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TRENDS IN AWARENESS AND USE OF HIV PrEP AMONG GAY, BISEXUAL, AND OTHER MEN WHO HAVE SEX WITH MEN IN VANCOUVER, CANADA 2012 – 2016.

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Abstract

Gay, bisexual, and other men who have sex with men (gbMSM) are at the highest risk for HIV infection in British Columbia (BC). Pre-exposure prophylaxis (PrEP) has been recently licensed but is currently not publicly funded in BC. Using respondent-driven sampling, we recruited a cohort of gbMSM to complete a computer-assisted self-interview with follow-up every six months. Stratified by HIV status, we examined trends in awareness of PrEP from 11/2012–02/2016 and factors associated with PrEP awareness. 732 participants responded to the PrEP awareness question. Awareness of PrEP among HIV-negative men increased from 18% to 80% ($p<0.0001$ for trend); among HIV-positive men, awareness increased from 36% to 77% ($p<0.0001$). PrEP awareness was associated with factors related to HIV risk including sero-adaptive strategies and sexual sensation seeking. Eight HIV-negative men reported using PrEP. Low PrEP uptake highlights that PrEP access should be expanded for at-risk gbMSM in BC.

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Research involving human participants: All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

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

Resumen

Los hombres que tienen relaciones sexuales con hombres (HSH) están en mayor riesgo de contraer la infección por el VIH en Columbia Británica (BC). La profilaxis previa a la exposición (PrEP) fue recientemente licenciada en Canadá pero actualmente no está financiada públicamente en BC. Usando el muestreo conducido por el encuestado, hemos reclutado una cohorte de HSH para completar una auto-entrevista asistida por ordenador con seguimiento cada seis meses. Estratificado por el estatus de VIH, examinamos las tendencias en el conocimiento de la PrEP de julio de 2012 a febrero de 2016 y los factores asociados con la conciencia de la PrEP. 732 participantes respondieron a la pregunta de sensibilización sobre la PrEP. La proporción de hombres seronegativos que conocían la PrEP aumentó de 18% a 80% (p <0,0001 para la tendencia); entre los hombres VIH positivos, la conciencia aumentó del 36% al 77% (p <0,0001). 8 hombres VIH-negativos informaron usar PrEP. La conciencia de PrEP se asoció con factores relacionados con el riesgo de VIH, incluyendo estrategias sero-adaptativas y búsqueda de sensaciones. La baja captación de PrEP destaca que el acceso a la PrEP debería ampliarse para los HSH en riesgo en BC.

Keywords

HIV/AIDS; pre-exposure prophylaxis; men who have sex with men; primary prevention; longitudinal data

INTRODUCTION

Gay, bisexual, and other men who have sex with men (gbMSM) have the highest risk for incident HIV infection in Canada, accounting for 56.8% of all incident cases in 2014 (1). Similar patterns are seen in British Columbia (BC) where 57.5% of new HIV diagnoses in 2014 were among gbMSM (2). As gbMSM continue to be disproportionately affected by HIV, a combination of strategies including behavioural, biomedical, and supportive interventions are required to curtail the rate of new HIV diagnoses (3).

One of the most recently developed interventions is pre-exposure prophylaxis (PrEP), where HIV-negative individuals are prescribed either daily or on-demand oral antiretroviral medication in advance of HIV exposure to reduce the risk of HIV acquisition. PrEP has been shown to be an effective method for preventing incident HIV infection among gbMSM in several studies. The iPrEX study of men and transgender women who have sex with men found a 92% reduction in relative risk for HIV infection among participants who took PrEP (emtricitabine and tenofovir disoproxil fumarate (FTC–TDF)) as prescribed, compared to the control group (4). Researchers of the IPERGAY study assessed the efficacy of on-demand PrEP, a modified regimen of FTC-TDF before and after sexual activity rather than daily doses (5). They found that taking PrEP before and after sexual activity reduced the risk of HIV infection by 86% compared to those in the placebo group (5). Only two participants from the FTC-TDF group developed incident HIV, both of whom were found to be non-adherent to their PrEP regimen (5). Recently, the PROUD study in England assessed the efficacy of FTC–TDF in a real-world setting (6). Investigators found an 86% reduced risk of infection among those who used PrEP compared to those randomized to deferred PrEP

initiation (6). Given the proven efficacy of PrEP in the reduction of risk of HIV infection, PrEP could play an important role in the reduction of HIV incidence among gbMSM as part of a comprehensive risk-reduction program.

In the U.S., where PrEP is covered by Medicaid and most state and private insurance companies, use and awareness have significantly increased (7). National cross-sectional surveys of gbMSM in the US have shown increasing levels of PrEP awareness, from 12.5% in September-October 2010 (8) to 68.7% in March 2015 (9). These surveys have also shown PrEP use has increased from <1% in 2010/11 (8) to 4.9% by March 2015 (9). The uConnect study, a longitudinal study of young Black gbMSM in Chicago found that awareness increased from 45% in 2013 to 75% in 2016, while use increased from 3.7% to 6.0% over the same time (10). Additionally, a 2015 survey of HIV-negative gbMSM in Washington state found high-risk gbMSM reported awareness and use at 86% and 23% respectively (11). However, there have been concerns regarding disparities in PrEP use and an overall lack of uptake among those who would benefit most from its use (12, 13). The US Centers for Disease Control and Prevention estimates that 24.7% of gbMSM (approximately 492,000 individuals) and 1.23 million individuals overall have indications for PrEP (14). While there have been demonstrable increases in PrEP use and awareness in the U.S. since its approval for use in HIV prevention, especially in several major US cities, use remains relatively low in other urban and rural areas and indicates the majority of individuals who would benefit most from PrEP are not using it (9).

While FTC–TDF has been licensed in the U.S. for PrEP since July 2012, FTC–TDF was only licensed for PrEP for HIV prevention in Canada in February 2016 (15, 16). Except for individuals receiving Non-insured Health Benefits coverage through the Federal First Nations and Inuit Health Branch of Health Canada, there is currently no public funding for PrEP in BC (17). However, when used to treat rather than prevent HIV, FTC-TDF, along with other antiretroviral medications, are fully covered through the BC Centre for Excellence in HIV/AIDS (BC-CfE)'s Drug Treatment Program for all medically eligible persons living with HIV in BC (18).

A previous cross-sectional analysis in Vancouver, BC conducted during February 2012 – February 2014 found that among HIV-negative participants, 20.9% were aware of PrEP, whereas among HIV-positive participants, 26.5% were aware of PrEP; no participant from either group reported prior use of PrEP (19). We conducted the present study to examine four-year trends in PrEP awareness among HIV-positive and HIV-negative gbMSM and to examine which factors were associated with increased awareness over time. This work will inform potential policy options for consideration towards a provincial PrEP program in British Columbia, and identify the needs of health education and health promotion programs to address awareness gaps.

METHODS

We analyzed data from gbMSM in Vancouver, BC collected from November 2012-February 2016 as part of the Momentum Health Study, a longitudinal prospective cohort study of both HIV-negative and HIV-positive gbMSM in Vancouver. Participants were recruited using

respondent-driven sampling from February 2012 to February 2015. Respondent-driven sampling (RDS) is a modified chain referral method that relies on seeds to recruit peers from within their own networks to study hard-to-reach populations (20). To be eligible to participate, participants must have: 1. gender-identified as a man, 2. been 16 years of age or older, 3. reported sex with a man in the previous six months, 4. have received an RDS voucher for participation in the study, or been purposively selected to be an initial "seed" recruit, and 5. provided informed consent. Participants received $50 CDN per study visit or an equal value of entries into prize draws and an additional $10 CDN per eligible peer successfully recruited into the study. Written informed consent was obtained twice, once for the initial visit as a cross-sectional study and again if the participant opted to enrol in the cohort study, with study visits every 6 months, up to a maximum of 4 years. Participation in the cohort was not a requirement of all study participants. The study procedures received ethical approval from the University of British Columbia/Providence Health Care, Simon Fraser University, and the University of Victoria.

Questionnaires were completed via computer-assisted self-interview (CASI) and collected data on knowledge, behavioural and psychosocial variables relating to sex and sexual practices, as well as demographic and socioeconomic data. A study nurse then performed HIV and STI testing and administered a questionnaire regarding STI history.

The main outcomes of interest were PrEP awareness and reported use. Questions regarding PrEP awareness and use were first inserted into the questionnaire in November 2012. The following definition of PrEP was provided: "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 participants were asked "Have you ever heard of PrEP?" (Yes or No). Participants who answered "Yes" were asked to rate their PrEP knowledge as "Not much, or nothing at all", "A bit in general", or "A lot". They were also asked if they had talked about PrEP with friends or sex partners in the past 6 months (Yes or No), and, for HIV-negative participants, whether they had used PrEP in the previous 6 months (Yes or No). To examine trends in awareness and use of PrEP over time, responses were analyzed in six-month calendar periods, except for the first and final study periods which were truncated and only included November-December 2012 and January-February 2016.

Independent variables of interest include socio-demographic factors (i.e., age, annual income, race/ethnicity, sexual orientation, education, current neighbourhood, relationship status), behavioural factors (i.e., told family doctor of male sex partners, anal sex preference), HIV prevention strategies (consistent condom use, sero-positioning, sero-sorting, anal sex abstinence, viral load sorting, asking HIV status, frequency of asking sex partner's HIV status), HIV risk behaviours (condomless anal sex (CAS) with HIV sero-discordant/unknown partner in previous 6 months, number of male anal sex partners in previous 6 months, number of HIV-positive male sex partners in previous six months, drug use in previous 6 months), clinical variables (i.e., STIs diagnosed in previous 6 months and lifetime), self-assessed risk of lifetime HIV acquisition/transmission, and level of sexual sensation seeking. The Revised Sexual Sensation Seeking Scale (R-SSS, study α=0.73) was included and contains items to measure the need for new and varied sexual experiences and the willingness to accept physical and social risk for enhanced sexual sensation (21). The

HIV Incidence Risk Index for men who have sex with men (HIRI-MSM) is a validated clinical assessment tool that can serve to identify gbMSM at elevated risk of seroconversion, with a HIRI-MSM score >10 indicating high risk of seroconversion (22). The HIRI-MSM was included in the survey as six items assessing HIV risk factors where each item is scored to obtain a cumulative HIRI-MSM score. Data for independent variables were obtained at each visit where a response to the question "Have you heard of PrEP?" was obtained.

Stratified by HIV status, factors relating to PrEP awareness were modelled using multilevel univariable and multivariable Glimmix analyses. Participants were categorized as "unaware" if they reported no awareness of PrEP over the entire study period and as such, data from their final visit were included in the model. Data for participants who indicated they were aware of PrEP were drawn from the visit in which the participants reported the highest knowledge of PrEP. Multi-level modelling accounted for RDS recruitment chain and respondents' multiple visits over time. Final model selection was determined through a backward selection procedure based on the Akaike Information Criterion (AIC) and Type III ρ-values until a final model was reached with optimum minimized AIC. All statistical tests were two-sided and considered significant at $\alpha < 0.05$. All analyses in this study were conducted using SAS® versions 9.4 (SAS, North Carolina, United States).

RESULTS

From February 2012 to February 2015, 732 participants were enrolled into the study and responded to the PrEP awareness question. When first asked about PrEP, 528 (72%) were HIV-negative, while the remaining 204 (28%) were HIV-positive; 6 HIV-negative participants seroconverted during the study period. The median age was 34 years (Q1,Q3: 26,47). The majority (61.8%) reported an annual income of less than $30,000. Participants were predominantly white (75.7%); other ethnicities included 9.4% Asian, 6.3% Aboriginal, 4.6% Latino, and 4.0% other. Overall, 84.3% reported being gay, 9.6% reported being bisexual, and 6.2% identified as another sexual identity. Most participants (77.9%) reported some formal education beyond high school. When asked about their relationship status, 61.1% reported being single, 17.2% reported being in a closed relationship or married, and 21.7% reported having an open relationship. Descriptive characteristics stratified by HIV status and PrEP awareness are provided in Table I.

When first asked if they had heard of PrEP, 26.1% of the sample (191/732) indicated that they were aware; awareness was higher among HIV-positive gbMSM (38.2% vs. 21.4% among HIV-negative gbMSM). Among those who reported having heard of PrEP, 16.8% said they knew "a lot", 52.9% said they knew "a bit in general", and 30.4% said they knew "not much, or nothing at all". No participants indicated that they had used PrEP in the previous six months; however, 44.3% of HIV-negative men and 37.2% of HIV-positive men reported having talked about PrEP with friends or sex partners.

Of 732 baseline participants, 681 consented to participate in the cohort and 571 (83.1%) completed at least one follow-up visit (median follow-up time = 2.5 years). PrEP awareness increased significantly over time for both HIV-negative (Figure 1) and HIV-positive men (Figure 2). During the first study period (November - December 2012), 18% of HIV-negative

participants reported having heard of PrEP, but by the last study period, (January - February 2016), 80% reported being aware ($p<0.0001$ for test of trend). Likewise, among HIV-positive men, 36% reported PrEP awareness during the first study period and this proportion increased to 77% by the final study period ($p<0.0001$ for test of trend). Over the entire study, 67.4% of HIV-negative and 75.7% of HIV-positive participants reported having ever heard of PrEP at one or more study visits and among those, most (67.3% HIV-negative, 64.2% HIV-positive) reported talking about PrEP with friends or sex partners.

Eight (2.3%) HIV-negative individuals reported having used PrEP at some point during the study. Of these, 7 were Caucasian and 1 was Aboriginal. Median age was 48.5 years old; 3 reported annual incomes >$60,000, 1 reported income between $30,000-$60,000, and 4 reported income <$30,000. Four of these men (50%) indicated that they had condomless anal sex with an HIV-positive or unknown status partner; 5 had a minimum HIRI-MSM scores of 10 (i.e., indicated for PrEP use) while 3 had scores ≥25. Within the 6-month recall period, 5 users reported daily use, one reported taking 3 doses initially then another 60 doses, one took 30 doses, and one took 2 doses.

Univariable and multivariable models of PrEP awareness are shown in Table II (HIV-negative gbMSM) and Table III (HIV-positive gbMSM). Multivariable results showed that among HIV-negative gbMSM, PrEP awareness was associated with greater annual income ($30,000-$60,000 vs <$30,000: aOR= 1.57; 95%CI: 1.19, 2.08; >$60,000 vs <$30,000: aOR= 2.24; 95%CI: 1.52, 3.29), education level greater than high school (aOR=2.10; 95%CI: 1.41, 3.15), practicing viral load sorting as an HIV prevention strategy (aOR= 2.61; 95%CI: 1.72, 3.94), being between 29–40 years old versus 18–28 years old (aOR= 1.65; 95%CI: 1.20, 2.26), having used ecstasy in the previous 6 months (aOR= 1.45; 95%CI, 1.07, 1.95), and reporting higher sexual sensation seeking scale scores (aOR= 1.04 per point increase; 95%CI: 1.001, 1.07). HIV-negative gbMSM were less likely to be aware of PrEP if they identified as Aboriginal (aOR= 0.36; 95%CI: 0.17, 0.78) or Latino (aOR= 0.39; 95%CI: 0.20, 0.78) compared with White, identified as bisexual compared with gay (aOR= 0.58; 95%CI: 0.34, 0.98), were single versus in a closed relationship/married (aOR= 0.70; 95%CI: 0.52, 0.94), and if they reported prior but not recent receipt of drugs for sex compared with never (aOR= 0.23; 95%CI: 0.08, 0.64).

Among HIV-positive gbMSM, multivariable analyses found greater odds of PrEP awareness to be associated with an education level greater than high school (aOR= 2.57; 95%CI: 1.48, 4.44), practicing viral load sorting as an HIV prevention strategy (aOR= 1.83; 95%CI: 1.21, 2.75), being 29–40 years old in comparison with being 49 and older (aOR= 2.20; 95%CI: 1.09, 4.47), reporting any receptive CAS in the previous 6 months (aOR= 1.74; 95%CI: 1.13, 2.69), and reporting higher sexual sensation seeking scale scores (aOR= 1.11 per point increase; 95%CI: 1.05, 1.17). HIV-positive gbMSM were less likely to have heard of PrEP if they were Aboriginal versus White (aOR= 0.32; 95%CI: 0.13, 0.77), used methamphetamines or speed in the previous 6 months (aOR= 0.52; 95%CI: 0.32, 0.86), reported recent receipt of drugs for sex vs. never (aOR= 0.46; 95%CI: 0.22, 0.95), reported 1 or more previous STI diagnoses in their lifetime versus none (aOR= 0.54; 95%CI: 0.30, 0.96), and if they perceived themselves as likely (>60%) to transmit HIV in their lifetime versus unlikely (<40%) (aOR= 0.12; 95% CI: 0.03, 0.39).

DISCUSSION

This four-year longitudinal study of gbMSM in Vancouver, BC demonstrates that awareness of PrEP has increased significantly over time. At study commencement, initial PrEP awareness among gbMSM was low with approximately 1 in 3 HIV-positive and 1 in 5 HIV-negative men aware of PrEP between November 2012 – December 2012. By the end of the study, between January – February 2016, approximately 4 out of 5 gbMSM were aware of PrEP with similar levels of awareness among HIV-negative and HIV-positive men.

Recent studies in other jurisdictions have also assessed PrEP awareness among gbMSM. In Australia, like Canada, PrEP has only recently been approved and currently lacks any public funding (23, 24). A national online survey of Australian gbMSM in 2015 found comparable levels of PrEP awareness at 77% (25). In the United States, where PrEP was approved over four years ago, studies have shown comparable levels of PrEP awareness: 68.7% among U.S. gbMSM participating in online surveys between November 2014 - March 2015 (9), 75% among young Black gbMSM in Chicago in 2016 (10), and 86% among high-risk HIV-negative or unknown status gbMSM in Washington State in June 2015 (11). As all study visits included in the present study were completed prior to approval of PrEP in Canada, it is encouraging that awareness levels match those in the U.S. This suggests that there is a strong interest in PrEP among community and social networks and that campaigns to raise PrEP awareness and get PrEP approved in Canada by local gay community organizations have been successful (26).

PrEP use remained exceedingly low with only 8 (1.5%) HIV-negative men reporting PrEP use at some point during the study. While surveys in the United States have shown that increases in PrEP awareness coincide with moderate increases in PrEP use, up to 4.9% nationally and as high as 17% in some cities as of March 2015 (9), the same has not been demonstrated in our study. This is primarily due to lack of approval for PrEP in Canada during the study period, the high costs associated with acquiring the medication, and the relative difficulty in getting coverage through private insurance providers (27, 28).

While factors associated with PrEP awareness varied by HIV-status, certain factors were common among all participants. These include having an education greater than high school, being 29–40 years old, practicing sero-adaptive strategies, specifically viral load sorting, and reporting greater sexual sensation seeking. Among HIV-negative gbMSM, having an annual income greater than $30,000 and use of ecstasy was also positively associated with PrEP awareness. Ecstasy use has been shown to be strongly associated with high-risk sexual behaviour among gbMSM (29). The finding that PrEP awareness is associated with viral load sorting is consistent with previous studies that have found that HIV-negative gbMSM who were aware of PrEP were more likely than those unaware to practice sero-adaptive strategies (19, 30). Taken together, these findings suggest that a portion of HIV-negative gbMSM who engage in riskier sex have increased their sexual health literacy, given their increased awareness of PrEP, as an option to reduce the risk of HIV acquisition. Given that some HIV-negative gbMSM may be actively seeking out information regarding risk reduction strategies, there may be an opportunity to assess whether gbMSM find such

information easy to access and whether their sexual health information needs are being adequately met.

Among HIV-positive gbMSM, PrEP awareness was also positively associated with receptive CAS. CAS between sero-discordant gbMSM when the HIV-positive partner is not virally suppressed carries a high risk of HIV transmission even if the HIV-negative partner assumes the insertive role (31) and many HIV-positive gbMSM are concerned about passing HIV to their sexual partners (32). Therefore, their awareness and promotion of prevention tools will be a critical asset for prevention efforts and they should be considered important consumers of this information. HIV-positive gbMSM can initiate discussions of PrEP with their serodiscordant partners to reduce the risk of HIV transmission.

In our study, we found that having at least one STI in their lifetime was not associated with PrEP awareness among HIV-negative gbMSM and was negatively associated with PrEP awareness among HIV-positive gbMSM. This is contrary to several studies which have found gbMSM who have had prior STI diagnosis were more likely to have heard of PrEP (33, 34). The proposed explanation for increased PrEP awareness among gbMSM with prior STI diagnosis was that those individuals would have more frequent and more engaged access to sexual health services during STI screening and treatment which may have included discussions regarding sexual behaviour and counseling regarding PrEP (33). It was also suggested that gbMSM with prior STI diagnosis would perceive themselves at higher risk for HIV/STI infection and seek out information regarding risk reduction strategies including PrEP (34). This suggests, in the context of our study, that an opportunity was missed to engage these men in a discussion on PrEP as they would have been engaged in sexual health services during STI treatment. For some individuals, this may indicate challenges with comprehension or receiving of the messaging regarding sexual health and methods of delivery may need to be evaluated and addressed. However, it should be noted that HIV-positive gbMSM in this sample were generally older than HIV-negative gbMSM and thus some caution should be taken when interpreting these results as we considered lifetime STI diagnosis which may have occurred years before PrEP was available.

While associations between PrEP awareness and several risk behaviours have been identified, there was no association with HIRI-MSM score. The HIRI-MSM provides a measure of objective HIV risk with a score ≥10 having a sensitivity of 84% and specificity of 45% for predicting incident HIV infection making it an effective screening tool for HIV risk (22). This may suggest that objectively high-risk gbMSM are not adequately receiving information regarding risk reduction strategies including PrEP. However, it is worthwhile noting that 60% of the HIV-negative gbMSM in our study had a HIRI-MSM score ≥10 and with both risk and awareness levels high, it may make it difficult to detect a significant association. Nonetheless, as these are the men who would benefit most from PrEP, strategies to increase uptake including provider initiated referrals for PrEP would prove to be beneficial.

Our analysis has identified several factors negatively associated with PrEP awareness. Among HIV-negative gbMSM, these include being Latino, identifying as bisexual, and being single. Bisexual MSM may be less likely to be aware of PrEP due to differences in

their social networks relative to other MSM. Further, health literacy campaigns aimed at gay MSM may not be culturally relevant or appropriate for bisexual MSM. Additionally, disparities in PrEP awareness appear to have fallen along traditional lines of inequality, with gbMSM of lower socio-economic status (SES) also being less likely to be aware of PrEP. HIV-negative GbMSM having an education level no greater than high school earning less than $30,000 per year were significantly less likely to be aware of PrEP. Not only are these gbMSM less likely to be aware of PrEP, it is probable they would have the most difficult time paying for PrEP. Past research has shown that low SES is associated with poorer HIV treatment outcomes and increased mortality among individuals living with HIV (35–39). Therefore, every effort should be made to ensure these individuals have equitable access to all effective prevention strategies including PrEP.

Among all gbMSM, low PrEP awareness was associated with being Aboriginal and engaging in transactional sex. Aboriginal gbMSM have significantly higher incidence of health inequalities such as mental health issues and substance use (40, 41). Some Aboriginal gbMSM face stigmas associated with being both Aboriginal and gbMSM resulting in barriers to sexual health services, reduced health literacy, and difficulty developing supportive social networks (42, 43). As First Nations and Inuit peoples eligible for the Non-Insured Health Benefits Program can access coverage for PrEP, interventions in this population to increase awareness have the potential to have significant impact (17).

Our study is limited in that it did not assess participants' interest in, willingness to use, attitudes toward, or access to PrEP (44–47). Interviews with at-risk male youth in Vancouver prior to PrEP approval by Health Canada revealed frequent negative views towards PrEP including an association with "promiscuity" and high-risk behaviour which would stigmatize users, the belief that it would result in increased risk taking, and the belief that those on PrEP would excuse themselves from testing and other prevention strategies including condom use (48). It is also foreseeable that having been asked about PrEP at a previous study visit may result in some participants responding that they have heard of PrEP at subsequent visits. However, the questioning gave only minimal explanation of what PrEP is, what it stands for and that it may prevent HIV, and answering "no" to having heard of PrEP results in no further questions being asked regarding PrEP. Furthermore, the change in PrEP awareness seen over time was gradual, suggesting that being asked about PrEP had minimal impact on PrEP awareness at subsequent visits. Finally, our study was conducted in Metro Vancouver and nearly half (48.8%) or our participants lived downtown; therefore, these results may not be generalizable to gbMSM in other areas. In light of these limitations, it is important that further studies are conducted to assess knowledge, perspectives, and acceptance of PrEP in Vancouver.

Our study's findings have significant implications for policy makers, program planners, physicians, and researchers. As PrEP awareness has drastically increased over the last 4 years, it should be expected that substantially more men will be requesting information and access to PrEP in the future. Therefore, physicians must be aware, educated, and prepared to discuss and prescribed PrEP to indicated individuals. Surveys of physicians in Canada and the United States have found moderate levels of knowledge and support of PrEP and concerns that information regarding PrEP had not yet been properly made available to

physicians (49, 50). With increasing demand for PrEP, interested individuals will need to be referred to the proper resources and if use increases dramatically, could place a strain on existing sexual health clinics with limited capacity. Concerns regarding cost and funding will need to be addressed by provincial governments and private insurance providers. Additionally, while awareness of PrEP has significantly increased, many objectively high-risk men who do not perceive themselves as high-risk may not seek out PrEP (42, 51). Therefore, non-user initiated pathways to identify, educate and refer high-risk gbMSM to PrEP are needed to increase uptake among indicated individuals.

CONCLUSIONS

There have been significant increases in PrEP awareness among gbMSM in Metro Vancouver area since 2012, up to 80% in 2016, but with no corresponding change in the level of use (<2%). As in other studies, PrEP awareness was associated with factors that are indicative of potentially higher risk for HIV acquisition. Disparities in PrEP awareness are evident among certain groups, which face numerous health inequalities. However, the overall high levels of PrEP awareness and the subsequent approval of PrEP in Canada have removed several important challenges to PrEP implementation and scale-up. Unfortunately, numerous barriers remain including a lack of public funding for medication. With the low rates of PrEP use observed in this study, more work will need to be done to increase uptake to high-risk HIV-negative gbMSM, potentially through targeted programs.

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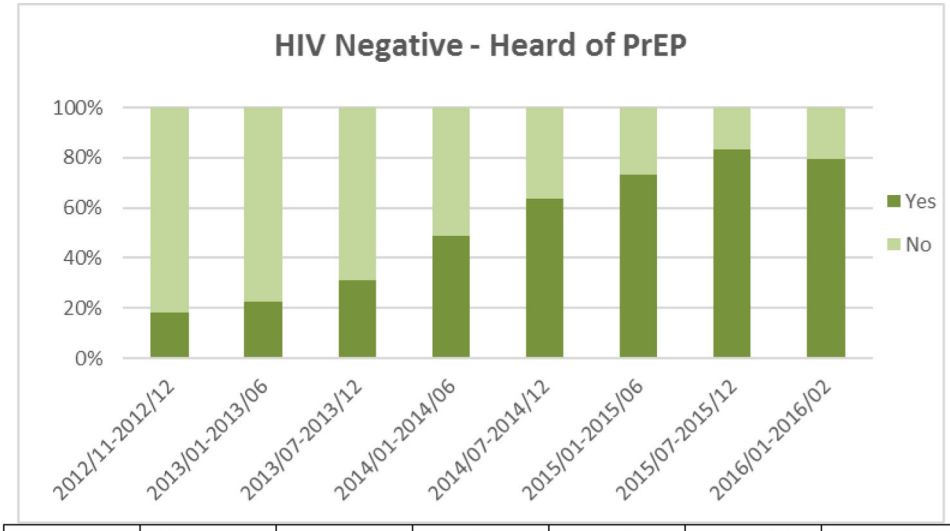
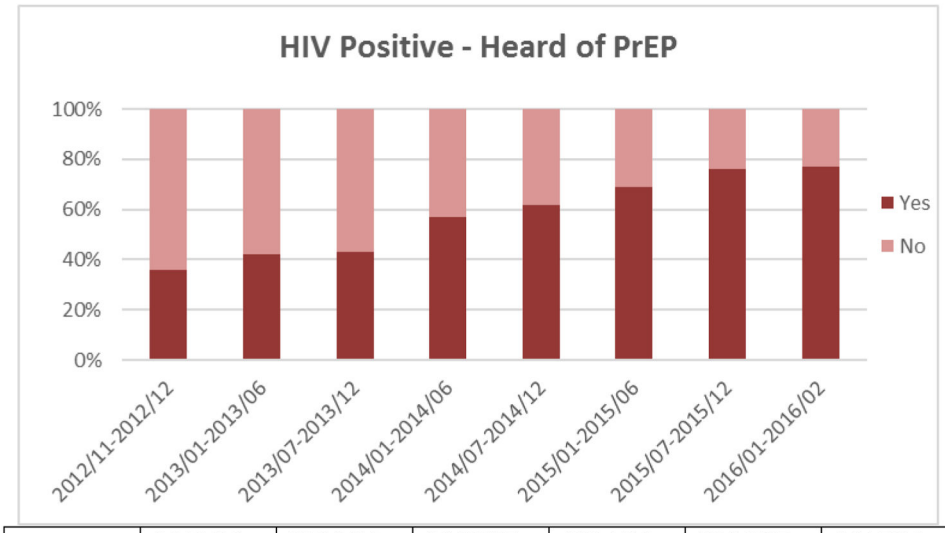


	2012/11-2012/12	2013/01-2013/06	2013/07-2013/12	2014/01-2014/06	2014/07-2014/12	2015/01-2015/06	2015/07-2015/12	2016/01-2016/02
N	71	290	378	334	316	322	302	108
Aware PreP	58	225	261	171	115	87	51	22
Unaware PreP	13	65	117	163	201	235	251	86

Figure 1.

Proportion of HIV-negative participants indicating PrEP awareness by 6-month interval from November 2012 to February 2016 ($p < 0.001$ for test of trend) and number of individuals aware/unaware per study period



	2012/11-2012/12	2013/01-2013/06	2013/07-2013/12	2014/01-2014/06	2014/07-2014/12	2015/01-2015/06	2015/07-2015/12	2016/01-2016/02
N	25	100	135	139	142	154	130	44
Aware PreP	16	58	77	60	54	48	31	10
Unaware PreP	9	42	58	79	88	106	99	34

Figure 2.

Proportion of HIV-positive participants indicating PrEP awareness by 6-month interval from November 2012 to February 2016 ($p < 0.0001$ for test of trend) and number of individuals aware/unaware per study period

Table I.

Descriptive characteristics of PrEP aware and unaware participants, stratified by HIV

	HIV Negative (n=523)				HIV Positive (n=209)			
Ever Heard of PrEP?	**No**		**Yes**		**No**		**Yes**	
	N=170		**N=353**		**N=51**		**N=158**	
	n	**%**	**n**	**%**	**n**	**%**	**n**	**%**
DEMOGRAPHICS								
Age: *median (Q1, Q3)*	*(29.5)*	*(25,40)*	*(31)*	*(27,41)*	*(47)*	*(38,52)*	*(48)*	*(42,53)*
Annual Income (CAD)								
<30K	119	70.0	167	47.3	40	78.4	111	70.3
30–60K	38	22.4	115	32.6	9	17.7	34	21.5
60K+	13	7.7	71	20.1	2	3.9	13	8.2
Ethnicity								
Caucasian	120	70.6	271	76.8	34	66.7	129	81.7
Asian	15	8.8	41	11.6	2	3.9	11	7.0
Aboriginal	14	8.2	13	3.7	10	19.6	9	5.7
Latino	12	7.1	15	4.3	2	3.9	5	3.2
Other	9	5.3	13	3.7	3	5.9	4	2.5
Sexual Orientation								
Gay	123	72.4	301	85.3	41	80.4	142	89.9
Bisexual	34	20.0	20	5.7	9	17.7	9	5.7
Other	13	7.7	32	9.1	1	2.0	7	4.4
Education								
No more than high school	59	34.7	41	11.6	28	54.9	32	20.3
Greater than high school	111	65.3	312	88.4	23	45.1	126	79.8
Told Family Doctor about Male Partners								
No	36	21.3	37	10.6	2	3.9	3	1.9
Yes	60	35.5	169	48.6	46	90.2	152	96.2
No Family Doctor	73	43.2	142	40.8	3	5.9	3	1.9
Relationship Open								
No/Married	40	23.5	81	23.0	12	23.5	35	22.2
Yes	25	14.7	90	25.5	8	15.7	28	17.7
No current partner	105	61.8	182	51.6	31	60.8	95	60.1
PREVENTION STRATEGIES USED								
Always Use Condoms								
No	57	33.9	138	39.7	21	42.0	112	70.9
Yes	111	66.1	210	60.3	29	58.0	46	29.1
Sero-positioning								
No	127	75.6	247	71.0	37	74.0	107	67.7
Yes	41	24.4	101	29.0	13	26.0	51	32.3
Anal Sex avoidance								
No	97	57.7	177	50.9	35	70.0	107	67.7

Ever Heard of PrEP?		HIV Negative (n=523)				HIV Positive (n=209)			
		No		Yes		No		Yes	
		N=170		N=353		N=51		N=158	
		n	%	n	%	n	%	n	%
	Yes	71	42.3	171	49.1	15	30.0	51	32.3
Sero-sorting									
	No	120	71.4	207	59.5	36	72.0	83	52.5
	Yes	48	28.6	141	40.5	14	28.0	75	47.5
Viral load sorting									
	No	157	93.5	294	84.5	40	80.0	82	51.9
	Yes	11	6.6	54	15.5	10	20.0	76	48.1
Withdrawal									
	No	129	76.8	275	79.0	37	74.0	117	74.1
	Yes	39	23.2	73	21.0	13	26.0	41	26.0
Ask HIV Status									
	No	73	43.5	133	38.2	34	68.0	70	44.3
	Yes	95	56.6	215	61.8	16	32.0	88	55.7
Ask HIV Status Frequency									
	0% of the time	36	21.2	60	17.0	15	29.4	27	17.1
	<25% of the time	22	12.9	56	15.9	11	21.6	25	15.8
	25–49% of the time	17	10.0	43	12.2	4	7.8	22	13.9
	50–74% of the time	21	12.4	42	11.9	3	5.9	10	6.3
	75–99% of the time	28	16.5	60	17.0	5	9.8	28	17.7
	100% of the time	46	27.1	92	26.1	13	25.5	46	29.1
SEXUAL BEHAVIOURS, RISK, AND SUBSTANCE USE									
CAS with serodiscordant/ unknown status partner, P6M									
	No	122	73.5	233	67.0	31	64.6	78	50.0
	Yes	44	26.5	115	33.1	17	35.4	78	50.0
CAS, P6M									
	No	85	50.3	120	34.0	25	50.0	47	29.9
	Yes	84	49.7	233	66.0	25	50.0	110	70.1
CAS with HIV+ Male, P6M									
	No	162	95.9	303	85.8	34	68.0	68	43.3
	Yes	7	4.1	50	14.2	16	32.0	89	56.7
CAS with HIV- Male, P6M									
	No	111	65.7	175	49.6	42	84.0	105	66.9
	Yes	58	34.3	178	50.4	8	16.0	52	33.1
# Male Anal Sex Partners, P6M									
	0	37	21.8	51	14.5	14	28.0	28	17.7
	1	32	18.8	83	23.5	7	14.0	20	12.7
	2 – 5	67	39.4	133	37.7	15	30.0	45	28.5
	6 – 19	23	13.5	55	15.6	8	16.0	30	19.0
	20+	11	6.5	31	8.8	6	12.0	35	22.2

Ever Heard of PrEP?	HIV Negative (n=523)				HIV Positive (n=209)			
	No		Yes		No		Yes	
	N=170		N=353		N=51		N=158	
	n	%	n	%	n	%	n	%
Number of past diagnosed STIs								
0	152	89.4	312	88.4	43	84.3	142	89.9
1+	18	10.6	41	11.6	8	15.7	16	10.1
Gave someone else drugs for sex								
No	161	94.7	348	98.6	44	86.3	142	89.9
Yes, in P6M	5	2.9	4	1.1	4	7.8	12	7.6
Yes, not in P6M	4	2.4	1	0.3	3	5.9	4	2.5
Received drugs from someone else for sex								
No	152	89.4	338	95.8	40	78.4	139	88.0
Yes, in P6M	12	7.1	9	2.6	9	17.7	13	8.2
Yes, not in P6M	6	3.5	6	1.7	2	3.9	6	3.8
Used EDDs, P6M								
No	150	88.2	286	81.0	32	62.8	90	57.0
Yes	20	11.8	67	19.0	19	37.3	68	43.0
Used Poppers, P6M								
No	131	77.1	255	72.2	38	74.5	81	51.3
Yes	39	22.9	98	27.8	13	25.5	77	48.7
Used Ecstasy, P6M								
No	130	76.5	255	72.2	45	88.2	127	80.4
Yes	40	23.5	98	27.8	6	11.8	31	19.6
HIRI-MSM Score								
<10	78	45.9	151	42.8	24	47.1	35	22.2
10–24	84	49.4	157	44.5	15	29.4	73	46.2
25+	8	4.7	45	12.8	12	23.5	50	31.7
HIRI-MSM: How Old Are You?								
≥49	28	16.5	53	15.0	22	43.1	75	47.5
41–48	11	6.5	37	10.5	14	27.5	47	29.8
29–40	53	31.2	133	37.7	12	23.5	31	19.6
18–28	78	45.9	130	36.8	3	5.9	5	3.2
HIRI-MSM: Number of Male Sex Partners, P6M								
0–5	119	70.0	223	63.2	31	60.8	83	52.5
6–10	25	14.7	50	14.2	10	19.6	17	10.8
>10	26	15.3	80	22.7	10	19.6	58	36.7
HIRI-MSM: Receptive CAS, P6M								
No	118	69.4	202	57.2	33	64.7	62	39.2
Yes	52	30.6	151	42.8	18	35.3	96	60.8
HIRI-MSM: # HIV+ Male Sex Partners, P6M								
0	156	91.8	282	79.9	26	51.0	46	29.1

Ever Heard of PrEP?	HIV Negative (n=523)				HIV Positive (n=209)			
	No		Yes		No		Yes	
	N=170		N=353		N=51		N=158	
	n	%	n	%	n	%	n	%
1	11	6.5	52	14.7	13	25.5	50	31.7
≥1	3	1.8	19	5.4	12	23.5	62	39.2
HIRI-MSM: # Insertive CAS with HIV+ Males, P6M								
0 – 0–4	170	100.0	333	94.3	47	92.2	128	81.0
6 - >=5	0	0.0	20	5.7	4	7.8	30	19.0
HIRI-MSM: Used meth or speed, P6M								
No	142	83.5	317	89.8	29	56.9	99	62.7
Yes	28	16.5	36	10.2	22	43.1	59	37.3
ATTITUDES AND BELIEFS								
Self-Assessed Lifetime Likelihood of Transmission								
Unlikely - < 40%	148	87.1	307	87.0	42	82.4	143	90.5
Somewhat Likely - 40–60%	20	11.8	37	10.5	4	7.8	13	8.2
Likely - > 60%	2	1.2	9	2.6	5	9.8	2	1.3
Sensation seeking scale score: *median (Q1, Q3)*	30	*(28,33)*	31	*(28,34)*	30	*(27,34)*	32	*(30,36)*

P6M: In Previous Six Months; **CAS**: Condomless anal sex; **EDDs:** Erectile Dysfunction Drugs; **HIRI-MSM:** HIV Incidence Risk Index for Men who have Sex with Men

Table II.

Univariable and multivariable associations with reporting PrEP awareness versus not for HIV-negative/unknown gbMSM

	Univariable		Multivariable	
	OR	**95% CI**	**aOR**	**95% CI**
Annual Income (CAD)				
<30K	1.00		1.00	
30–60K	**2.08**	**(1.60 – 2.72)**	**1.57**	**(1.19 – 2.08)**
60K+	**3.40**	**(2.35 – 4.92)**	**2.24**	**(1.52 – 3.29)**
Ethnicity				
Caucasian	1.00		1.00	
Asian	0.82	(0.53 – 1.27)	0.72	(0.46 – 1.13)
Aboriginal	**0.20**	**(0.10 – 0.41)**	**0.36**	**(0.17 – 0.78)**
Latino	**0.38**	**(0.20 – 0.74)**	**0.39**	**(0.20 – 0.78)**
Other	0.86	(0.43 – 1.71)	0.91	(0.43 – 1.94)
Sexual Orientation				
Gay	1.00		1.00	
Bisexual	**0.44**	**(0.27 – 0.71)**	**0.58**	**(0.34 – 0.98)**
Other	1.25	(0.80 – 1.95)	1.50	(0.94 – 2.40)
Education				
No more than high school	1.00		1.00	
Greater than high school	**2.93**	**(2.01 – 4.28)**	**2.10**	**(1.41 – 3.15)**
Current Neighbourhood				
Downtown Vancouver	1.00		Not selected	
Vancouver, Outside Downtown	0.82	(0.62, 1.09)		
Metro Vancouver	0.72	(0.52, 1.003)		
Told Family Doctor about Male Partners				
No	1.00		Not selected	
Yes	**2.17**	**(1.44 – 3.27)**		
No Family Doctor	1.23	(0.81 – 1.85)		
Relationship Open				
No/Married	1.00		1.00	
Yes	1.14	(0.81 – 1.60)	1.08	(0.76 – 1.54)
No current partner	**0.65**	**(0.48 – 0.86)**	**0.70**	**(0.52 – 0.94)**
Always Use Condoms as HIV Prevention Strategy				
No	1.00		Not selected	
Yes	0.81	(0.64 – 1.01)		
Anal Sex Avoidance as HIV Prevention Strategy				
No	1.00		Not selected	
Yes	1.20	(0.97 – 1.50)		
Sero-sorting as HIV Prevention Strategy				
No	1.00		Not selected	

	Univariable		Multivariable	
	OR	**95% CI**	**aOR**	**95% CI**
Yes	**1.38**	**(1.10 – 1.74)**		
Viral Load Sorting as HIV Prevention Strategy				
No	1.00		1.00	
Yes	**2.87**	**(1.94 – 4.23)**	**2.61**	**(1.72 – 3.94)**
Attended Group Sex Event, P6M				
No	1.00		Not selected	
Yes	1.22	(0.92 – 1.63)		
CAS with Serodiscordant/Unknown HIV Status Partner, P6M				
No	1.00		Not selected	
Yes	**1.29**	**(1.01 – 1.64)**		
Past History of STI				
No	1.00		Not selected	
Yes	0.90	(0.64 – 1.25)		
Gave Someone Else Drugs for Sex			Not selected	
No	1.00			
Yes, in P6M	0.42	(0.15 – 1.16)		
Yes, not in P6M	**0.09**	**(0.01 – 0.78)**		
Received Drugs for Sex				
No	1.00		1.00	
Yes, in P6M	**0.51**	**(0.26 – 0.99)**	0.63	(0.29 – 1.37)
Yes, not in P6M	**0.26**	**(0.10 – 0.67)**	**0.23**	(**0.08 – 0.64)**
Used Erectile Dysfunction drugs, P6M				
No	1.00		Not selected	
Yes	**1.47**	**(1.06 – 2.05)**		
Used Poppers, P6M				
No	1.00		Not selected	
Yes	1.25	(0.96 – 1.63)		
Used Ecstasy in P6M				
No	1.00		1.00	
Yes	**1.42**	**(1.08 – 1.87)**	**1.45**	**(1.07 – 1.95)**
HIRI-MSM: How old are you?				
≥49	1.00		1.48	(0.97 – 2.26)
41–48	0.94	(0.56 – 1.56)	1.50	(0.93 – 2.41)
29–40	1.00	(0.66 – 1.52)	**1.65**	**(1.20 – 2.26)**
18–28	**0.54**	**(0.35 – 0.82)**	1.00	
HIRI-MSM: # Male Sex Partners, P6M				
0–5	1.00		Not selected	
6–10	0.89	(0.67 – 1.18)		
>10	1.04	(0.77 – 1.40)		
HIRI-MSM: Receptive CAS, P6M				
No	1.00		Not selected	

		Univariable		Multivariable	
		OR	**95% CI**	**aOR**	**95% CI**
	Yes	1.22	(0.97 – 1.53)		
HIRI-MSM: # of HIV+ Male Sex Partners, P6M					
	0	1.00		Not selected	
	1	**1.82**	**(1.31 – 2.55)**		
	>1	1.60	(0.95 – 2.73)		
HIRI-MSM: # Insertive CAS with HIV+ Male P6M					
	0–4	1.00		Not selected	
	>=5	**2.86**	**(1.46 – 5.61)**		
HIRI-MSM: Used meth or speed, P6M					
	No	1.00		1.00	
	Yes	0.70	(0.48 – 1.03)	0.63	(0.39 – 1.0002)
HADS Anxiety					
	Normal/Mild	1.00		Not selected	
	Moderate/Severe	0.80	(0.61 – 1.05)		
Sensation Seeking Scale Score (α=0.73) (Continuous)		**1.05**	**(1.01 – 1.08)**	**1.04**	**(1.001 – 1.07)**

Bolded text OR and aOR indicates statistical significance at $p < 0.05$; **CAS::** Condomless anal sex; **P6M:** In Previous Six Months;

HIRI-MSM: HIV Incidence Risk Index for Men who have Sex with Men

Table III.

Univariable and multivariable associations with reporting PrEP awareness versus not for HIV-positive gbMSM

	Univariable		Multivariable	
	OR	**95% CI**	**aOR**	**95% CI**
Annual Income (CAD)				
<30K	1.00		Not selected	
30–60K	1.47	(0.86 – 2.51)		
60K+	1.43	(0.59 – 3.50)		
Ethnicity				
Caucasian	1.00		1.00	
Asian	1.23	(0.45 – 3.36)	0.73	(0.28 – 1.91)
Aboriginal	**0.19**	**(0.08 – 0.48)**	**0.32**	**(0.13 – 0.77)**
Latino	0.94	(0.23 – 3.82)	0.93	(0.24 – 3.57)
Other	2.91	(0.57 – 14.80)	3.24	(0.48 – 22.07)
Sexual Orientation				
Gay	1.00		Not selected	
Bisexual	**0.35**	**(0.15 – 0.80)**		
Other	1.06	(0.41 – 2.74)		
Education				
No more than high school	1.00		1.00	
Greater than high school	**3.83**	**(2.22 – 6.63)**	**2.57**	**(1.48 – 4.44)**
Relationship Open				
No/Married	1.00		Not selected	
Yes	0.95	(0.49 – 1.85)		
No current partner	**0.57**	**(0.33 – 0.98)**		
Always Use Condoms as HIV Prevention Strategy				
No	1.00		Not selected	
Yes	0.68	(0.45 – 1.04)		
Viral Load Sorting as HIV Prevention Strategy				
No	1.00		1.00	
Yes	**2.15**	**(1.46 – 3.15)**	**1.83**	**(1.21 – 2.75)**
Withdrawal as HIV Prevention Strategy				
No	1.00		Not selected	
Yes	1.34	(0.85 – 2.11)		
Ask Partners' Status as HIV Prevention Strategy				
No	1.00		Not selected	
Yes	1.44	(0.99 – 2.09)		
CAS with serodiscordant/unknown HIV-status Partner, P6M				
No	1.00		Not selected	
Yes	**1.77**	**(1.19 – 2.63)**		
HIRI-MSM: How Old Are You?				
≥49	1.00		1.00	

	Univariable		Multivariable	
	OR	**95% CI**	**aOR**	**95% CI**
41–48	0.82	(0.48 – 1.39)	0.83	(0.49 – 1.42)
29–40	1.13	(0.59 – 2.18)	**2.20**	**(1.09 – 4.47)**
18–28	0.95	(0.25 – 3.52)	1.78	(0.42 – 7.55)
HIRI-MSM: Receptive CAS, P6M				
No	1.00		1.00	
Yes	**1.79**	**(1.22 – 2.63)**	**1.74**	**(1.13 – 2.69)**
HIRI-MSM: # of HIV+ Male Sex Partners, P6M				
0	1.00		Not selected	
1	**1.66**	**(1.06 – 2.62)**		
>1	1.24	(0.78 – 1.98)		
HIRI-MSM: Used meth or speed, P6M				
No	1.00		1.00	
Yes	**0.63**	**(0.40 – 0.98)**	**0.52**	**(0.32 – 0.86)**
Gave Someone Else Drugs for Sex				
No	1.00		Not selected	
Yes, in P6M	0.66	(0.31 – 1.39)		
Yes, not in P6M	0.30	(0.07 – 1.23)		
Received Drugs for Sex				
No	1.00		1.00	
Yes, in P6M	**0.37**	**(0.19 – 0.70)**	**0.46**	**(0.22 – 0.95)**
Yes, not in P6M	0.41	(0.11 – 1.50)	0.42	(0.10 – 1.75)
Used Cocaine, P6M				
No	1.00		Not selected	
Yes	0.65	(0.40 – 1.07)		
Ask HIV Status Frequency				
0% of the time	1.00		Not selected	
less than 25% of the time	0.92	(0.53 – 1.61)		
25–49% of the time	1.23	(0.63 – 2.40)		
50–74% of the time	1.04	(0.50 – 2.16)		
75–99% of the time	**2.04**	**(1.06 – 3.92)**		
100% of the time	1.18	(0.70 – 2.00)		
Past History of STI				
No	1.00		1.00	
Yes	0.61	(0.36 – 1.03)	**0.54**	**(0.30 – 0.96)**
Self- Assessed Lifetime Likelihood of Transmission				
Unlikely - <40%	1.00		1.00	
Somewhat Likely - 40–60%	0.86	(0.45 – 1.62)	0.94	(0.49 – 1.84)
Likely - > 60%	**0.11**	**(0.03 – 0.36)**	**0.12**	**(0.03 – 0.39)**
HADS Depression				
Normal/Mild	1.00		Not selected	
Moderate/Severe	0.64	(0.33 – 1.23)		

	Univariable		Multivariable	
	OR	**95% CI**	**aOR**	**95% CI**
Sensation Seeking Scale Score (α=0.73)	**1.10**	**(1.04 – 1.16)**	**1.11**	**(1.05 – 1.17)**

Bolded text OR and aOR indicates statistical significance at $p < 0.05$; **CAS:** Condomless anal sex; **P6M:** In Previous Six Months;

HIRI-MSM: HIV Incidence Risk Index for Men who have Sex with Men