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Pre-Exposure Prophylaxis Awareness Among Gay and Other Men who have Sex with Men in Vancouver, British Columbia, Canada

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Abstract

Men who have sex with men (MSM) account for approximately half of Canada's new HIV infections. Pre-exposure prophylaxis (PrEP), a recently established and effective HIV prevention tool for MSM is currently not approved nor publicly funded. We recruited MSM via respondent-driven sampling to complete a self-administered computer-based interview. Stratified by HIV status, multivariable logistic regression identified factors associated with PrEP awareness. Of 673 participants, 102/500 (20.9%) HIV-negative and 63/173 (26.5%) HIV-positive men were aware of PrEP, but none had used it. One third of PrEP-aware MSM spoke about it with friends or sex partners. Self-declared knowledge was limited. Factors associated with PrEP awareness varied by HIV status, but included greater HAART optimism for HIV-negative MSM. Among HIV-negative MSM, being PrEP unaware was associated with younger age, not always having condoms, and preferring receptive versus insertive anal sex. Future longitudinal research should identify early adopters of PrEP and its associated impacts.

Keywords

HIV/AIDS; primary prevention; pre-exposure prophylaxis; health promotion

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INTRODUCTION

The number of new HIV diagnoses has remained relatively stable among gay, bisexual, and other men who have sex with men (MSM) who continue to be disproportionately represented compared with other exposure categories. In Canada, MSM account for approximately half of estimated new HIV infections in 2013 and about one third of all new AIDS cases in 2011 (1,2). Combination HIV prevention to reduce incidence includes strategic use of all effective behavioural, structural, and biomedical interventions, and capitalizes on the inherent secondary prevention benefits of expanded access to ART (3).

Pre-exposure prophylaxis (PrEP) is an effective biomedical HIV prevention strategy that involves the use of antiretroviral chemoprophylaxis prior to potential HIV exposure. Over the past five years, seven large randomized control trials have evaluated the efficacy of PrEP as a daily dose of tenofovir disoproxil fumarate (TDF) and/or combination tenofovir-emtricitabine (TDF-FTC): 44% efficacy in iPrEx (MSM), 62% for TDF and 73% for TDF-FTC in Partners PrEP (Heterosexual Sero-discordant Couples), 63% in TDF2 (heterosexual men and women), no effect in FEM-PrEP (African women), no effect in VOICE (African women), 49% in Bangkok Tenofovir Study (IDU), and 86% in PROUD (MSM) (4–10 respectfully). Efficacy was positively associated with adherence levels (4,6,7). Among MSM, the initial iPrEx study found 44% efficacy (4), while recent results from two more recent studies (PROUD and Ipergay) found similar reductions of 86% in incident HIV (10,11). The PROUD trial investigated the efficacy of daily PrEP (TDF-FTC) between immediate and 12-month delayed treatment arms (10). The Ipergay trial investigated the efficacy of “on demand” PrEP (a double dose 2–24 hours before sex, then a single dose 24 hours and 48 hours after sex) by randomizing participants to active TDF-FTC or placebo (11). In both of these trials PrEP was offered as a component of a comprehensive prevention strategy including risk-reduction counseling, provision of condoms, access to HIV testing and regular screening for sexually transmitted infections (4,10,11).

TDF-FTC is not currently licensed for use as PrEP in Canada, but a regulatory application for use as PrEP has been filed in August 2015 (12). The United States Food and Drug Administration have approved it for this indication since 2012. Previous studies of PrEP awareness and use in the US over the past decade have found that the proportion of participants who were aware of PrEP was low (13–38% of respondents) and it was rarely used (<2% of those surveyed) (13–22). All of these studies were conducted in the US, and few specifically examined PrEP knowledge after the iPrEx results were available in 2011 (14,17,22). Among MSM surveyed in the United States, PrEP awareness increased from 13% in the two months before iPrEx results were released to 19% one month after the iPrEx results were released (17), to 30.3% in August 2013 and 48.5% in January 2014 (22). PrEP use has increased slightly but remains uncommon: 0.9% one month after iPrEx results were released (17), 1.5% in August 2013 (22), and 2.3% in January 2014 (22).

We undertook the present study to evaluate PrEP awareness following licensure in the US, and to describe the socio-demographic, behavioral, and psychosocial factors associated with PrEP awareness amongst a large population-based sample of MSM in Metro Vancouver, Canada. The Momentum Health Study was conducted within the context of other established

province-wide HIV prevention strategies (23), as part of the Seek and Treat for Optimal Prevention (STOP) program funded by the British Columbia (BC) Ministry of Health, which expands access to HIV testing and treatment in BC, with a particular emphasis on hard-to-reach and vulnerable populations (24).

METHODS

Data were drawn from participants enrolled in the Momentum Health Study, a longitudinal bio-behavioural prospective cohort study of HIV-positive and HIV-negative MSM in Vancouver, Canada. Respondent driven sampling (RDS) was used to recruit MSM in the Greater Vancouver area (25) from February 2012 to February 2014. To be eligible, participants had to be men aged 16 or older, living in Metro Vancouver at the time of enrolment, reported sex with another man in the 6 months prior to survey, and able to complete a questionnaire in English. Once informed consent was provided, participants completed a ninety-minute study visit in-person at the study office, which was located in the West End, Vancouver's traditional gay neighborhood. A computer-assisted, self-administrated (CASI) questionnaire was used to collect socio-demographic, psychosocial, and behavioral variables. Subsequently, a nurse-administered questionnaire included clinical screening and questions regarding history of STI diagnoses. Participants were then trained in RDS recruitment and given a number of vouchers to recruit additional MSM from their socio-sexual networks. Participants were given \$50 for their study visit and provided with \$10 for each successful peer they recruited into the study. All Project Investigators' institutional Research Ethics Boards granted ethical approval.

Main outcome measures: PrEP Awareness

Questions regarding PrEP were first added in November 2012. Participants were prompted with the following definition of PrEP ("PrEP stands for Pre-Exposure Prophylaxis. It's a treatment that may reduce the chances of you contracting HIV if taken before risky sex") and asked, "have you ever heard of PrEP?". The primary outcome in this study was PrEP awareness as based on responses to that question (Yes versus No). Among those aware of PrEP, participants were then asked how much they thought they knew about PrEP ("Not much, or nothing at all", "A bit in general", or "A lot") and whether they talked about PrEP with friends or sex partners in the past six months (Yes versus No). HIV-negative and participants of unknown HIV status were asked whether they had used PrEP in the previous six months (Yes versus No). Data for each variable were collected from participants' first response to the main outcome questions, irrespective of study visit. We examined the first response to the PrEP questions obtained up until the end of February 2014.

Independent Variables of Interest

Independent variables included demographic factors, sexual behavior and substance use, prevention strategies, sexual health and risk, and attitudes and beliefs regarding HIV treatment, prevention, and condoms (see Table 1 for details). Lastly, attitude and belief variables included self-assessed risk for and likelihood of HIV transmission, level of agreement with the following statements (i.e., "I always have condoms with me when I have sex") and previously validated psychological scales. The Treatment Optimism scale (study

Cronbach's $\alpha=0.82$) uses 12 items to measure positivity/optimism and skepticism regarding HAART (26). Example items include "A person with undetectable viral load cannot pass on the virus" and "HIV/AIDS is a less serious threat than it used to be because of new treatments". The Sexual Altruism scale has two 7-item subscales (study $\alpha = 0.81$ and 0.87 respectively), a *personal* one regarding their own or their partner's sexual health and a *communal* one regarding collective well being of the gay community and one's role in that (27). Example items from the personal subscale are, "I don't want any partner of mine to get any disease from me" and "By having safer sex, I am setting an example for others", while from the communal subscale examples include, "safer sex is everybody's responsibility" and "having safer sex is a way I can help protect the next generation of gay men". The Revised Sexual Sensation Seeking Scale (R-SSS, study $\alpha=0.73$) uses 11 items to measure the need for varied, novel, and complex sexual experiences and willingness to take personal physical and social risks to enhance sexual sensations (28). Example items include "I like wild "uninhibited" sexual encounters" and "I am interested in trying out new sexual experiences".

Statistical Analyses

All analyses were stratified by participants' self-identified HIV status, conducted using SAS® version 9.3 (SAS, North Carolina, United States) and adjusted by weights generated using RDSAT version 7.1.46 (29) to reflect better population estimates (30). In order to address potential bias introduced through peer-chain recruitment, the RDS-II (Volz-Heckathorn) weights used consider homophily (the tendency to recruit subsequent participants with the same characteristics) and network size (31). Descriptive statistics were generated, including crude frequencies and RDS-adjusted population parameters. Logistic regression was used to determine whether there were any differences in level of PrEP awareness by month over the duration of the study period after controlling for study visit number. Univariate and multivariable logistic regression was used to identify covariates of PrEP awareness. Model selections were conducted using a backward elimination technique based on two criteria (i.e., Akaike Information Criterion (AIC) and Type III p-values) until the final model reached the optimum (minimum) AIC (32). All statistical tests were two-sided and considered significant at $\alpha<0.05$.

RESULTS

Sample Demographics

A total of 719 participants were recruited into the baseline (visit #1) cross-sectional study, 524 of which self-identified as HIV-negative and 195 as HIV-positive. Overall, and after RDS-adjustment, 68.3% were Caucasian, 80.3% identified as gay, the median age was 33 years (1st-3rd quartile: 26–47 years), 65.7% had formal education greater than high school, 19.1% were currently a student, 74.1% had an annual income of less than CAD \$30,000, and 51.8% lived in downtown Vancouver. Descriptive information on demographics, substance use, sexual behavior, partner characteristics, sexual health, and attitudes and beliefs are shown in Table 1 stratified by self-identified HIV status.

PrEP Awareness and Use

Of all 673 participants who answered questions regarding PrEP awareness (500 HIV-negative and 173 HIV-positive), 165 (18.4%) had heard of PrEP, but none had used it. There were no statistically significant trends month-by-month in PrEP awareness among HIV-negative or unknown status MSM ($p=0.40$) or HIV-positive MSM ($p=0.06$). Stratified by self-identified HIV status, 102/500 (20.9%) of HIV-negative or unknown status men and 63/173 (26.5%) of HIV-positive men were aware of PrEP. For HIV-positive men, the crude proportion PrEP-aware (36.4%) was reduced to 26.5% by RDS weights, which indicates that men from larger networks were more likely to be PrEP aware and that HIV-positive men were more likely to recruit participants who had similar PrEP awareness to themselves (high homophily). This was not the case for HIV-negative or unknown status men. Among the 102 PrEP-aware HIV-negative men, 31.2% had talked about PrEP with friends or sex partners in the past 6 months; in terms of self-declared knowledge, 11.0% indicated that they knew “a lot” about PrEP, 46.8% “a bit in general” and 42.1% “not much, or nothing at all”. Among the 63 PrEP-aware HIV-positive men, 27.3% had talked about PrEP with friends or sex partners; in terms of self-declared knowledge, 25.4% knew “a lot”, 43.8% “a bit in general” and 30.8% “not much, or nothing at all”. Tables 2a and 2b show the RDS-adjusted prevalence of PrEP awareness and univariable associations for all independent variables of interest for HIV-negative and HIV-positive MSM respectively.

The adjusted multivariable logistic regression models are shown in Table 3a and 3b, again stratified by self-identified HIV status. HIV-negative/unknown status MSM were more likely to be aware of PrEP if they were older, a student, reported being the receptive partner with ten or more anal sex partners over their lifetime, attended group sex events, and reported a prevention strategy of only having condomless anal sex with HIV-positive partners who are on treatment or have low viral loads, and had higher levels of HAART optimism. HIV-negative MSM were less likely to be aware of PrEP if they were not White-identified, preferred to bottom during anal sex, reported 6–19 recent sex partners versus only one in the past six months, and agreed to a lesser extent that they always had condoms when having sex. HIV-positive MSM were more likely to be aware of PrEP if they reported being the insertive partner with ten or more anal sex partners over their lifetime, and reported a prevention strategy of only having condomless anal sex with HIV-positive partners who are on treatment or have low viral loads. HIV-positive MSM were less likely to be aware of PrEP if they were not White-identified and used cocaine in the past six months. Reporting any recent condomless anal sex with a serodiscordant or status unknown partner was marginally associated with lower odds of PrEP awareness for HIV-positive MSM.

DISCUSSION

Among MSM surveyed from November 2012 to February 2014 in Metro Vancouver, PrEP awareness was greater among HIV-positive men (approximately 1 in 3 being aware) compared with HIV-negative men (approximately 1 in 5 being aware). No one reported PrEP use. The level of self-assessed knowledge regarding PrEP was low, and less than half of MSM had ever discussed PrEP with friends or sexual partners.

Factors associated with PrEP awareness among HIV-negative MSM in our current study highlight a nexus of potentially increased risk for HIV acquisition. As found in previous studies (14,18,19,21), HIV-negative MSM in Vancouver with greater numbers of sexual partners were more likely to be PrEP aware. Fortunately, other risk factors for HIV acquisition such as receiving drugs in exchange for sex and attending group sex events were also positively associated with PrEP awareness. However, HIV-negative MSM who were younger, reported less consistent access to condoms when having sex, and reported a preference to bottom (receptive anal sex role) during anal intercourse were significantly less likely to be aware of PrEP. Given the far increased risk of HIV acquisition during condomless receptive anal sex, PrEP may be a particularly valuable strategy for these men. Efforts to educate about or increase access to PrEP must target and ensure equitable uptake among HIV-negative MSM most likely to acquire HIV.

Numerous psychosocial measures were positively associated with PrEP awareness at the univariable level for HIV-negative MSM, including greater HAART optimism, personal sexual altruism, and sexual sensation seeking. Only HAART optimism remained as a significant psychosocial predictor of PrEP awareness in the multivariable model. We believe this is the first study to demonstrate an empirical link between HAART optimism and PrEP awareness for HIV-negative MSM, which is a logical extension of confidence in antiretroviral treatment options for HIV and the improved prognosis of an HIV diagnosis. No previous study on PrEP awareness has used the Sexual Sensations Scale although one study used a similar scale – the Arousal Barriers to Condom Use Scale – to find that participants who scored higher were more likely to be PrEP aware (15). For HIV-positive MSM, personal and communal sexual altruism were marginally significantly associated with PrEP awareness at the univariable level, but not in the multivariable model. Altruism has been identified as key factor that would help facilitate positive use of and possible integration of PrEP (33). PrEP-aware, HIV-positive MSM were more likely to report asking their sex partners about their HIV status, which indicates that PrEP may be a lead-in for conversations regarding disclosure.

Regardless of HIV status, PrEP awareness was associated with participants who reported only having condomless anal sex with partners on HIV treatment or who have low viral loads. These results are consistent with a study in San Francisco which found that PrEP-aware men were more likely to adhere to a seroadaptive strategy than men who were PrEP-unaware (34). One possible explanation is that PrEP awareness might be a proxy for higher sexual health literacy or greater access to sexual health information, which participants may draw on to practice various seroadaptive strategies. Unfortunately, the current study's questionnaire did not include any direct items on sexual health literacy or health information access. PrEP-aware participants may also be part of a social/sexual network where seroadaptive strategies are the norm and they have translated their higher sexual literacy into their personal risk reduction practices. HIV-positive MSM were included in this analysis as they could play a particularly important role as PrEP educators given their knowledge of HIV transmission, treatments, and adherence. This is supported by our findings that participants with larger network size and higher levels of homophily with respect to PrEP awareness were key factors for HIV-positive MSM, but not for HIV-negative MSM. Future research should investigate more directly the impact of social and sexual networks on PrEP

awareness, and how PrEP use may impact users and their networks. Qualitative interviews with participants who are PrEP-aware may provide additional information on the association between seroadaptive strategies and PrEP, as well as how they heard about PrEP (e.g. the Internet, traditional media sources, peers, healthcare provider, etc.) and whether their source is credible and knowledge is accurate.

This is one of few quantitative studies outside of the United States to provide prevalence estimates for, and factors related to, PrEP awareness and use among MSM using RDS methodology to obtain weighted population estimates (29–31). A strength of this study was the use of various previously validated scales to assess psychological factors associated with PrEP awareness (26–28). Further, the use of RDS enabled us to have increased representation of participants who identified as non-White (32.0%) compared with the general population of Canada and Vancouver (1). Also, unlike other studies that used interviewer-conducted surveys (14,15,18,19), we used CASI to decrease the likelihood of social desirability bias in the responses. We also stratified our analysis to understand further the factors associated with PrEP awareness that may differ by HIV status.

The PrEP awareness prevalence from this study is lower than some other studies (13,16,19,21), most likely because PrEP remains to be licensed in Canada and as a result there has not been a formal public health PrEP campaign. Nevertheless, this study's PrEP awareness prevalence is still higher than some other studies (17,18), likely due to more time since the iPrEx efficacy trial results were available in 2011 (4) and approval by the US FDA in 2012, or possibly due to the existence of HIV prevention strategies such as TasP and STOP in BC (23,24) as well as education and advocacy by local gay community organizations (35). The PrEP awareness prevalence found in this study is higher than the only other Canadian study that found a PrEP awareness of 14% amongst HIV-negative MSM undergoing HIV testing at a sexual health clinic in Toronto, Canada in 2010 (36), which is likely due to the reasons stated above. It will be important for future research to understand who the “early adopters” of biomedical innovation are (37), which may be possible in our study given its longitudinal design.

Readers should be cautious when interpreting our findings due to the fact that we did not assess participants' interests in, willingness to use, access to or attitudes about PrEP (14,16–19,36). Further research using qualitative study designs could provide more detailed information on how to incorporate PrEP within existing public health, clinical, and health promotion programs in Canada. Given the recent regulatory application for TDF-FTC use as PrEP in Canada (12), research should identify which MSM in Canada hold private medical insurance that would cover these drugs, as there is no current public-payer program or plan in place for PrEP.

There are several implications of our findings that may be relevant to physicians, program planners, researchers, and policy makers in Canada. Physicians must be aware of and educated regarding PrEP. Demand can also be driven by patients' request. However, given the low PrEP awareness among MSM in our study, this is unlikely to play a major role, in the absence of further community and health professional education efforts. Community organizations that offer programs or support services to MSM can play an important role in

educating their members who may benefit the most from PrEP, such as clients that engage in sexual activities with greater probability for HIV transmission. Further, MSM who did not identify as White were less likely to be aware of PrEP. Health promotion and care delivery must overcome structural barriers to ensure cultural relevance and equitable access for all MSM.

CONCLUSION

Overall PrEP knowledge was low amongst MSM in our current study in Metro Vancouver, and no respondents had used PrEP. PrEP awareness was associated with a number of factors that could be associated with greater risk of transmission although certain groups had disparities in awareness. It will be important to examine how uptake of PrEP impacts direct users themselves, their sexual partners and networks, and broader gay communities. Researchers, public health, and healthcare providers can play a pivotal role to ensure optimal integration of PrEP into our HIV and sexual health response.

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Table 1

Sample demographics and descriptive statistics stratified by HIV status

Demographic Variables	HIV-negative (n=524)			HIV-positive (n=195)		
	n	%	RDS %	n	%	RDS %
Age						
< 30	267	51.0	49.0	8	4.1	3.7
30	257	49.1	51.0	187	95.9	96.3
White						
Yes	390	74.4	69.8	149	76.4	68.1
No	134	25.6	30.2	46	23.6	31.9
Sexual Identity						
Gay	445	84.9	82.2	167	85.6	82.7
Bisexual/Other	79	15.1	17.8	28	14.4	17.3
Education						
Greater than high school	407	79.2	71.0	130	68.1	66.0
Some/completed high school	107	20.8	29.0	61	31.9	34.0
Neighborhood						
Downtown Vancouver	222	42.4	45.0	134	68.7	68.9
Other Vancouver	187	35.7	31.3	36	18.5	18.9
Outside Vancouver	115	22.0	23.7	25	12.8	12.2
Current Student						
No	392	75.0	74.7	176	90.3	90.3
Yes	131	25.1	25.3	19	9.7	9.7
Annual Income (Canadian dollars)						
< \$30,000	313	59.7	69.1	144	73.9	79.3
\$30,000	211	40.3	30.9	51	26.2	20.7
Current Regular Partner						
No	323	61.6	63.1	123	63.1	66.3
Yes	201	38.4	36.9	72	36.9	33.7

	HIV-negative (n=524)				HIV-positive (n=195)			
	n	%	RDS %	CI	n	%	RDS %	CI
Sexual Behavior & Substance Use								
Anal Sex Preference								
Bottom	173	33.0	32.1	26.3	37.8	68	34.9	37.4
Versatile	132	25.2	23.7	18.6	28.7	61	31.3	27.8
Top	195	37.2	39.4	33.5	45.4	58	29.7	23.9
No anal sex	24	4.6	4.8	2.1	7.5	8	4.1	10.9
Number of Male Anal Sex Partners, P6M								
0	65	12.4	12.7	8.8	16.6	24	12.4	15.4
1	80	15.3	18.3	13.1	23.4	27	13.9	20.2
2-5	225	42.9	40.8	35.1	46.6	65	33.5	27.9
6-19	113	21.6	19.8	14.8	24.8	33	17.0	16.8
20+	41	7.8	8.4	4.5	12.2	45	23.2	19.8
Number of Lifetime Insertive Anal Sex Partners								
< 10	252	48.1	51.3	45.3	57.4	42	21.5	32.4
10	272	51.9	48.7	42.6	54.7	153	78.5	67.6
Number of Lifetime Receptive Anal Sex Partners								
< 10	260	49.6	54.7	48.7	60.7	34	17.4	27.4
10	264	50.4	45.3	39.3	51.3	161	82.6	72.6
Attended Group Sex Event, P6M								
No	410	78.2	79.4	74.4	84.4	129	66.2	74.0
Yes	114	21.8	20.6	15.6	25.6	66	33.9	26.0
Received Drugs in Exchange for Sex, P6M								
No	464	88.6	88.3	83.9	92.6	139	71.3	71.1
Yes	60	11.5	11.7	7.4	16.1	56	28.7	28.9
Substances Used, P6M (mutually exclusive variables):								
Alcohol	463	88.5	87.3	82.9	91.8	146	74.9	71.9
Crystal Methamphetamine	59	11.3	12.4	7.9	16.8	77	39.5	32.6
Cocaine	133	25.4	28.1	22.3	34.0	47	24.1	28.8
Ecstasy	135	25.8	23.6	18.6	28.6	41	21.0	14.2
Ketamine	59	11.3	11.3	7.2	15.4	35	18.0	14.2

	HIV-negative (n=524)				HIV-positive (n=195)			
	n	%	RDS %	RDS 95% CI	n	%	RDS %	CI
GHB	70	13.4	13.9	9.4	18.5	56	28.7	27.2 36.9
Prevention Practices								
Behavioral Strategies, PoM (mutually exclusive variables):								
Always using condoms	335	64.4	66.2	60.6	71.8	68	34.9	33.9 44.1
Strategic positioning	138	26.5	22.8	18.2	27.4	71	36.4	32.1 41.8
Anal sex abstinence	258	49.6	42.7	36.9	48.6	67	34.4	38.1 48.8
Sero-sorting for condomless anal sex	182	35.0	30.6	25.4	35.9	102	52.3	46.8 57.5
No condoms if HIV-positive partner has a low viral load or is on treatment	51	9.8	8.2	5.1	11.3	68	34.9	30.8 40.4
Withdrawal	146	28.1	23.5	18.6	28.3	56	28.7	28.3 37.7
Ask Partners Their HIV Status	326	62.7	59.6	53.5	65.7	95	48.7	37.2 46.8
Ask Status Frequency								
Always	117	22.3	20.9	16.2	25.6	47	24.1	25.7 35.0
Almost every time	107	20.4	18.5	13.8	23.1	33	16.9	10.4 15.0
A lot of the time/Sometimes	167	31.9	32.9	27.2	38.6	57	29.2	27.8 37.4
Rarely/Never	133	25.4	27.7	22.1	33.3	58	29.7	36.1 46.9
Tell Status Frequency								
Always	136	26.0	22.9	18.2	27.6	63	32.3	29.2 38.6
Almost every time	66	12.6	10.9	7.5	14.4	38	19.5	14.2 19.9
A lot of the time/Sometimes	68	13.0	14.3	9.7	18.8	34	17.4	17.4 25.2
Rarely/Never	30	5.7	5.8	2.7	9.0	22	11.3	14.7 23.6
Told only when asked	223	42.6	46.1	40.0	52.2	38	19.5	24.4 34.4

Sexual Health & Risk

HIV Tested Ever								
No	39	7.4	8.4	5.3	11.5	--	--	--
Yes	485	92.6	91.6	88.5	94.7	--	--	--
HIV Tested in Past 2 Years								
No	89	17.0	19.6	14.9	24.3	--	--	--

	HIV-negative (n=524)				HIV-positive (n=195)			
	n	%	RDS %	RDS 95% CI	n	%	RDS %	CI
Yes	435	83.0	80.4	75.7	85.1	--	--	--
Any previous lifetime STI diagnosis								
No	275	52.5	55.8	49.8	61.9	30	15.4	21.6
Yes	249	47.5	44.2	38.1	50.2	165	84.6	78.4
Any serodiscordant/unknown status condomless anal sex, P6M								
No	335	65.4	68.7	63.2	74.2	106	55.5	55.3
Yes	177	34.6	31.3	25.8	36.8	85	44.5	44.7
Attitudes & Beliefs								
Self-Assessed HIV Transmission Risk								
Low	468	89.3	88.5	84.2	92.9	179	91.8	85.5
High	56	10.7	11.5	7.1	15.8	16	8.2	14.5
Self-Assessed Likelihood of HIV Transmission								
Very unlikely	447	85.3	84.1	79.2	88.9	159	81.5	81.2
(Somewhat/Very) Likely	77	14.7	15.9	11.1	20.8	36	18.5	18.8
"I Always Have Condoms when Having Sex"								
Strongly Agree	193	36.8	36.6	30.7	42.5	64	33.0	30.9
Agree	186	35.5	34.6	29.0	40.3	63	32.5	39.6
(Strongly) Disagree	145	27.7	28.8	23.2	34.4	67	34.5	29.6
Psychosocial scales (continuous; mutually exclusive)								
HAAART Optimism Scale (median [Q1,Q3])	24	21, 26				28	25, 32	
Sexual Altruism - Personal (median [Q1,Q3])	3.6	3.1, 3.9				3.4	2.7, 3.9	
Sexual Altruism - Communal (median [Q1,Q3])	3.7	3, 4				3.3	2.5, 4	
Sexual Sensations Score (median [Q1,Q3])	30	28, 33				31	28, 35	

RDS = Respondent-Driven Sampling; 95% CI = 95% Confidence Interval; P6M = Past 6 Months; HAAART = Highly Active Antiretroviral Therapy; STI = sexually transmitted infection.

Table II**a. Descriptive statistics and univariable associations of PrEP awareness among HIV-negative and unknown status MSM**

Demographic Variables	Heard of PrEP (n=102/500)			Univariable Associations		
	n	RDS %	95%CI	OR	95%CI	p-value
Age (continuous: median [Q1,Q3])	30 [25,44]			1.02	1.00	1.04
Race/Ethnicity						
White	85	20.2	14.8	25.5	1.00	0.0331
Other	17	12.7	4.2	21.3	0.56	0.33
Sexual Identity						
Gay	88	19.5	14.3	24.8	1.00	0.0840
Bisexual/Other	14	10.8	3.5	18.1	0.55	0.28
Education						
Greater Than	85	17.5	13.2	21.8	1.00	0.5471
Some/completed high school	16	17.5	6.6	28.4	1.17	0.70
Neighborhood						
Downtown Vancouver	49	20.8	13.0	28.6	1.00	0.2937
Other Vancouver	37	14.7	8.9	20.4	0.68	0.40
Outside Vancouver	16	16.8	7.2	26.5	0.72	0.40
Current Student						
No	74	15.4	10.7	20.2	1.00	0.0147
Yes	28	25.3	14.6	36.0	1.82	1.13
Annual Income (Canadian dollars)						
< \$30,000	61	17.5	11.7	23.3	1.00	0.7242
\$30,000	41	18.8	12.2	25.5	1.09	0.67
Regular Partner Currently						
No	58	18.4	12.2	24.7	1.00	0.6953
Yes	44	17.0	11.0	23.0	0.91	0.57
Sexual Behavior & Substance Use						
Anal Sex Preference						
Top	43	21.4	13.5	29.4	1.00	0.1960

a. Descriptive statistics and univariable associations of PrEP awareness among HIV-negative and unknown status MSM

	Heard of PrEP (n=102/500)					Univariable Associations				
Bottom	27	12.4	5.8	19.1	0.54	0.31	0.94			
Versatile	26	19.1	9.5	28.7	0.78	0.44	1.39			
No anal	6	19.8	0.0	39.6	0.85	0.31	2.37			
Number of Male Anal Sex Partners, P6M										
0	12	19.1	4.3	33.9	1.29	0.56	2.95	0.0008		
1	17	15.7	4.9	26.5	1.00					
2–5	37	15.1	9.6	20.6	0.95	0.49	1.84			
6–19	22	14.2	6.8	21.6	0.77	0.35	1.68			
20+	14	44.3	18.8	69.8	3.96	1.74	9.02			
Number of Lifetime Insertive Anal Sex Partners										
< 10	48	15.6	9.6	21.5	1.00			0.2364		
10	54	20.4	13.5	27.2	1.32	0.84	2.07			
Number of Lifetime Receptive Anal Sex Partners										
< 10	44	14.4	8.8	20.1	1.00			0.0478		
10	58	22.0	14.8	29.2	1.58	1.00	2.50			
Attended Group Sex Event, P6M										
No	65	14.3	9.9	18.8	1.00			0.0002		
Yes	37	32.6	19.2	46.0	2.58	1.56	4.27			
Received Drugs in Exchange for Sex, P6M										
No	88	16.7	12.1	21.2	1.00			0.0255		
Yes	14	27.2	9.2	45.2	2.07	1.11	3.87			
Substances Used, P6M (mutually exclusive variables):										
Alcohol	89	17.0	12.6	21.5	0.65	0.35	1.21	0.1716		
Crystal Methamphetamine	10	18.8	2.9	34.7	1.25	0.63	2.46	0.5214		
Cocaine	25	15.6	7.2	24.0	0.86	0.52	1.44	0.5747		
Ecstasy	30	19.9	11.5	28.3	1.16	0.69	1.95	0.5832		
Ketamine	12	15.6	4.4	26.7	0.87	0.42	1.83	0.7209		
GHB	17	19.9	8.1	31.7	1.23	0.66	2.29	0.5116		
Prevention Practices										

a. Descriptive statistics and univariable associations of PrEP awareness among HIV-negative and unknown status MSM

		Heard of PrEP (n=102/500)				Univariable Associations			
Behavioral Strategies, P6M (mutually exclusive variables):									
Always use condoms	56	14.8	9.7	19.9	0.58	0.37	0.93	0.0223	
Strategic positioning	26	19.3	9.8	28.8	1.06	0.63	1.80	0.8320	
Anal sex avoidance	55	20.2	13.7	26.7	1.21	0.76	1.91	0.4225	
Sero-sorting for condomless anal sex	38	18.8	11.8	25.9	1.03	0.63	1.68	0.9071	
No condoms with partners who have low viral load or are on treatment	20	52.8	32.2	73.4	6.20	3.06	12.54	0.0000	
Withdrawal	34	21.1	11.6	30.7	1.29	0.77	2.15	0.3307	
Ask HIV status	65	16.9	11.7	22.1	0.86	0.54	1.37	0.5137	
Ask Status Frequency									
Always	22	15.4	8.0	22.8	1.00				0.7998
Almost every time	20	15.6	7.1	24.2	1.03	0.49	2.19		
A lot of the time/Sometimes	36	21.7	12.2	31.1	1.32	0.70	2.52		
Rarely/Never	24	16.8	8.2	25.5	1.10	0.56	2.17		
Tell Status Frequency									
Always	24	15.6	8.3	22.8	1.00				0.0092
Almost every time	18	21.1	8.7	33.6	1.39	0.61	3.16		
A lot of the time/Sometimes	15	27.9	10.9	44.8	1.73	0.83	3.58		
Rarely/Never	11	35.4	6.6	64.1	3.14	1.28	7.73		
Told only when asked	34	13.3	7.6	19.0	0.80	0.43	1.50		
Sexual Health & Risk									
Any previous lifetime STI diagnosis									
No	46	13.5	8.5	18.5	1.00				0.0076
Yes	56	23.7	15.7	31.6	1.86	1.18	2.93		
Any serodiscordant/unknown status condomless anal sex, P6M									
No	57	13.9	9.4	18.5	1.00				0.0023
Yes	42	26.6	16.4	36.7	2.08	1.30	3.32		
Attitudes & Beliefs									

a. Descriptive statistics and univariable associations of PrEP awareness among HIV-negative and unknown status MSM

	Heard of PrEP (n=102/500)					Univariable Associations				
Self-Assessed HIV Transmission Risk										
Low	88	18.2	13.3	23.1	1.00					0.6976
High	14	15.6	4.3	27.0	0.86	0.41			1.81	
Self-Assessed Likelihood of HIV Transmission										
Very unlikely	83	17.6	12.8	22.4	1.00					0.6262
(Somewhat/Very) Likely	19	19.5	6.4	32.6	1.16	0.63			2.13	
"I Always Have Condoms when Having Sex"										
Strongly Agree	40	17.3	10.4	24.3	1.00					0.0024
Agree	27	11.5	6.1	17.0	0.57	0.32			1.03	
(Strongly) Disagree	35	26.7	15.6	37.7	1.61	0.95			2.72	
Psychosocial scales (continuous; mutually exclusive)										
HAART Optimism Scale (median [Q1,Q3])	24 [21,29]				1.08	1.03			1.13	0.0017
Sexual Altruism - Personal (median [Q1,Q3])	3.4 [3.0,3.9]				0.61	0.42			0.89	0.0092
Sexual Altruism - Communal (median [Q1,Q3])	3.5 [2.8,3.9]				0.78	0.54			1.12	0.1719
Sexual Sensations Score (median [Q1,Q3])	32 [29,35]				1.11	1.05			1.18	0.0003

b. Descriptive statistics and univariable associations of PrEP awareness among HIV-positive MSM

Demographic Variables	Heard of PrEP (n=63/173)					Univariable Associations				
	n	RDS %	95%CI	OR	95%CI	p-value				
Age (continuous; median [Q1,Q3])	48 [41,53]			1.00	0.95	1.05			0.9962	
Race/Ethnicity										
White	53	25.2	15.3	35.0	1.00				0.0109	
Other	10	7.5	1.4	13.6	0.22	0.07			0.70	
Sexual Identity										
Gay	59	21.5	13.3	29.7	1.00				0.0624	
Bisexual/Other	4	6.7	0.0	14.7	0.21	0.04			1.08	
Education										
Greater Than	51	23.0	13.7	32.4	1.00				0.0931	
Some/completed high school	10	10.1	1.0	19.1	0.39	0.13			1.17	
Neighborhood										

b. Descriptive statistics and univariable associations of PrEP awareness among HIV-positive MSM

	Heard of PrEP (n=63/173)				Univariable Associations			
Downtown Vancouver	40	16.3	8.6	23.9	1.00			0.3777
Other Vancouver	14	25.7	6.0	45.5	2.13	0.71	6.35	
Outside Vancouver	9	21.1	1.7	40.6	1.56	0.43	5.59	
Current Student								
No	57	19.2	11.8	26.6	1.00			0.7149
Yes	6	14.6	0.0	30.2	0.75	0.16	3.52	
Annual Income (Canadian dollars)								
< \$30,000	42	16.1	9.0	23.1	1.00			0.1201
\$30,000	21	30.7	12.2	49.2	2.23	0.81	6.12	
Regular Partner Currently								
No	43	15.3	7.8	22.7	1.00			0.0754
Yes	29	25.8	12.1	39.4	2.27	0.92	5.63	
Sexual Behavior & Substance Use								
Anal Sex Preference								
Top	16	23.2	8.1	38.3	1.00			0.5477
Bottom	22	20.2	8.4	32.0	0.92	0.30	2.75	
Versatile	24	18.9	6.6	31.3	0.89	0.27	2.94	
No anal	1	2.8	0.0	11.6	0.09	0.00	2.33	
Number of Male Anal Sex Partners, P6M								
0	6	13.5	0.0	28.6	0.93	0.17	5.03	0.5908
1	6	14.3	0.0	29.5	1.00			
2–5	17	22.6	8.4	36.9	1.76	0.48	6.42	
6–19	14	29.7	8.5	50.9	2.12	0.53	8.50	
20+	20	13.5	2.6	24.4	0.81	0.18	3.71	
Number of Lifetime Insertive Anal Sex Partners								
< 10	6	7.7	0.0	15.9	1.00			0.0151
10	57	24.8	15.4	34.2	4.32	1.33	14.03	
Number of Lifetime Receptive Anal Sex Partners								
< 10	9	11.5	0.0	23.2	1.00			0.2177
10	54	21.6	13.4	29.8	2.00	0.67	6.00	

b. Descriptive statistics and univariable associations of PrEP awareness among HIV-positive MSM

		Heard of PrEP (n=63/173)				Univariable Associations	
Attended Group Sex Event, P6M							
No	36	18.2	9.9	26.5	1.00		0.8206
Yes	27	20.2	8.7	31.7	1.12	0.43	2.92
Received Drugs in Exchange for Sex, P6M							
No	47	22.3	13.4	31.2	1.00		0.1180
Yes	16	10.6	2.7	18.5	0.42	0.14	1.25
Substances Used, P6M (mutually exclusive variables):							
Alcohol	48	20.0	11.9	28.2	1.32	0.46	3.76
Crystal Methamphetamine	23	13.5	4.4	22.6	0.49	0.18	1.35
Cocaine	11	6.1	0.9	11.4	0.13	0.03	0.53
Ecstasy	14	22.8	5.5	40.1	1.54	0.45	5.24
Ketamine	12	14.3	1.5	27.2	0.85	0.22	3.29
GHB	16	13.6	2.7	24.4	0.49	0.17	1.46
Prevention Practices							
Behavioral Strategies, P6M (mutually exclusive variables):							
Always use condoms	20	13.7	5.5	22.0	0.56	0.21	1.47
Strategic positioning	24	27.4	12.2	42.6	1.90	0.77	4.65
Anal sex avoidance	22	16.3	6.1	26.6	0.72	0.29	1.81
Sero-sorting for condomless anal sex	40	27.5	15.5	39.4	2.85	1.15	7.10
No condoms with partners who have low viral load or are on treatment	32	32.9	16.0	49.8	3.26	1.33	7.98
Withdrawal	20	21.4	7.2	35.5	1.22	0.46	3.24
Ask HIV status	35	30.4	17.3	43.5	2.86	1.17	6.97
Ask Status Frequency							
Always	13	12.9	1.7	24.1	1.00		0.1796
Almost every time	13	28.7	9.8	47.5	3.55	0.72	17.61
A lot of the time/Sometimes	19	29.8	11.0	48.7	2.72	0.80	9.20
Rarely/Never	18	12.7	3.7	21.7	1.13	0.31	4.09
Tell Status Frequency							
Always	17	17.7	4.5	31.0	1.00		0.0220

b. Descriptive statistics and univariable associations of PrEP awareness among HIV-positive MSM									
	Heard of PrEP (n=63/173)					Univariable Associations			
Almost every time	19	44.0	20.8	67.1	4.88	1.24	19.24		
A lot of the time/Sometimes	11	25.1	4.9	45.2	2.05	0.57	7.42		
Rarely/Never	7	7.4	0.0	15.8	0.32	0.05	1.90		
Told only when asked	9	10.7	1.2	20.2	0.66	0.16	2.66		
Sexual Health & Risk									
Any previous lifetime STI diagnosis									
No	8	13.5	0.0	27.9	1.00		0.3579		
Yes	55	20.2	12.4	27.9	1.75	0.53	5.76		
Any serodiscordant/unknown status condomless anal sex, PoM									
No	36	26.4	14.7	38.1	1.00				
Yes	27	13.9	6.1	21.7	0.43	0.17	1.11	0.0822	
Attitudes & Beliefs									
Self-Assessed HIV Transmission Risk									
Low	60	21.7	13.9	29.5	1.00		0.0239		
High	3	3.6	0.0	9.5	0.07	0.01	0.70		
Self-Assessed Likelihood of HIV Transmission									
Very unlikely	55	21.6	13.5	29.8	1.00		0.0851		
(Somewhat/Very) Likely	8	6.7	0.0	14.0	0.25	0.05	1.21		
"I Always Have Condoms when Having Sex"									
Strongly Agree	18	12.0	4.3	19.8	1.00		0.0175		
Agree	16	11.5	3.6	19.4	1.09	0.31	3.83		
(Strongly) Disagree	29	36.9	19.8	54.1	4.04	1.26	12.97		
Psychosocial scales (continuous; mutually exclusive)									
HAART Optimism Scale (median [Q1,Q3])	29[25,32]				1.03	0.95	1.11	0.4785	
Sexual Altruism - Personal (median [Q1,Q3])	3.2 [2.7,3.7]				0.57	0.31	1.05	0.0724	
Sexual Altruism - Communal (median [Q1,Q3])	3 [2.3,4.0]				0.65	0.40	1.04	0.0743	
Sexual Sensations Score (median [Q1,Q3])	32[29,36]				0.98	0.89	1.08	0.6929	

RDS = Respondent-Driven Sampling; 95% CI = 95% Confidence Interval; OR = odds ratio; Q1,Q3 = first and third quartile values; PoM = Past 6 Months; HAART = Highly Active Antiretroviral Therapy; STI = sexually transmitted infection.

Table III

a. Multivariable Model of Factors Associated with PrEP Awareness Among HIV negative and unknown status MSM

	AOR	95% CI	
Age (continuous: median [Q1,Q3])	1.02	1.00	1.05
Race/Ethnicity			
White	1.00		
Other	0.40	0.21	0.77
Current Student			
No	1.00		
Yes	5.03	2.61	9.70
Anal Sexual Position Preference			
Top	1.00		
Bottom	0.37	0.18	0.74
Versatile	0.49	0.24	1.00
No anal sex	1.02	0.27	3.94
Received Drugs in Exchange for Sex, P6M			
No	1.00		
Yes	1.92	0.88	4.16
Number of Male Anal Sex Partners, P6M			
0	1.07	0.37	3.10
1	1.00		
2–5	0.67	0.29	1.54
6–19	0.32	0.11	0.94
20	1.36	0.37	3.10
Number of Lifetime Insertive Anal Sex Partners			
< 10	1.00		
10	2.13	1.10	4.11
Attended Group Sex Event, P6M			
No	1.00		
Yes	2.88	1.42	5.84
Prevention strategy: “only have condomless sex with partners who are on treatment or have low viral loads”			
No	1.00		
Yes	2.54	1.04	6.20
“I Always Have Condoms When Having Sex”			
Strongly Agree	1.00		
Agree	0.35	0.17	0.70
(Strongly) Disagree	0.96	0.51	1.82
Attitude:			
HAART Optimism	1.08	1.01	1.14

b. Multivariable Model of Factors Associated with PrEP Awareness Among HIV-positive MSM

	AOR	95% CI	
Race/Ethnicity			
White	1.00		
Other	0.21	0.05	0.83
Used Cocaine, P6M			
No	1.00		
Yes	0.18	0.04	0.84
Number of Lifetime Receptive Anal Sex Partners			
< 10	1.00		
10	5.32	1.23	22.98
Any serodiscordant/unknown status condomless anal sex, P6M			
No	1.00		
Yes	0.30	0.08	1.10
Prevention strategy: “only have condomless sex with partners who are on treatment or have low viral loads”			
No	1.00		
Yes	4.64	1.29	16.73
Prevention strategy: “asking sex partners about their HIV status before sex”			
No	1.00		
Yes	2.59	0.83	8.07
“I Always Have Condoms When Having Sex”			
Strongly Agree	1.00		
Agree	1.92	0.41	9.01
(Strongly) Disagree	4.01	0.95	16.91

AOR = adjusted odds ratio; 95% CI = 95% Confidence Interval; Q1,Q3 = first and third quartile values; P6M = Past 6 Months; HAART = Highly Active Antiretroviral Therapy.

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