs and 364 (57%) in SOPVs. A total of 993 GBM were recruited in Melbourne for the COUNT study, 755 (76%) at the *Midsumma*

Table 1: Characteristics of Suck It & See (2008) and COUNT (2014) participants.

	SIAS	COUNT			
		Overall	Sex & social venue-recruited[a]	Anonymous participation[a]	Confidential participation
	N=639	N=993	N=238	N=278	N=715
Serological HIV Prevalence	61 (9.5)	70 (7.1)	17 (7.1)	54 (19.1)***	16 (2.2)***
Previously diagnosed HIV positive	42 (6.6)	65 (6.6)	14 (5.9)	53 (19.1)***	12 (1.7)***
Undiagnosed HIV positive	19 (3.0)	5 (0.5)***	3 (1.3)	1 (0.4)*	4 (0.6)***
% of all positives (95% CI)	31.1 (19.5-42.7)	7.1 (1.1-13.1)***	17.6 (0.0-35.7)	1.9 (0.0-5.5)***	25.0 (3.7-46.2)

a: denotes COUNT study design characteristics comparable with SIAS

** p<0.05; ** p<0.01, *** p<0.001*

community festival and 238 (24%) through gay community sex and social venues. Of the participants recruited into COUNT through sex and social venues, 149 (63%) were recruited at gay bars or dance clubs and 89 (37%) at SOPVs.

Table 1 compares HIV prevalence in SIAS with all COUNT participants, those participating anonymously (consistent with SIAS) and participating confidentially (opting to receive results; inconsistent with SIAS), and those recruited in sex and social venues only (consistent with SIAS). Serological HIV prevalence was 9.1% in SIAS and 7.1% in COUNT. The proportion of participants reporting a previous HIV diagnosis was identical (6.6%) between samples, but the proportion classified as having an undiagnosed HIV infection was significantly higher in SIAS (3.0%) than in COUNT (0.5%). A significant difference in undiagnosed HIV was detected between SIAS (31.1%) and the overall COUNT sample (7.1%). Undiagnosed HIV was higher among COUNT participants recruited in sex and social venues (17.6%) and not significantly different from the venue-recruited SIAS sample. Undiagnosed HIV was also higher among confidential (25.0%) compared to anonymous participants (1.9%).

The characteristics of anonymous and confidential COUNT participants were broadly similar, and comparisons between SIAS and overall COUNT participants broadly reflect comparisons with confidential and anonymous COUNT participants. Table 2 compares the characteristics of SIAS participants, overall COUNT participants and those recruited at sex and social venues, consistent with SIAS. SIAS participants were, on average, older than COUNT participants and more likely to be employed, but were similar in relation to country of birth and education. A greater proportion of SIAS participants (23.0%) reported no prior HIV testing compared with COUNT participants (11.6%), although similar proportions reported testing in the past 12 months.

The sexual behaviours reported by COUNT participants overall were indicative of a lower risk profile compared with SIAS participants; lower proportions reported sex with casual partners (although the proportion reporting condomless sex with casual partners was similar), group sex or sex with more than 10 partners in the past six months, while a greater proportion reported having a regular sex partner. However, COUNT participants recruited from sex and social venues were more similar to SIAS participants; sexual behaviour and risk were largely similar, with the exception of lower proportions reporting group sex in the past six months and a higher proportion reporting lifetime HIV testing.

Discussion

Findings from this study suggest a decline in the prevalence of undiagnosed HIV among GBM in Melbourne between 2008 and 2014. HIV infection was detected among 61 participants in 2008 and 70 participants in 2014, and based on self-reported HIV status, 19 (31.1%) were classified as undiagnosed infections in 2008 compared with 5 (7.1%) in 2014. The magnitude of this decline is likely to have been affected by the addition of GBM recruited at a gay community festival in COUNT in 2014; these participants reported a generally lower sexual risk profile compared with venue-recruited participants in 2008 and 2014. A more appropriate comparison to assess trends in undiagnosed HIV comes from sex and social venues-recruited participants in COUNT, venues where SIAS participants were also recruited. When comparisons of undiagnosed HIV are restricted to GBM recruited in these venues, the difference in undiagnosed HIV prevalence detected (31.1% compared to 17.6%) represents a marked decline with a potentially meaningful impact on HIV prevention.

Table 2: Characteristics of Suck It & See (2008) and overall and sex and social venue recruited COUNT participants (2014).

	SIAS	COUNT	
		Overall	Sex & social venue-recruited
	N=639 (%)	N=993 (%)	N=238 (%)
Median age (years)	35	32	33
Aged <30 years	195 (32.6)	401 (40.4)**	95 (39.9)*
Australian born	453 (73.7)	730 (73.9)	169 (71.6)
Education			
Less than university	284 (46.6)	451 (45.4)	117 (49.2)
University Degree/Postgraduate	326 (53.4)	542 (54.6)	121 (50.8)
Currently employed	512 (83.8)	765 (77.6)*	186 (78.2)
HIV testing history			
Ever tested for HIV	475 (77.0)	859 (88.4)***	198 (87.6)***
Tested for HIV in the past 12 months[a]	285 (73.8)	596 (72.8)	137 (74.5)
In the past 6 months reported…			
Sex with casual partners	511 (80.0)	662 (66.7)***	179 (75.2)
Condomless anal sex with casual partners	175 (35.4)	246 (37.2)	78 (43.6)
A regular partner	361 (56.7)	706 (71.1)***	153 (64.3)
>10 sexual partners	192 (30.6)	209 (21.1)***	65 (27.3)
Group sex	259 (53.9)	301 (30.9)***	89 (38.5)*

** p<0.05; ** p<0.01, *** p<0.001*

a: Among participants who self-reported HIV negative or unknown/untested status.

There is strong evidence of increased HIV testing and testing frequency among GBM in Melbourne over the period between these studies, which may have contributed to reductions in undiagnosed HIV. Analyses of testing data from inner-metropolitan high HIV caseload clinics between 2007 and 2013 showed significant increases in the annual number of HIV tests conducted and in 12-monthly repeat testing among all GBM,[22] and in three and six-monthly repeat testing in GBM classified as 'high risk'.[23] Changes in HIV testing frequency among GBM in Melbourne have also been supported by high profile targeted social marketing campaigns,[24,25] the implementation of new HIV point-of-care peer testing models in general practice,[26] and GBM community-based peer-led services.[27] However, changes in HIV testing frequency and our estimates of reductions in undiagnosed HIV are yet to translate into declines in notifications of new HIV diagnoses. In the state of Victoria, where approximately 80% of HIV notifications are attributed to sex between men, annual diagnoses have plateaued over recent years at post-antiretroviral therapy (ART) era highs.[28] Despite the optimism associated with UNAIDS 90-90-90 global HIV prevention targets, population–level changes in HIV incidence in response to improvements in the HIV care cascade are yet to emerge in Melbourne.[29] Indeed, recent modelling of concurrent changes in HIV and hepatitis C incidence among people who inject drugs in Vancouver have suggested a relatively modest impact of increasing ART coverage on HIV prevention in this population.[30] There remain concerns that 90-90-90 targets may be insufficient to drive the inferred declines in HIV incidence,[31] especially in settings where testing, treatment and viral suppression coverage is already high.[32] (32). Australia is among the countries in the world closest to achieving these UNAIDS targets,[33] and current estimates of the care cascade in Victoria suggests an undiagnosed HIV prevalence at 10% (an estimate that sits between the prevalence of undiagnosed HIV detected in the overall COUNT sample and among venue-recruited GBM) based on statistical back-projection methods.[29] Changes in testing patterns and undiagnosed HIV, alongside high treatment coverage (the Victorian cascade estimates 94% of people diagnosed with HIV are receiving ART of whom 93% have achieved viral suppression),[29] appear to have had little impact to date on reducing the trend in new HIV diagnoses (as a surrogate marker of incidence) among GBM. Collectively, these findings support the notion that jurisdictions already performing well in relation to the HIV care cascade may need to achieve targets beyond 90-90-90 to have any meaningful prevention impact.[32]

HIV testing among those at risk has a clear role in influencing undiagnosed HIV prevalence. One marked difference between our two samples of GBM was the prevalence of ever having tested for HIV; 77% of SIAS participants and 88% of COUNT participants reported ever having tested for HIV. However, recent testing, which is arguably more important in influencing rates of undiagnosed HIV, were similar between samples. Our findings, and those of international studies of GBM, point to the important contribution recently acquired infections make to undiagnosed HIV prevalence and ongoing transmission and underscore the need for high frequency HIV testing among GBM reporting high risk behaviors. While almost one-third of HIV undiagnosed GBM in our 2008 SIAS sample reported no prior HIV testing, undiagnosed cases were most commonly detected among GBM who reported a test in the past 12 months. Similarly, three of the five cases of undiagnosed HIV in the 2014 Melbourne COUNT sample reported an HIV test in the past six months (one case each reporting their last test was 7-12 months and 12-24 months ago; data not reported). In populations with ready access to HIV testing and where a large majority report lifetime testing, minimising time between tests and reducing the cumulative time individuals remain undiagnosed is crucially important for HIV prevention. This is particularly relevant for GBM engaged in high risk sexual practices and underscores the importance of risk-based HIV testing guidelines[34-36] and appropriate risk perception by individuals' that prompt them to frequently present for HIV testing.[37] Findings from cross-sectional studies of GBM in Glasgow and Edinburgh (2005-2011) show that, despite significant increases in HIV testing in the past 12 months, undiagnosed HIV prevalence remained relatively stable and that nearly half of undiagnosed GBM in 2011 reported testing for HIV within the past 12 months.[13] Similarly, cross-sectional studies of venue-recruited GBM in London (2000-2013) showed significant increases in past 12 months HIV testing among men with undiagnosed HIV infection (29% to 67%).[14]

When considered alongside modelling of jurisdiction-specific HIV epidemics suggesting that most of HIV transmissions among GBM are attributed to undiagnosed acute infections,[6,38] these findings support calls for novel strategies to improve HIV testing accessibility to facilitate high frequency testing.[13,23,39,40] One such strategy is to make prevention interventions like HIV pre-exposure prophylaxis more accessible to motivate GBM who have high risk condomless sex to come forward for testing.

The most important limitation of our comparative analyses relates to differences in study protocols and recruitment locations between studies. In our study, we disaggregated findings from COUNT across the type and location of recruitment to allow for more direct comparisons with the SIAS sample. COUNT results showed some influence of these aspects of study design on prevalence outcomes; in particular, venue-recruitment contributed a higher sexual risk sample (more consistent with the SIAS sample) compared to festival-recruited participants and a higher prevalence of undiagnosed HIV. While the small number of undiagnosed infections detected in COUNT limited statistical power to undertake recruitment location-specific comparisons, undiagnosed HIV prevalence was meaningfully lower among venue-recruited GBM in COUNT compared with SIAS. While adding an option for test results delivery in COUNT reflected World Health Organization (WHO) and UNAIDS guidelines (published after SIAS was implemented) that recommend participants in serological HIV surveillance be given an opportunity to learn their correct status,[41,42] this difference in study protocol remains a potential limitation in our comparative analysis. As might be expected, men reporting a previous diagnosis tended to participate anonymously given they would receive no direct benefit from confidential participation and results delivery. While these preferences biased findings towards a low serological prevalence/high undiagnosed prevalence outcome in the confidential arm of COUNT, strongly discrepant patterns in the anonymous arm of COUNT resulted in a non-significant difference in HIV prevalence and a significantly lower undiagnosed prevalence in the overall COUNT sample compared with SIAS.

Conclusion

Our study provides the first data on potential changes in undiagnosed HIV among GBM in Australia and suggests a substantial decline in undiagnosed HIV in this population in Melbourne between 2008 and 2014. Global HIV prevention strategies are increasingly focused on treatment-as-prevention, with an emphasis on reducing undiagnosed HIV, timely access to treatment and viral suppression; these outcomes are also a focus of Australia's HIV strategy. Our data confirm recent modelling that shows Australia has made major in-roads in reducing undiagnosed HIV and is as close as anywhere in the world in achieving UNAIDS 90-90-90 targets.[43,44]

Implications for public health

While our findings are consistent with recent reports of increases in HIV testing, comparable proportion of GBM with undiagnosed HIV in 2008 and 2014 reported recent testing histories. In the context of sustained and historically high annual HIV diagnosis rates among GBM in Australia and the potential substantial contribution of undiagnosed acute infection to transmission,[6] new testing strategies that expand the reach of high frequency testing may be required to impact the trajectory of the Australian HIV epidemic.

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