



Comfort Relying on HIV Pre-exposure Prophylaxis and Treatment as Prevention for Condomless Sex: Results of an Online Survey of Australian Gay and Bisexual Men

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Abstract

HIV-negative and untested gay and bisexual men from Victoria, Australia ($n = 771$) were surveyed during August–September 2016 about their comfort having condomless sex with casual male partners in scenarios in which pre-exposure prophylaxis (PrEP) or treatment as prevention were used. Men not using PrEP were most comfortable with the idea of condomless sex with HIV-negative partners (31%), followed by partners using PrEP (23%). PrEP users were more comfortable with the idea of condomless sex with these partner types (64 and 72%, respectively). Very few men not taking PrEP were comfortable with condomless sex with HIV-positive partners (3%), even with undetectable viral loads (6%). PrEP users were more comfortable with condomless sex with HIV-positive partners (29%), and those with undetectable viral loads (48%). Being on PrEP, having recent condomless sex with casual partners or a HIV-positive regular partner were independently associated with comfort having condomless sex.

Keywords Attitudes · Condoms · Diffusion of innovations theory · HIV treatment · Men who have sex with men · Pre-exposure prophylaxis

Introduction

There is an increased international emphasis on the use of HIV treatment as prevention (TasP) and pre-exposure prophylaxis (PrEP) as part of a ‘combination prevention’ approach [1]. In Australia, TasP and PrEP are acknowledged in the National HIV Strategy [2], and the country’s most populous jurisdictions have intensively promoted TasP and PrEP to people at high risk of HIV [3–5]. HIV treatment use has been increasing for over a decade, with 75% of Australians living with HIV estimated to be on treatment by 2015 [6]. However, up until 2017, PrEP use remained in its infancy, given

that, without a public subsidy, access was largely restricted to demonstration projects and the personal importation of generic drugs [7]. Since 2014, PrEP use has been targeted to HIV-negative gay and bisexual men (GBM) at high risk of HIV [8], against a backdrop of gradually increasing HIV infections among Australian GBM, declining condom use and increased serosorting (restricting condomless sex to partners believed to be seroconcordant) [9, 10].

The increased promotion of TasP and PrEP has prompted acceptability research, identifying those interested in the strategies, barriers to uptake and community education needs [11, 12]. In Australia, the majority of GBM support the early initiation of HIV treatment, but up until recently most have remained sceptical about the effectiveness of TasP in preventing transmission [13]. When surveyed in late 2012, only a tenth of HIV-negative and untested men indicated they would rely on TasP during condomless sex with a HIV-positive partner [14]. However, belief in the effectiveness of TasP has increased considerably over the last few years, particularly among HIV-positive men and their partners [13], and more compelling evidence of TasP’s effectiveness in preventing HIV infection for GBM has subsequently been published [15]. Most GBM support others using PrEP, and

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GBM at high risk of HIV are the most willing to use it [7]. However, this research also shows that only a third of men were willing to have sex with someone using PrEP (with or without condoms), suggesting a degree of caution about relying on the strategy during sex.

These findings suggest a discrepancy between high levels of support for others using TasP or PrEP but caution in personally relying on either strategy. This may make sense because of the relative newness of strategies like PrEP and TasP in comparison with condoms. Theoretical models like the Precaution Adoption Process Model and Diffusion of Innovations theory indicate that when people are unfamiliar with new strategies they may remain undecided about using them until the issue becomes more pressing or relevant e.g. until they know more about them, are persuaded to use them, or notice their use becoming more common (or normative) [16–18]. The Diffusions of Innovations theory also suggests that those who are first interested in a new technology ('innovators' and 'early adopters') tend to be greater risk-takers, more open to new ideas, favourable to change and comfortable experimenting with new practices [18]. Those that follow (the 'early majority') tend to be more cautious about adopting and using the technology, require more evidence that it works, and that its use is proven and socially acceptable.

Previous research has found that HIV-negative GBM have historically regarded consistent condom use as the safest form of anal intercourse, followed by condomless sex with HIV-negative partners, then condomless sex with HIV-positive partners, regardless of HIV treatment or viral load [19]. This suggests potential barriers to increasing HIV treatment uptake and PrEP use, or encouraging GBM to switch from less effective strategies (like HIV-negative serosorting) to more effective ones like TasP and PrEP [15, 20, 21]. This also relates to a key aspect of commonly used theories in HIV prevention such as the Theory of Planned Behavior or the Theory of Reasoned Action. These theories postulate that attitudes to HIV-related sexual behaviours (as well as subjective norms and perceived control over sexual interactions) are determinants of behavioural intentions and influence the likelihood of subjects engaging in those behaviours [22].

We set out to investigate the degree to which GBM were willing to rely on TasP or PrEP by assessing GBM's comfort having condomless sex in situations in which TasP or PrEP were being used. We did this by surveying GBM in Victoria, an Australian jurisdiction in which the benefits of TasP have been promoted and PrEP has been made available through a large demonstration project. At the time we conducted this research, PrEP use by GBM in Victoria was rapidly increasing, from 5% in early 2016 to 16% in early 2017, driven by the scaling up of the local demonstration project, PrEPX [23]. This means that many GBM were becoming

aware of biomedical prevention strategies, encouraged to consider using them, and were increasingly likely to know other GBM or meet sexual partners who had adopted either PrEP or TasP.

Methods

GBM aged 18 or over who resided in Victoria, Australia, were recruited into wave 9 of a longitudinal, online cohort study (conducted during 2008–16). All cisgender men, transgender and non-binary people were eligible to participate if they reported sex with male partners or identified as gay or bisexual. The study methods have been published [24, 25]. The purpose of the cohort was to monitor and evaluate HIV prevention programs for GBM in Victoria. Standard questions included demographics, recent sexual behaviour with casual and regular male partners, HIV testing and treatment use, post-exposure prophylaxis (PEP) and PrEP use, with new questions added to wave 9 (conducted from 1st August to 13th September 2016) about TasP and PrEP. Existing cohort members were invited to complete the wave 9 survey via email, with two reminder emails sent within the 2-month period, if participants did not respond. New participants were recruited into the cohort primarily through Facebook advertisements. As an incentive, all participants were entered into a draw to win one of two \$200 Coles/Myer vouchers.

Participants were asked how effective they thought condoms, TasP (having an undetectable viral load), PrEP and serosorting were in preventing HIV (from 1 = not all effective to 10 = most effective). HIV-negative and untested participants were also asked, 'How comfortable would you be having anal sex without a condom with casual partners in the following scenarios?' and were asked to respond for each of these partner types: (a) Any casual partner, (b) Casual partner whose status I don't know, (c) Casual partner who is HIV-negative, (d) Casual partner who is on PrEP, (e) Any casual partner who is HIV-positive, and (f) Casual partner who is HIV-positive and has an undetectable viral load. Participants responded to each scenario on a 5-point scale from very uncomfortable [1] to very comfortable [5]. We dichotomised responses to each scenario into not comfortable [1–3] and comfortable [4, 5], reflecting the labels for the response scale. HIV-positive men were only presented with one scenario (comfort having condomless sex with HIV-negative partners on PrEP) and were excluded from the following analyses.

For this analysis, we compared the characteristics of PrEP users and non-users using the Wilcoxon rank sum test (median age), Fisher's exact test (categorical variables if any cell size < 5) and Pearson's Chi square test (remaining categorical variables). We assessed beliefs about the

effectiveness of condoms, TasP, PrEP and serosorting using the non-parametric Skillings-Mack (SM) test for the whole sample and Wilcoxon rank sum tests to compare men who were and weren't using PrEP [26]. We then compared the responses of HIV-negative and untested men who were and weren't using PrEP to the six condomless sex scenarios using Pearson's Chi square test. Using multivariate logistic regression, we assessed independent associations with three scenarios: comfort having condomless sex with i) HIV-negative men on PrEP, ii) HIV-positive men and iii) HIV-positive men with an undetectable viral load. For the multivariate analyses, we included these variables, related to experience with antiretroviral-based prevention (PEP and PrEP use), being in a serodiscordant relationship, and factors associated with interest in or belief in PrEP and TasP identified in previous research, such as age, number of sex partners and engaging in condomless sex [7, 11–14]: age in years, sexual identity (gay vs. other), country of birth (Australia vs. overseas), residing in inner Melbourne (vs. not), HIV status (HIV-negative or untested), number of male partners in the previous 6 months (none, 1, 2–5, 6–10, 11+), having a HIV-positive regular partner in the previous 6 months (vs. not), any condomless sex with regular male partners in the previous 6 months (vs. not), any condomless sex with casual male partners in the previous 6 months (vs. not), ever having used PEP (yes/no) and current PrEP use (yes/no). The relationships between these variables and the outcome measures were assessed at a bivariate level, and any variables with a statistically significant bivariate relationship ($p < 0.05$) were block entered into the multivariate models. We report unadjusted and adjusted odds ratios (OR and AOR) and 95% confidence intervals (CI). Statistical significance was set at $p < 0.05$. Analyses were conducted using Stata version 13.1.

Results

The sample in the 2016 survey included 844 participants, of whom 688 (82%) were HIV-negative or untested and not using PrEP, 83 (10%) were HIV-negative and using PrEP and 63 (7%) were HIV-positive. Ten participants were excluded because they did not report their HIV status. The remaining analyses include 771 HIV-negative or untested men. Although survey questions were optional, there were no more than 8 missing cases per variable, and therefore we included all 771 participants in the analyses.

Participant characteristics are shown in Table 1. The majority of the whole sample of HIV-negative and untested men were cisgender (98%) and identified as gay (95%) or bisexual (4%). Their median age was 31 years (interquartile range 25–40) and most were Australian born (80%) and resided in inner Melbourne (64%). In the previous 6 months, most (67%) reported at least two male sex

partners and a fifth (20%) reported 11 or more partners. In the same period, 3% reported a HIV-positive regular male partner, 50% reported any condomless sex with regular male partners and 32% reported condomless sex with casual male partners. Nearly one in five (19%) said they had previously used PEP and 14% said they had ever used PrEP. All current PrEP users (11% of the sample) identified as gay and reported that they were HIV-negative. PrEP users were more likely than non-users to reside in inner Melbourne, have a higher number of recent male partners, have a regular partner (compared with no partner), to report recent condomless sex with regular and casual male partners, and to have ever used PEP.

Table 2 shows the degree of belief in the effectiveness of different HIV prevention strategies, stratified by PrEP use. Condoms were regarded as the most effective strategy, followed by PrEP, undetectable viral load and then serosorting (SM = 694.29, $p < 0.001$). HIV-negative men on PrEP were more likely to believe in the effectiveness of TasP and PrEP than men not using PrEP.

Table 3 shows the degree of comfort in having condomless sex with different types of casual partner, stratified by PrEP use. Participants were the least comfortable with condomless sex with HIV-positive men and men of unknown HIV status, regardless of PrEP use. Participants not on PrEP were most comfortable with the idea of condomless sex with partners believed to be HIV-negative, followed by partners on PrEP. PrEP users were most comfortable with condomless sex with other PrEP users, followed by HIV-negative men. Knowledge about viral load affected participants' responses, with greater comfort expressed about condomless sex with HIV-positive men who had undetectable viral loads (compared to HIV-positive men in general), although the absolute level of comfort was low. Compared to men not on PrEP, PrEP users were much more comfortable with the idea of condomless sex with every type of casual partner, including HIV-positive partners in general and those with undetectable viral loads.

Table 4 shows the results of the regression analyses of factors associated with comfort having condomless sex with three different types of casual partner: HIV-negative men on PrEP, HIV-positive men (regardless of treatment status) and HIV-positive men with an undetectable viral load. Concentrating on the multivariate regression results, comfort having condomless sex with HIV-negative men on PrEP was not independently associated with sociodemographic variables, HIV status (HIV-negative or untested), number of male partners, having a HIV-positive regular partner, condomless sex with regular partners, or PEP use. Comfort having condomless sex with HIV-negative men on PrEP was greater among men who had had recent condomless sex with casual partners (AOR = 6.44, 95% CI 3.97–10.43) and current PrEP users (AOR = 3.82, 95% CI 1.99–7.32).

Table 1 Participant characteristics ($N = 771$)

	Total ($N = 771$) n (%)	HIV-negative or untested and not using PrEP ($n = 688$) n (%)	HIV-negative and using PrEP ($n = 83$) n (%)	Test statistic	p value
Median age in years (interquartile range)	31 (25–40)	31 (25–40)	33 (28–40)	-2.10 ^a	0.036
Gender				^b	0.775
Cisgender male	758 (98)	676 (98)	82 (99)		
Transgender male	5 (0.7)	5 (0.7)	0 (0)		
Non-binary/genderqueer	8 (1)	7 (1)	1 (1)		
Sexual identity				^b	0.142
Gay	730 (95)	647 (94)	83 (100)		
Bisexual	32 (4)	32 (5)	0 (0)		
Heterosexual	1 (0.1)	1 (0.2)	0 (0)		
Other	7 (0.9)	7 (1)	0 (0)		
Country of birth				0.17 ^c	0.677
Australia	616 (80)	548 (80)	68 (82)		
Overseas	152 (20)	137 (20)	15 (18)		
Residential location				7.36 ^c	0.007
Inner Melbourne suburbs	486 (64)	423 (62)	63 (78)		
Outer Melbourne suburbs/rest of Victoria	272 (36)	254 (38)	18 (22)		
HIV status				^b	0.001
HIV-negative	710 (92)	627 (91)	83 (100)		
Untested/unknown status	61 (8)	61 (9)	0 (0)		
No. of male partners in the last 6 months				^b	< 0.001
None	71 (9)	70 (10)	1 (1)		
One	188 (24)	185 (27)	3 (4)		
2–5	249 (32)	232 (34)	17 (21)		
6–10	111 (14)	99 (14)	12 (15)		
11 or more	150 (20)	101 (15)	49 (60)		
Regular male partner in last 6 months				^b	0.002
No regular partner	269 (36)	252 (37)	17 (21)		
HIV-negative partner	429 (57)	375 (55)	54 (67)		
HIV-positive partner	19 (3)	13 (2)	6 (7)		
Untested/unknown status partner	40 (5)	36 (5)	4 (5)		
Sex with regular male partners in last 6 months				10.95 ^c	0.004
No sex/no partner	269 (35)	252 (37)	17 (21)		
Consistent condom use	112 (15)	102 (15)	10 (12)		
Any condomless sex	385 (50)	330 (48)	55 (67)		
Sex with casual male partners in last 6 months				104.10 ^c	< 0.001
No sex/no partner	351 (46)	345 (50)	6 (7)		
Consistent condom use	170 (22)	161 (24)	9 (11)		
Any condomless sex	244 (32)	178 (26)	66 (82)		
Post-exposure prophylaxis (PEP)				64.31 ^c	< 0.001
Never used PEP	602 (81)	561 (85)	41 (50)		
Used over 6 months ago	110 (15)	81 (12)	29 (35)		
Used in last 6 months	29 (4)	17 (3)	12 (15)		
Pre-exposure prophylaxis (PrEP)				^b	< 0.001
Never used PrEP	621 (86)	621 (98)	0 (0)		
Previously used	14 (2)	14 (2)	0 (0)		
Using at the time of the survey	83 (12)	0 (0)	83 (100)		

^aWilcoxon rank sum test^bFisher's exact test^cPearson's Chi square test

Table 2 HIV-negative and untested men's belief in the effectiveness of different HIV prevention strategies, by PrEP use

Strategy	Median score ^a (median absolute deviation)			Skillings-Mack test (z)	p value
	HIV-negative & untested men (N = 771)	HIV-negative & untested, not on PrEP (n = 688)	HIV-negative and on PrEP (n = 83)		
Condoms	9 (1)	9 (1)	9 (1)	1.72	0.08
PrEP	8 (1)	8 (1)	9 (1)	-6.80	< 0.001
Undetectable viral load	8 (1)	7 (2)	9 (1)	-7.27	< 0.001
Serosorting	5 (2)	5 (2)	5 (2)	0.40	0.69

^aFrom 1 = not all effective to 10 = most effective

Table 3 HIV-negative and untested men's comfort having condomless sex with different types of casual partner, by PrEP use (N = 771)

Type of casual partner	Per cent comfortable having condomless sex			Pearson's Chi square test	p value
	HIV-negative & untested men n = 771	HIV-negative & untested, not on PrEP n = 688	HIV-negative and on PrEP n = 83		
Any casual partner	80 (10%)	47 (7%)	33 (40%)	86.2	< 0.01
Unknown HIV status	63 (8%)	35 (5%)	28 (34%)	80.4	< 0.01
HIV-negative	263 (34%)	210 (31%)	53 (64%)	36.4	< 0.01
HIV-negative and on PrEP	216 (28%)	157 (23%)	59 (72%)	86.8	< 0.01
HIV-positive	41 (5%)	17 (3%)	24 (29%)	104.0	< 0.01
HIV-positive with undetectable viral load	82 (11%)	42 (6%)	40 (48%)	137.6	< 0.01

Comfort having condomless sex with HIV-positive men was not independently related to country of birth, residential location, HIV status, number of partners, having a HIV-positive regular partner, recent condomless sex with regular or casual partners or experience of PrEP use (Table 4). Comfort having condomless sex with HIV-positive men was slightly higher among older men (AOR = 1.04, 95% CI 1.00–1.08) and slightly lower among gay-identified men (AOR = 0.17, 95% CI 0.03–0.87; note the wide confidence interval). Current PrEP users were much more likely to indicate comfort having condomless sex with HIV-positive men than non-users (AOR = 19.71, 95% CI 6.50–59.75; note wide confidence interval).

For the scenario of condomless sex with HIV-positive men with undetectable viral loads, comfort was not independently associated with sociodemographic variables, HIV status, number of male partners, recent condomless sex with regular partners or experience of PrEP (Table 4). Comfort having condomless sex with HIV-positive men with undetectable viral loads was greater among men who had a HIV-positive regular partner (AOR = 5.01, 95% CI 1.27–19.72), those who had had recent condomless sex with casual partners (AOR = 4.55, 95% CI 2.01–10.30) and current PrEP users (AOR = 8.85, 95% CI 4.26–18.38).

Discussion

We assessed the degree to which HIV-negative and untested GBM were willing to rely on TasP or PrEP to prevent HIV acquisition during a period in which PrEP uptake in particular was rapidly increasing. The level of PrEP use we found in our sample (11%) was the highest level reported in Australian, community-based surveys in 2016 [27, 28], providing us with an opportunity to assess the impact of this new prevention technology as it entered the 'early adoption' stage of its rollout [18].

We found that HIV-negative and untested men regarded both condoms and PrEP as highly effective in preventing HIV, and undetectable viral load as slightly less effective. Serosorting was regarded as the least effective strategy. Men who were not on PrEP had low levels of comfort with the idea of condomless sex with casual partners. They were most likely to be comfortable with the idea of condomless sex with HIV-negative men, followed by men using PrEP, which was surprising given that serosorting was regarded as less effective than PrEP. This may reflect a relative lack of familiarity or confidence with PrEP at this stage of its rollout, suggesting GBM remained undecided

Table 4 Multivariate logistic regression analysis of factors associated with HIV-negative and untested men's comfort having condomless sex with three different types of casual partner (N = 771)

		Comfort having condomless sex with casual partners who are											
		HIV-negative men on PrEP			HIV-positive men			HIV-positive men with an undetectable viral load					
		Comfortable n = 216 n(%)	Not comfort- able n = 550 n(%)	OR (95% CI)	AOR (95% CI)	Comfortable n = 41 n(%)	Not com- fortable n = 727 n(%)	OR (95% CI)	AOR (95% CI)	Comfortable n = 82 n(%)	Not com- fortable n = 687 n(%)	OR (95% CI)	AOR (95% CI)
Mean age in years (SD)	34.2 (10.77)	33.5 (11.7)	1.00 (0.99–1.02)	1.00 (0.99–1.02)	37.98 (11.87)	33.54 (11.43)	1.03 (1.01–1.05)	1.04 (1.00–1.08)*	37.67 (11.41)	33.33 (11.40)	1.03 (1.01–1.05)*	1.04 (1.01–1.07)	
Sexual identity													
Gay	208 (96)	517 (94)	1.61 (0.73–3.55)	0.92 (0.34–2.48)	38 (93)	689 (95)	0.68 (0.20–2.31)	0.17 (0.03–0.87)*	79 (96)	649 (95)	1.50 (0.45–4.98)	0.74 (0.18–3.07)	
Other	8 (4)	32 (6)	1	1	3 (7)	37 (5)	1	1	3 (4)	37 (5)	1	1	
Country of birth													
Australia	172 (80)	440 (80)	1	1	34 (83)	579 (80)	1	1	66 (80)	549 (80)	1	1	
Overseas	44 (20)	107 (20)	1.05 (0.71–1.56)	1.41 (0.85–2.36)	7 (17)	145 (20)	0.82 (0.36–1.89)	0.91 (0.31–2.65)	16 (20)	135 (20)	0.98 (0.55–1.76)	1.11 (0.52–2.37)	
Residential location													
Inner Melbourne	145 (69)	337 (62)	1.34 (0.95–1.88)	0.94 (0.61–1.45)	25 (66)	458 (64)	1.09 (0.55–2.16)	0.50 (0.20–1.25)	54 (68)	431 (64)	1.23 (0.75–2.03)	0.67 (0.35–1.30)	
Elsewhere	66 (31)	205 (38)	1	1	13 (34)	259 (36)	1	1	25 (32)	246 (36)	1	1	
HIV status													
HIV-negative	209 (97)	497 (90)	3.18 (1.42–7.12)*	2.89 (0.90–9.34)	38 (93)	670 (92)	1.08 (0.32–3.60)	0.28 (0.04–1.85)	79 (96)	631 (92)	2.34 (0.71–7.64)	0.44 (0.11–1.81)	
Untested/unknown status	7 (3)	53 (10)	1	1	3 (7)	57 (8)	1	1	3 (4)	56 (8)	1	1	
No. of male partners in the last 6 months													
None	5 (2)	65 (12)	1	1	3 (7)	67 (9)	1	1	3 (4)	67 (10)	1	1	
One	16 (7)	172 (31)	1.21 (0.43–3.43)	0.96 (0.29–3.21)	2 (5)	185 (26)	0.24 (0.04–1.48)	0.90 (0.07–12.42)	7 (9)	181 (26)	0.86 (0.22–3.44)	2.62 (0.29–23.96)	
2–5	73 (34)	173 (32)	5.49 (2.12–14.18)**	2.28 (0.74–7.05)	8 (20)	241 (33)	0.74 (0.19–2.87)	0.77 (0.06–9.06)	24 (30)	224 (33)	2.39 (0.70–8.19)	2.83 (0.32–24.64)	
6–10	38 (18)	72 (13)	6.86 (2.55–18.48)**	1.76 (0.53–5.88)	9 (22)	102 (14)	1.97 (0.51–7.54)	3.10 (0.24–39.37)	12 (15)	99 (14)	2.71 (0.74–9.96)	2.18 (0.22–21.91)	
11 or more	83 (39)	67 (12)	16.10 (6.14–42.27)**	2.02 (0.61–6.71)	19 (46)	130 (18)	3.26 (0.93–11.42)	1.24 (0.09–17.15)	35 (43)	115 (17)	6.80 (2.01–22.95)*	2.33 (0.24–22.50)	

Table 4 (continued)

Comfort having condomless sex with casual partners who are											
HIV-negative men on PrEP				HIV-positive men				HIV-positive men with an undetectable viral load			
Comfortable <i>n</i> = 216 <i>n</i> (%)	Not comfortable <i>n</i> = 550 <i>n</i> (%)	OR (95% CI)	AOR (95% CI)	Comfortable <i>n</i> = 41 <i>n</i> (%)	Not comfortable <i>n</i> = 727 <i>n</i> (%)	OR (95% CI)	AOR (95% CI)	Comfortable <i>n</i> = 82 <i>n</i> (%)	Not comfortable <i>n</i> = 687 <i>n</i> (%)	OR (95% CI)	AOR (95% CI)
HIV-positive regular male partner in last 6 months											
Yes	8 (4)	1.91 (0.76–4.82)	1.23 (0.34–4.41)	2 (5)	17 (2)	2.22 (0.49–9.97)	0.59 (0.08–4.44)	7 (9)	12 (2)	5.46 (2.08–14.32)*	5.01 (1.27–19.72)*
No	202 (96)	531 (98)	1	37 (95)	698 (98)	1	1	71 (91)	665 (98)	1	1
Condomless sex with regular male partners in last 6 months											
Yes	131 (61)	252 (46)	1.82 (1.32–2.51)**	23 (56)	361 (50)	1.28 (0.68–2.41)	1.76 (0.67–4.60)	47 (58)	338 (49)	1.41 (0.89–2.25)	1.02 (0.54–1.94)
No	84 (39)	294 (54)	1	18 (44)	361 (50)	1	1	34 (42)	345 (51)	1	1
Condomless sex with casual male partners in last 6 months											
Yes	151 (71)	91 (17)	11.98 (8.28–17.35)**	30 (73)	213 (30)	6.50 (3.20–13.22)**	2.80 (0.82–9.61)	60 (74)	184 (27)	7.73 (4.57–13.07)**	4.55 (2.01–10.30)**
No	63 (29)	455 (83)	1	11 (27)	508 (70)	1	1	21 (26)	498 (73)	1	1
Ever used PrEP											
Yes	54 (26)	84 (16)	1.89 (1.28–2.79)	14 (37)	124 (18)	2.71 (1.36–5.39)*	1.16 (0.45–3.01)	29 (38)	110 (17)	3.03 (1.83–5.02)**	1.54 (0.78–3.04)
No	152 (74)	447 (84)	1	24 (63)	576 (82)	1	1	48 (62)	552 (83)	1	1
Using PrEP at time of the survey											
Yes	59 (29)	23 (5)	8.85 (5.28–14.84)	24 (65)	58 (9)	19.73 (9.54–40.81)**	19.71 (6.50–59.75)**	40 (53)	43 (7)	15.42 (8.93–26.64)*	8.85 (4.26–18.38)**
No	142 (71)	490 (96)	1	13 (35)	620 (91)	1	1	36 (47)	597 (93)	1	1

PrEP pre-exposure prophylaxis, OR odds ratio, CI confidence interval, AOR adjusted odds ratio, PrEP post-exposure prophylaxis

* $p < 0.05$, ** $p < 0.001$

about relying on PrEP (a stage in the Precaution Adoption Process Model) or had not been persuaded to consider using it (as in Diffusion of Innovations theory) [16–18, 29]. It could also reflect awareness that confirmed HIV-negative partners present no HIV transmission risk but that trying to confirm HIV status by HIV disclosure and serosorting can be unreliable [19]. HIV-negative and untested men not on PrEP were uncomfortable about the idea of condomless sex with HIV-positive men and men of unknown status, and knowledge of undetectable viral load made little difference to this discomfort, echoing previous Australian research [14]. Once again, this suggests an emphasis on knowledge of HIV status to reduce HIV risk. It also echoes the finding that HIV-negative men tend to perceive all sex with HIV-positive partners as potentially risky, regardless of condom use, HIV treatment or viral load [19].

Current PrEP users were more likely to believe in the effectiveness of TasP and PrEP than other men [17], and expressed much higher levels of comfort with the idea of condomless sex with all types of casual partner. However, PrEP users did not express high levels of comfort with condomless sex, except with other PrEP users and HIV-negative partners, suggesting ongoing caution about avoiding HIV. Australian and US qualitative research has described confidence (and relief) in avoiding HIV because of PrEP, and that PrEP users may combine PrEP with other strategies, such as serosorting [30–32]. Almost one third of PrEP users were comfortable with the idea of condomless sex with HIV-positive men and about half were comfortable having sex with men with undetectable viral loads. These findings suggest greater knowledge of the protective benefits of both TasP and PrEP (and a willingness to rely and act upon them) among PrEP users. Referring to the Precaution Adoption Process Model, this suggests that PrEP users were more likely to have contemplated or used TasP than other GBM (and were already engaged in maintaining PrEP use) [16]. It also underscores PrEP users' status as 'early adopters' of disruptive prevention innovations (as defined in Diffusion of Innovations theory), holding more confident views about experimenting and relying upon antiretroviral-based prevention than the majority of their peers [17, 18].

In the multivariate analyses, comfort with the idea of condomless sex with PrEP users, HIV-positive men, and HIV-positive men with undetectable viral loads men was independently associated with participants being on PrEP or recently engaging in condomless sex with casual partners. This underlines that PrEP users are more comfortable than other men with the idea of condomless sex, including with HIV-positive men. It also suggests that the minority of men who have more relaxed attitudes to condomless sex are more likely to engage in the practice, or that once men start to engage in condomless sex, they develop more optimistic

attitudes about it, as has been found in other studies [33]. In addition, men with HIV-positive partners were more comfortable about condomless sex with HIV-positive men with undetectable viral loads, suggesting greater knowledge of and confidence in TasP, as has been previously found [13].

We believe our findings point to the gradual and inconsistent process of change, particularly when new strategies are promoted to an affected population which has up to that point been primarily reliant on condoms or serosorting to mitigate HIV transmission. This is consistent with earlier stages outlined in the Precaution Adoption Process Model and Diffusion of Innovations theory [16, 17], in which people may remain unaware or uncertain about using new strategies until they gain greater familiarity with them or are encouraged to use them. In general, HIV-negative and untested GBM indicated that they remained more comfortable negotiating condomless sex based on knowledge of HIV status, rather than PrEP or undetectable viral load, suggesting greater familiarity with the process of serosorting rather than negotiating sex based on antiretroviral-based prevention. This suggests that many GBM remained undecided about using or relying on PrEP or TasP at the time we conducted this research [16]. This may need to be addressed in community-based education, particularly if jurisdictions decide they wish to discourage HIV-negative serosorting as a relatively ineffective prevention strategy, as compared with condoms, PrEP or TasP [15, 20, 21].

The early cohort of PrEP users in our survey were much more comfortable with the idea of condomless sex (echoing their recent, reported sexual practice), but still appeared to prefer the idea of condomless sex with HIV-negative rather than HIV-positive partners. This suggests that expectations that the wider use of PrEP and TasP will dismantle or repair the 'sero-divide' [34], reducing HIV stigma and the fear of sex with HIV-positive partners, may be exaggerated or only partially realised [18]. As PrEP use enters the 'early majority' phase of use in Victoria and other Australian jurisdictions (over 13.5% and under 50% use within the target population), HIV prevention and health promotion messaging related to PrEP will also need to evolve. 'Early majority' PrEP users are likely to need greater assurance and evidence that PrEP works and is socially respectable than early adopters. Based on our findings, we think that messages for the early majority could emphasise how PrEP can make existing and relatively common sexual practices safe (i.e. condomless sex with presumed HIV-negative partners), rather than focusing on practices which are less common and regarded with less comfort (i.e. condomless sex with serodiscordant or unknown status partners). Diffusions of Innovations theory suggests that, as PrEP and TasP-based condomless sex becomes more common (and more accepted), it will be easier to discuss these sexual practices with the majority of GBM. It is likely that community attitudes (and practice)

will continue to shift as GBM become more aware, engaged and contemplate the use of both PrEP and TasP [16, 18, 29].

There were a number of limitations to our analysis that should be borne in mind. We acknowledge that our results may have limited generalisability, given our sample of GBM was recruited online for a cohort designed to evaluate HIV prevention programs, and was restricted to men who were resident in Victoria. A representative sample of Australian GBM would feature a broader age range, and higher proportions of bisexually-identifying men and men from regional areas [35]. However, our sample was similar in terms of sociodemographics, HIV status, relationships and sexual practice compared with other community-based and online surveys of GBM conducted in Victoria [23, 28], suggesting our sample was focused on GBM at higher risk of HIV (as in targeted behavioural surveillance) [36]. Because we drew on newly developed questions our analysis was cross-sectional, despite being drawn from a longitudinal cohort study. We therefore could not ascertain the direction of the relationship between attitudes and behaviour (e.g. does comfort lead to a greater likelihood of condomless sex or vice versa), although we hope to do this in follow-up research. Our survey was conducted at an early stage of PrEP rollout in a jurisdiction with a long tradition of promoting condom use for casual sex, high availability and uptake of HIV testing and treatment, a relatively low prevalence of HIV among GBM, and relatively high awareness of PrEP and TasP, compared with many international settings [6, 11, 12, 23, 37]. Attitudes to biomedical HIV prevention are likely to vary considerably in other settings with different epidemic contexts, histories of prevention, community organising and access to health care.

Conclusions

In the early adoption stage of PrEP rollout in Victoria, Australia [18], most HIV-negative and untested GBM we surveyed had low levels of comfort with the idea of condomless sex with casual partners. They were most likely to feel comfortable about the practice with HIV-negative men and PrEP users, suggesting an ongoing reliance on HIV-negative serosorting, despite its partial effectiveness, and a growing awareness of PrEP. Having an undetectable viral load did not generate high levels of confidence in having sex with HIV-positive partners at this point in the rollout and promotion of biomedical HIV prevention. The exceptions were men using PrEP and those with HIV-positive regular partners, who expressed more confidence in having condomless sex, and were more comfortable with the idea of sex with HIV-positive partners on treatment. As PrEP use becomes more common in Victoria and enters the ‘early majority’ phase of use, we expect these attitudes (and community practice) to shift and evolve. It is likely that HIV prevention and health

promotion messaging will need to adapt to the more cautious views of the next cohort of GBM to engage with biomedical prevention in Australia.

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Compliance with Ethical Standards

Conflict of interest The authors have no conflicts of interest to declare.

Ethical Approval All procedures were in accordance with the ethical standards of the Alfred Health Human Research Ethics Committee (Project 62/16) and the National Health and Medical Research Council (Australia).

Informed Consent Informed consent was obtained from all individual participants included in the study.

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