

High Rates of Undiagnosed HIV Infections in a Community Sample of Gay Men in Melbourne, Australia

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Abstract: Undiagnosed HIV infections contribute disproportionately to the HIV epidemic. We recruited 639 gay men attending social venues, who completed a cross-sectional survey with oral fluid collection for HIV testing in 2008. We calculated HIV and undiagnosed HIV prevalence and used χ^2 tests and logistic regression to examine associations between participant characteristics and HIV status. Among 639 men, 61 (9.5%, 95% confidence interval: 7.4% to 12.1%) tested HIV positive, of which 19 (31.1%, 95% confidence interval: 19.9% to 44.3%) were classified as undiagnosed HIV positive. Almost a third of HIV-positive men were unaware of their HIV status, and of these men, a large proportion engaged in high-risk behaviors.

Key Words: HIV, gay men, prevention, sexual risk behavior, undiagnosed infection

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INTRODUCTION

In Australia, more than 65% of newly diagnosed HIV infections are among gay men.^{1,2} Despite high self-reported annual testing rates (~60%)³ and a reduction in community viral loads among those on antiretroviral therapy,⁴ Australia has witnessed substantial increases in newly diagnosed HIV infections over the past decade.² A recent study assessing

compliance with HIV testing frequency guidelines among gay men attending primary care clinics in Melbourne reported annual retesting rates among those recommended for annual testing as low as 35%, indicating that self-reported testing rates among gay men could be over estimated.⁵

People who are unaware of their HIV infection (undiagnosed HIV positive) are considered to contribute disproportionately to HIV transmissions due, in part, to ongoing sexual risk practices and high viremia at HIV seroconversion.⁶ Recent epidemic modelling of HIV in Australia estimates that approximately 31% of new HIV infections are transmitted by the estimated 9% of gay men with undiagnosed HIV.⁶ Regular HIV testing is likely to reduce HIV transmissions by providing timely access to treatment and suppression of viral load^{7–9} and through the modification of sexual risk behaviors.¹⁰

We report HIV prevalence and the proportion of undiagnosed HIV infection in a community-recruited sample of gay men in Melbourne, Australia. We compare risk and health-seeking behaviors of men with diagnosed HIV, undiagnosed HIV and HIV-negative men.

METHODS

Setting

Melbourne is the capital of Victoria, Australia, a jurisdiction with the second largest gay population in Australia.¹¹ Melbourne's gay community venues consist largely of gay social venues (bars/clubs) and sex-on-premises venues (SOPV), with at least 10 SOPVs in operation in 2007.¹²

Study Design

Using a facility-based sampling method,¹³ a convenience sample of gay men were recruited from gay community social venues (3 bars/clubs and 4 SOPVs chosen by popularity and location) in Melbourne over the month of June 2008. Locations and times of the week were chosen to maximize recruitment (Friday and Saturday nights for bars/clubs; Thursday, Friday, Saturday, and Sunday evenings for SOPVs). A social marketing campaign preceded data collection to enhance participation and raise awareness about the novel specimen collection.

Men were approached by trained field researchers and invited to participate. The inclusion criteria were anyone aged 18 years or older, who self-identified as gay, or had sex with

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another man in the past 5 years and was able to provide verbal informed consent. Consenting men self-completed a questionnaire and provided an oral fluid specimen using the OraSure collection kit (Technologies, Inc, Bethlehem, PA) according to the manufacturer's instructions. HIV test results were not provided to participants because HIV oral fluid testing is not registered in Australia for screening purposes. Researcher recruitment logs recorded how many men were approached to participate.

Questionnaire

The questionnaire was adapted from the instrument used in the annual Melbourne Gay Community Period Surveys (MGPCS)¹⁴ which includes questions on sexual relationships, sexual risk practices (number of partners, partner type, knowledge of partners' HIV status), HIV and other sexually transmitted infection testing, self-reported perceived HIV status, gay community social attachment, and demographics. Additional questions included for this study were confidence about knowing HIV status and acceptability of oral fluid specimen collection.

HIV Testing

HIV testing was undertaken at the National Serological Reference Laboratory using an anti-HIV-1 IgG antibody capture enzyme-linked immunosorbent assay (GACELISA) using the method developed by Parry et al.¹⁵ An internal validation study of the anti-HIV-1 IgG antibody capture enzyme-linked immunosorbent assay at National Serological Reference Laboratory demonstrated 100% sensitivity [95% confidence interval (CI): 95.0 to 100.0] and 100% specificity (95% CI: 95.0% to 100.0%) upon repeat testing as per the test protocol. All specimens testing positive by the HIV-1 enzyme immunoassay were confirmed by Western blot.

Statistical Analysis

Questionnaires and oral fluid specimens were matched by a numeric unique identifier. HIV prevalence was calculated from the biological test result. An undiagnosed HIV infection (undiagnosed HIV positive) was defined as a positive biological test result from any man self-reporting as HIV negative or who had never had a HIV test or was unsure of their HIV status. HIV prevalence and the prevalence of undiagnosed HIV with 95% confidence intervals were calculated.

The χ^2 tests were used to determine associations between undiagnosed HIV positive, diagnosed HIV positive, and HIV-negative men with participant characteristics and sexual risk behaviors. Univariate logistic regression was used to determine associations between self-reported HIV-negative men (undiagnosed HIV positive and HIV negative) and participant characteristics and sexual risk behaviors.

Data analysis was performed using Stata 10.1 (StataCorp, TX).¹⁶ A cut off of $P < 0.05$ was used for all statistical tests.

Ethics approval was obtained from the Victorian Department of Health Human Research Ethics Committee

and the Monash University Standing Committee on Ethics in Research Involving Humans.

RESULTS

Sample

One thousand twenty-seven men were approached to participate and 639 men (62.2%) completed a questionnaire that could be matched to an oral fluid sample (3 questionnaires could not be matched to an oral fluid sample).

Most participants (57.0%) were recruited from SOPVs and 43.0% from bars/clubs. Median age of the participants was 35 years (range: 18–75 years), 73.7% were born in Australia, 88.5% reported residing in metropolitan Melbourne, 83.8% were in full-time employment, and 53.5% had completed tertiary education (Table 1).

HIV Prevalence

Of the 639 men, 61 provided specimens that were HIV positive, equating to a HIV prevalence of 9.5% (95% CI: 7.4% to 12.1%). HIV prevalence was 6.9% (95% CI: 4.2 to 10.6) at bars/clubs and 11.5% (95% CI: 8.4 to 15.3) at SOPVs. HIV prevalence was highest among those aged 40–49 years (17.3%) and lowest among men aged 18–29 years (2.6%).

Undiagnosed HIV-Positive Prevalence

Of the 61 men testing HIV positive, 19 were unaware of their positive HIV status, providing an undiagnosed HIV-positive prevalence estimate of 31.1% (95% CI: 19.9% to 44.3%) (Table 1).

Characteristics of Undiagnosed HIV-Positive Cases

Of the 19 undiagnosed HIV-positive men, 6 (31.6%) reported no HIV testing history, 6 (31.6%) reported their last HIV test as more than 12 months ago, and 7 (36.8%) reported a HIV test in the past 12 months (Table 1). Almost a third of men (31.6%) with undiagnosed HIV reported more than 10 sex partners, and over half (52.9%) reported unprotected anal intercourse with casual partners in past 6 months. The majority (80.0%) reported group sex in the past 6 months. Almost two-thirds (63.1%) of undiagnosed HIV-positive men reported being "very confident" or "confident" in knowing their HIV status (Table 2).

Comparison of HIV Undiagnosed Cases With Diagnosed and HIV-Negative Men

The χ^2 analyses showed HIV-negative men and those with undiagnosed HIV (median age = 35 years) were significantly younger than diagnosed HIV-positive men (median age = 45 years) (P value < 0.01). No significant differences in sociodemographics, recruitment site, or HIV testing history were detected between HIV undiagnosed, diagnosed, and HIV-negative men (Table 1).

TABLE 1. Characteristics of HIV-Negative Men, HIV-Positive Men With Diagnosed Infections and HIV-Positive Men With Undiagnosed HIV Infections Based on Oral Fluid Test Result

	Negative (n = 578)		Undiagnosed Positive (n = 19)		Diagnosed Positives (n = 42)		Total (n = 639)		χ^2 Significance P
	n	%	n	%	n	%	n	%	
Recruitment site									
Bars/clubs	256	44.3	4	21.0	15	35.7	278	43.0	0.08
SOPVs	322	55.7	15	79.0	27	64.3	364	57.0	
Sexual identity									
Gay/homosexual	482	83.5	16	84.2	39	92.9	537	84.2	0.41
Bisexual	72	12.5	2	10.5	1	2.4	75	11.8	
Other	23	4.0	1	5.3	2	4.8	26	4.1	
Age group (yrs)									
18–29	190	34.1	3	16.7	2	5.0	195	31.7	—
30–39	167	30.0	8	44.4	6	15.0	181	29.4	
40–49	124	22.3	5	27.8	21	52.5	150	24.4	
50+	76	13.7	2	11.1	11	27.5	89	14.5	
Median age (yrs)	35	—	35	—	45	—	35	—	<0.001†
Country of birth									
Australia	410	73.6	11	61.1	32	80.0	453	73.7	0.32
Other	147	26.4	7	38.9	8	20.0	162	26.3	
Ethnicity									
Anglo-Australian	308	55.3	9	50.0	22	55.0	339	55.1	0.91
Other	249	44.7	9	50.0	9	45.0	276	44.9	
Education									
Secondary or less	158	28.6	9	50.0	10	25.6	177	29.0	0.10
Further/vocational	95	17.2	1	5.6	11	28.2	107	17.5	
Degree/postgraduate	300	54.3	8	44.4	18	46.2	326	53.5	
Employment status									
Employed (full/part time)	467	84.3	17	94.4	28	71.8	512	83.8	0.06
Unemployed*	87	15.7	1	5.6	11	28.2	99	16.2	
No. sex partners (in past 6 months)									
10 or less	404	71.1	13	68.4	19	46.3	436	69.4	0.004†
More than 10	164	28.9	6	31.6	22	53.7	192	30.6	
UAI with casual partner (in past 6 months)									
Never	296	67.9	8	47.1	12	34.3	316	64.8	<0.001†
Occasionally/often	140	32.1	9	52.9	23	65.7	172	35.3	
Any group sex‡ (in past 6 months)									
No	296	54.4	6	33.3	11	28.2	313	52.1	0.002†
Yes	248	45.6	12	66.7	28	71.8	288	47.9	
HIV status of current regular partner									
Negative/do not know	562	97.7	19	100.0	29	69.1	610	95.9	<0.001†
Positive	13	2.3	0	0.0	13	31.0	26	4.1	
Disclose of HIV status to casual partners before sex*									
None	216	51.1	7	43.7	9	26.5	232	49.1	0.02†
Some/all	207	48.9	9	56.3	25	73.5	241	50.9	
Any STI test (other than HIV) in past 12 months									
No	121	23.2	4	23.5	1	2.8	126	21.9	0.02†
Yes	401	76.8	13	76.5	35	97.2	449	78.1	
HIV testing history									
No, Never tested	136	24.4	6	31.6	0	—	142	23.0	0.47§
Yes, ever tested	422	75.6	13	68.4	40	100.0	475	77.0	
Reported HIV test results (if ever tested)									
HIV negative	418	72.3	13	68.4	4	9.5	435	91.6	0.72§
HIV positive	4	0.7	0	0.0	36	85.7	40	8.4	

(continued on next page)

TABLE 1. (Continued) Characteristics of HIV-Negative Men, HIV-Positive Men With Diagnosed Infections and HIV-Positive Men With Undiagnosed HIV Infections Based on Oral Fluid Test Result

	Negative (n = 578)		Undiagnosed Positive (n = 19)		Diagnosed Positives (n = 42)		Total (n = 639)		χ ² Significance P
	n	%	n	%	n	%	n	%	
Recent HIV testing (in the 12 months prior to the survey)									
In the past 12 months	288	75.2	7	53.8	25	73.5	320	74.4	0.08§
>12 months ago	95	24.8	6	46.2	9	26.5	110	25.6	
Reason for not testing in the 12 months prior to the survey									
Always practice safe sex	33	39.3	0	0.0	0	0.0	33	35.5	—
Consider myself at low risk of HIV	25	29.8	2	40.0	0	0.0	27	29.0	
Problems finding time to get tested	3	3.6	1	20.0	0	0.0	4	4.3	
Afraid to know if I was HIV positive	8	9.5	2	40.0	0	0.0	10	10.8	
Simply had not thought about it	8	9.5	0	0.0	0	0.0	8	8.6	
Other	7	8.3	0	0.0	4	100.0	11	11.8	

Unknowns excluded from Table.

*Unemployed include pensioner/social security benefits and other.

†P value < 0.05.

‡Can include regular partner.

§Diagnosed HIV-positive men are excluded from this χ² test as, by definition, all have been tested.

||Other included being in a monogamous relationship, being too lazy, and being HIV positive.

STI, sexually transmitted infection; UAI, unprotected anal intercourse.

There was a significant association between recent sexual risk behaviors and HIV undiagnosed, diagnosed, and HIV-negative men. Higher rates of unprotected anal intercourse with casual partners ($P < 0.001$) and group sex ($P = 0.002$) were reported by HIV undiagnosed and diagnosed men compared with HIV-negative men (Table 1). Diagnosed HIV-positive men were significantly more likely to report a sexually transmitted infection test within the past 12 months ($P = 0.02$), having more than 10 sex partners in the past 6 months ($P = 0.004$), having a HIV-positive regular sex partner ($P < 0.001$) and disclosing their HIV status to casual partners ($P = 0.02$), compared with HIV-negative and undiagnosed HIV-positive men (Table 1).

Predictors of Undiagnosed HIV-Positive Infection

Univariate analyses showed that men with undiagnosed HIV infection were more likely be recruited from SOPVs [odds ratio (OR): 3.0, 95% CI: 1.0 to 9.1] and more likely to report being unsure of their HIV status (very/confident vs. unsure) (OR: 4.4, 95% CI: 1.7 to 11.7), compared with negative men (Table 2). Undiagnosed HIV-positive men in our sample were also more likely to report group sex in the past 6 months (OR: 2.4, 95% CI: 0.9 to 6.5) and having tested for HIV more than 12 months ago (OR: 2.6, 95% CI: 0.9 to 7.9), both close to significance (Table 2).

DISCUSSION

This is one of the first studies in Australia to assess HIV and undiagnosed HIV prevalence using a biological sample and the first to examine the characteristics of HIV-negative, HIV-positive, and undiagnosed HIV-positive gay men.

Among social venue-recruited gay men, we found a HIV prevalence of 9.5%, of which 31.1% had undiagnosed HIV infections. Men with undiagnosed HIV reported higher risk behaviors and less frequent HIV testing compared with HIV-negative men, however, due to small numbers of undiagnosed infections and the associated limitation on multivariate analysis, these results should be interpreted cautiously. In addition, although our sample may not be representative of all gay men,¹¹ recruitment protocols are likely to have provided a sample representative of gay men most at risk of HIV.¹⁷

HIV prevalence in our study is similar to that reported in the only other Australian HIV prevalence study (8.8%)¹⁸ and similar to recent self-reported estimates from behavioral surveillance (6%–12%).^{3,19} Our undiagnosed HIV estimate is higher than reported by Birrell et al¹⁸ (19.5%) and much higher than estimated in recent HIV modelling (9%).⁶ Although our sample would be considered high risk compared with other Australian studies^{3,6,18} due to the proportion of SOPV recruited men, sample demographics and sexual risk behaviors are largely comparable.

HIV prevalence in this study is comparable with those in the United Kingdom (4.4% to 9.1%),^{20,21} and lower than in the United States (12.1% to 19%)^{22,23}; and our undiagnosed HIV estimate sits within the wide range reported internationally (20%–77%).^{20,21,24–26} The large variation in estimates of undiagnosed infection is likely due to different study designs and varying access to primary health care and testing in gay male populations.

Although the small number of undiagnosed HIV infections in this study limits generalization, the high rates of sexual risk behaviors reported by this group is a concern. Although diagnosed HIV-positive men reported the most risky sexual practices, there was evidence of risk-reduction strategies, including serosorting; almost a third reported HIV-positive regular partners and the majority (74%) reported

TABLE 2. Reported Sexual Risk Behaviors of HIV-Negative Men Compared With Men With Undiagnosed HIV Infections

	OR* (95% CI)	P
Recruitment site		
Bars/clubs	1.0	0.05†
SOPVs	3.0 (1.0 to 9.1)	
Age group (yrs)		
<40	1.0	0.80
≥40	1.1 (0.4 to 3.0)	
Country of birth		
Australia	1.0	0.24
Other	1.8 (0.7 to 4.7)	
No. sex partners (in past 6 months)*		
10 or less	1.0	0.80
More than 10	1.1 (0.4 to 3.0)	
UAI with casual partner (in past 6 months)*		
Never	1.0	0.43
Occasionally/often	1.6 (0.5 to 4.9)	
Any group sex (in past 6 months)*‡		
No	1.0	0.09
Yes	2.4 (0.9 to 6.5)	
HIV status of current regular partner		
Negative/Don't know	1.0	—
Positive	—	
Disclose of HIV status to casual partners before sex*		
Some/all	1.0	0.57
None	0.7 (0.3 to 2.0)	
HIV testing history		
No, never tested	1.0	0.47
Ever tested	0.7 (0.3 to 1.9)	
Recent HIV testing history (if ever tested)		
In the past 12 months	1.0	0.09
> 12 months ago	2.6 (0.9 to 7.9)	
How confident are you of knowing your own HIV status		
Confident/Very Confident	1.0	<0.01†
Unsure/No Idea	4.4 (1.7 to 11.7)†	
Any STI test (other than HIV) in past 12 months		
No	1.0	0.97
Yes	1.0 (0.3 to 3.1)	

*In the past 6 months.

†P value < 0.05.

‡Can include regular partner.

STI, sexually transmitted infection; OR, unadjusted odds ratio; UAI, unprotected anal intercourse.

disclosing their HIV status to causal partners before sex. Comparatively, just over half of the men with undiagnosed HIV infection reported disclosing their HIV status to casual partners before sex; which most likely did not reflect their true HIV status.

Australia testing guidelines recommend annual testing for sexually active gay men and more frequent testing (3–6 monthly) for men at “high risk”.²⁷ These recommended testing frequencies applied to a large proportion of our sample but most reported much lower testing rates. Although self-reported annual HIV testing rates among gay men in Australia

are high (60%–70%)^{3,19,28} compared with other countries (eg, ~40.0% in the United Kingdom²⁹), our findings suggest that HIV testing rates may be insufficient to limit the impact of undiagnosed HIV on transmissions among Australian gay men. In our sample, past 12 months HIV-testing rates (74%) were comparable with reports from recent behavioral surveys,¹⁹ but considerably lower (54%) among those with undiagnosed HIV. Although this difference fell marginally short of statistical significance and require cautious interpretation, the participant-centred (eg, risk perception) and structural barriers to recent testing nominated by both HIV-negative and undiagnosed men (Table 1) are consistent with other studies.^{30–32} A recent study assessing compliance with recommended HIV testing guidelines among gay men attending clinics in Melbourne showed the proportions of attendees adhering to recommended annual retesting (all sexually active gay men) was only 35% and recommended 6 monthly retesting (“high-risk” gay men) was only 15%.⁵ Combined, these findings highlight the need to address barriers to testing among gay men in Australia.

There are several limitations associated with this study. First, the recruitment strategy may have resulted in selection bias. Our recruitment protocol replicated only the venue-based recruitment for the MGCPs. We did not recruit at the gay fair day or “Midsumma Carnival”, which constitutes approximately two-thirds of MGCPs respondents. This limits direct comparisons between the 2 samples, with the MGCPs potentially more representative of the broader gay community. However, WHO behavioral surveillance guidelines recommend targeting subpopulations where most new infections are concentrated.³³ Given the places gay men report meeting sex partners,^{19,30} social venue recruitment is likely to better represent those most at risk of HIV and better placed to meet the study aims. Sexual identification of our study participants (84% gay, 12% bisexual, 4% other) also better reflects homosexually active men recently diagnosed with HIV in Australia (90% gay, 7% bisexual, 3% other)¹⁷ compared with population surveys (70% gay, 26% bisexual, 4% other).³⁴ Second, there may have been reporting bias; a small number of participants (n = 4) self-reporting being HIV positive but returning a negative test. The reason for this is unclear but could reflect incorrect survey completion, question misinterpretation, a belief they really were HIV positive, or the false negative test result (unlikely given the documented test performance).^{15,35} Third, the small sample size of undiagnosed infections restricted statistical power and precluded multivariate analysis. However, this study has provided the basis for a planned National study that will yield significantly more outcomes.

In conclusion, almost a third of HIV-positive gay men in our study were unaware of their HIV status, and these men reported high-risk behaviors and less than ideal testing rates. These new data contributes to our understanding of potential drivers of HIV transmission among gay men in Australia and demonstrate a need to enhance HIV testing strategies, particularly more frequent testing in high-risk gay men in Australia.

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