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Elevated HIV prevalence and correlates of PrEP use among a community sample of Black men who have sex with men

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Abstract

Background: The HIV epidemic among Black men who have sex with men (BMSM) demands urgent public health attention. Pre-Exposure Prophylaxis (PrEP) is a highly efficacious option for preventing HIV, but characteristics of PrEP use among community samples of BMSM are not well-understood.

Methods: A serial cross-sectional survey assessment (N=4,184 BMSM reporting HIV negative/unsure status) and HIV testing were conducted at Black Gay Pride events in six US cities in 2014, 2015, 2016, and 2017.

Results: HIV prevalence was higher among BMSM self-reporting current PrEP use (1 out of 3 participants) than BMSM not self-reporting current PrEP use (1 out of 5 participants) (32.3%, N=103/319 vs. 20.0%, N=639/3,193, aOR=1.68, 95%CI=1.31-2.15). BMSM reporting current PrEP use (N=380) were more likely to report having a greater number of male sex partners (aOR=1.02, 95%CI=1.01-1.03), a STI diagnosis (aOR=2.44, 95%CI=1.88-3.16), and stimulant drug use (aOR=2.05, 95%CI=1.21-3.47) when compared to BMSM not reporting current PrEP use (N=3,804). PrEP use increased from 4.7% (2014) to 15.5% (2017) (aOR=1.19, 95%CI=1.13-1.25). Among PrEP users, inability to afford health care coverage was associated with testing HIV positive (aOR=2.10, 95%CI=1.24-3.56).

Conclusion: The high prevalence of HIV infection among BMSM reporting PrEP use is concerning. It does not, however, challenge the efficacy of PrEP itself but rather the uptake of the surrounding preventative package including behavioral risk reduction support, STI treatment, and medication adherence counseling. Further research to understand barriers to fully effective PrEP are needed in order to guide operational and behavioral interventions that close the gap on incident infection.

Keywords: PrEP; Black/African American; Men who have sex with men; HIV prevalence

The HIV epidemic among Black men who have sex with men (BMSM) is alarming and demands urgent public health attention. BMSM account for the largest proportion of new HIV diagnoses in the United States. Additionally, while rates of HIV have decreased or remained stable among most groups, rates of HIV among BMSM between 25-34 have increased[1]. Further, by the age of 40, it is estimated that 60% of BMSM will be living with HIV if current epidemiological trends continue[2].

Pre-Exposure Prophylaxis (PrEP) for HIV prevention has demonstrated efficacy for preventing HIV transmission[3], and therefore, has the potential to greatly impact the HIV epidemic among BMSM. Challenges, however, to PrEP implementation and uptake have emerged[4-6]; PrEP requires access to comprehensive health care, and adherence to PrEP is of critical importance for HIV prevention effectiveness[7,8]. Understanding use of PrEP among BMSM is imperative for reducing the health related disparities observed among this group. Although interest among BMSM in using PrEP is high, uptake has been low compared with MSM of other races[9].

In general, much of what is understood about PrEP use is limited to clinical trials and, therefore, little is known regarding how PrEP is being used among community samples of BMSM. Moreover, the limited uptake of PrEP has impeded our ability to assess and understand factors correlated with its use in naturalistic settings[9]. Likewise, it is unclear if PrEP is reaching those who are in greatest need, for example, individuals who report sexual risk taking and correlates of risk such as substance use, transactional sex, and sexually transmitted infection (STI) diagnosis[10]. Given the strength of PrEP as a prevention tool, we must better understand PrEP use patterns among large samples of BMSM.

Study Objectives

The focus of the current study was to assess and evaluate variables associated with PrEP use in a large, community-based sample of BMSM. The specific study objectives included (1) assessing the level of PrEP awareness and use, (2) evaluating sociodemographics, HIV testing histories, sex behavior histories, substance use, and STI diagnosis by PrEP use status, and (3) assessing HIV prevalence among BMSM reporting current PrEP use and non-use.

METHODS

Sampling, recruitment, and enrollment

Data from the current study were collected by the Promoting Our Worth, Equality, and Resilience (POWER) Study Team. The study included a multi-US city, serial cross-sectional survey assessment conducted at Black Gay Pride events occurring in 2014 (*N*=1,117), 2015 (*N*=1,440), 2016 (*N*=1,129), and 2017 (*N*=498). The cities included Philadelphia, PA, Detroit, MI, Washington, DC, Atlanta, GA, Houston, TX, and Memphis, TN. At each Black Gay Pride the POWER Study Team identified official events and randomly selected events for recruitment.

For each event, an intercept zone was established. As individuals entered into this intercept zone they were counted, approached, and invited to participate in the study.

Study activities included an audio computer-assisted self-interview (ACASI) survey, and a subset of participants opted to partake in HIV testing. Survey assessments were anonymous and took approximately 20 minutes to complete. Participants were compensated $10 for survey completion. Using a unique code (based on a sequence of letters and numbers from their name, a family member's name, birthdate, and state of birth[11]), participants completing more than one survey assessment were identified. Only the most recent survey was retained.

All participants were offered confidential HIV testing, which occurred after completion of the survey assessment. HIV testing, including counseling and referral, was provided on site by a local community based organization partnered with the POWER Study Team. Testing kits varied by agency and included Oraquick (OraSure Technologies, Inc., Bethlehem, PA), Clearview STAT-PAK (Alere Inc., Waltham, MA), and INSTI (bioLythical Laboratories, Richmond, BC) HIV tests. Participants declining confidential HIV testing were asked if they would provide an anonymous saliva sample for HIV testing for surveillance purposes only. All HIV test results were linked to the electronic assessment using a unique subject identification. Participants were compensated an additional $10 for HIV testing. All study procedures were approved by the University of Pittsburgh Institutional Review Board.

Participants were eligible to participate if they (a) were aged 18 years of age or older, (b) identified as male or transfemale, and (c) reported having a male sex partner in their lifetime. Participants interested in study activities were screened via electronic tablet for eligibility. Eligible participants were provided informed consent. In total, 13,396 individuals were approached; 44.89% of those approached (*N*=6,015) agreed to screening, and 97.37% of

screened participants completed a questionnaire (*N*=5,857). Participants reporting living with HIV (*N*=1,006), transgender identity (*N*=152, to be addressed separately from BMSM), non-identification with Black/African American race/ethnicity (*N*=217), or with missing PrEP use data (*N*=4), and repeated surveys (*N*=294) were removed from analyses, leaving a final, analytic sample size of *N*=4,184.

Measures

Socio-demographic variables. Participants were asked their age, highest level of education (high school or less/some college or more), current gender identity (male, transgender female), sexual orientation (gay/same gender loving, bisexual, other sexual identity, heterosexual), employment status (employed/unemployed), residential stability (yes/no), income (< or ≥$30,000), and relationship status (partnered, single, and other). Participants also completed the Center for Epidemiologic Studies Short Depression Scale (CES-D 10) containing 10 items[12].

Health care factors. Health care related questions included whether the participant had current health care coverage (*yes/no*), if they were able to afford health care (*yes/no*), and if they had a place to go when in need of health care (*yes/no*).

HIV testing results and history. Participants reported whether they had tested for HIV in the past six months (*yes/no*), how many times they tested for HIV in the past two years, and the results of their most recent HIV test (*negative/positive/unknown*). HIV test results from in-field testing were also reported.

Pre-Exposure Prophylaxis awareness and use. Participants were asked the following about PrEP use: "Have you ever heard of PrEP (pre-exposure prophylaxis)? PrEP is when HIV-negative people take anti-HIV medications (anti-retrovirals like Truvada) BEFORE HAVING SEX to prevent HIV infection." and "Are you currently taking anti-HIV medications (PrEP) to prevent HIV infection?"[13,14]. Participants reporting current PrEP use were also asked whether they had: (1) received PrEP from a health care provider, (2) from someone other than a health care provider (*e.g.*, friend, sex partner), (3) purchased PrEP online, and/or (4) received PrEP via other, unspecified sources. Responses included a dichotomous '*yes/no*'.

Sex behavior and sexually transmitted infections. Participants reported on the number of male anal sex partners (total, receptive, and insertive) from the past year, and how often condoms were used during receptive and insertive anal sex (never/less than half the time/about half the time [denoted as *Never/sometimes* in table for interpretation] and more than half the time/always [denoted as *Always/almost always* in table for interpretation]). Participants reported on whether they had received items (*e.g.*, money, drugs, or other goods) in exchange for sex with a male partner in the past year. STI diagnoses was assessed by asking participants if they had tested positive for gonorrhea, chlamydia, syphilis, or other STI in the past year (yes/no).

Substance use. Use of marijuana, amyl nitrates, stimulants (cocaine, crack, methamphetamine, ecstasy), erectile dysfunction medications, heroin, and opiates in the past three months were asked (*yes/no*). Items from the CAGE alcohol screening questionnaire[15] (*i.e.*, others suggest you cut down drinking, others criticize drinking, feel guilty about drinking, and need a drink in morning *[yes/no]*) and heavy episodic drinking (5 or more drinks in one occasion [0=*never*-7=*more than once a day*]) were also included in the assessment.

Data Analysis

Socio-demographic data, including age, education, sexual orientation identity, employment status, income, housing stability, relationship status, health care coverage, and HIV testing history, were assessed for statistical association with current PrEP use. Generalized linear modeling with a dichotomous *yes*/*no* outcome was specified in binary logistic models. Bivariate and multivariable analyses were conducted to determine whether variables of interest were associated with current PrEP use. Bivariate analyses were also performed to analyze variables associated with testing HIV positive among PrEP users. Variables were entered into the multivariable model if they were related to PrEP use in the bivariate analysis ($p<.01$) and did not result in multicollinearity. Given the large sample size, only $p<.01$ was interpreted as significant[16]. All results controlled for city and year of survey assessment, and therefore, findings are reported as adjusted odds ratios (aOR). IBM SPSS Statistics version 20.0 (SPSS Inc., Chicago, IL) was used for all of the analyses.

RESULTS

PrEP Awareness and Use. Across all cities and years, PrEP awareness and PrEP use were reported among 52.4% (*N*=2,194) and 9.1% (*N*=380) of participants, respectively. Date of assessment was significantly, positively associated with PrEP awareness (aOR=1.22, 95%CI=1.19-1.26) and PrEP use (aOR=1.19, 95%CI=1.13-1.25); PrEP awareness increased from 37.2% (2014) to 66.7% (2017), and current PrEP use increased from 4.7% (2014) to 15.5% (2017).

Sociodemographics. Across all participants, the average age was 30.47 (SD=9.69) and a majority of the sample identified as gay/same gender loving (*N*=3,253/77.7%). Most participants reported current employment (*N*=3,271/78.2%). A minority of participants reported residential

instability (*N*=477/11.5%) and incomes <$30,000 (*N*=1,892/45.2%). Health care coverage (*N*=3,494/83.5%) and having a place to go to receive health care (*N*=3,292/78.7%) were frequently reported. Around three-fourths of participants reported their relationship status as single (*N*=3,135/75.7%). Participants reporting current PrEP use were more likely to report residential instability, being in a relationship (as opposed to being single), health care coverage, a place to go for health care, having tested for HIV in the past 6 months, and higher depression scores than individuals not currently on PrEP (Table 1).

In-field HIV testing results. A subsample of participants (*N*=3,512, 84% of both PrEP users and PrEP non-users) elected to engage in HIV testing during study activities. Individuals reporting current PrEP use were more likely to test HIV positive than individuals not reporting current PrEP use (32.3%, *N*=103/319 vs. 20.0%, *N*=639/3,193, aOR=1.68, 95%CI=1.31-2.15, *p*<.001, Table 1). Forty-four percent (*N*=1,579/3,512) of the sample elected to test with a local, community-based partner organization, and therefore, receive their results. The remaining sample (*N*=1,933/3,512) provided POWER Team with an oral mucosal swab for HIV testing for surveillance purposes, and therefore, did not receive results. PrEP users were more likely than non-PrEP users to provide POWER Team with an oral swab for HIV testing (66.3%, *N*=216/319, 55.1%, *N*=1,802/3,804, aOR=1.69, 95%CI=1.32-2.16, *p*<.001) than to test with a local partner.

Variables associated with testing HIV positive among PrEP users. PrEP users who tested HIV positive were more likely to report not being able to afford health care (OR=2.10, 95%CI=1.24-3.56, *p*<.05), not recently testing for HIV (OR=.48, 95%CI=.25-.92, *p*<.05), and having tested for HIV fewer times in the past two years (OR=.70, 95%CI=.55-.88, *p*<.05) than PrEP users who tested HIV negative. There were no differences between groups (HIV positive

vs. HIV negative PrEP users) on demographics, drug use, alcohol use, sex behavior, depression, or STI diagnosis (Table 2).

Sex behaviors. Participants currently using PrEP reported a greater number of male sex partners (M[mean]=6.48, SD[standard deviation]=11.03, M=3.77, SD=6.52), a greater number of receptive anal sex partners (M=2.81, SD =5.39, M=1.78, SD =3.56), and a greater number insertive anal sex partners (M=4.04, SD =6.78, M=2.50, SD =4.74) than participants not using PrEP (Table 3). Further, participants taking PrEP were less likely to report condom use during anal sex, both receptive (*N*=240, 63.2% vs. *N*=2856, 75.1%) and insertive (*N*=250, 65.8% vs. *N*=2,823, 74.2%), than participants not on PrEP. There were no differences in transactional sex across PrEP use groups.

Substance use and sexually transmitted infections. Participants currently taking PrEP were more likely to report marijuana (30% vs. 22%), amyl nitrates (13% vs. 4%), stimulants (16% vs. 6%), erectile dysfunction medications (8% vs. 2%), heroin (6% vs. 3%), and opiate (7% vs. 2%) use in the past three months than non-PrEP users (Table 3). Moreover, participants currently taking PrEP were more likely to report problematic alcohol use (32% vs. 18%, as assessed by CAGE), yet equally likely to report instances of heavy episodic drinking (51% vs. 54%). Rates of STI were higher among participants taking PrEP as compared to participants not taking PrEP. Gonorrhea was most frequently reported (36% vs. 9%), followed by chlamydia (32% vs. 7%), syphilis (26% vs. 5%) and other STI (23% vs. 4%).

Multivariable model of PrEP use. The multivariable model with PrEP use as the outcome demonstrated multiple significantly associated variables (Table 4). Residential instability (aOR=3.28, 95%CI=2.42-4.45), currently having health care coverage (aOR=2.41, 95%CI=1.64-3.56), having tested for HIV in the prior 6 months (aOR=3.83, 95%CI=2.79-5.21), greater

number of male sex partners (aOR=1.02, 95%CI=1.01-1.04), any past year STI diagnosis (aOR=2.43, 95%CI=1.88-3.15), and recent stimulant use (aOR=2.01, 95%CI=1.18-3.15) were all positively associated with a greater likelihood of reporting PrEP use. All other associations were non-significant.

PrEP access. Among a subsample of participants reporting PrEP use (*N*=201/380); items added in latter two years of data collection), PrEP access variables were assessed. Participants using PrEP were most likely to report receipt of PrEP through a prescription from a health care provider (*N*=153, 76.1%). Access was also reported via receipt from someone other than health care provider, including friend or sex partner (*N*=13, 6.5%), receipt from purchasing online (*N*=12, 6.0%), and receipt from an other, unspecified source (*N*=21, 5.5%) (note: participants could choose more than one option to denote how they received PrEP).

DISCUSSION

Findings from the current study are unique in that they come from the largest sample of BMSM collected across multiple US cities to date. Based on the findings, PrEP awareness and use have increased in the years since FDA approval in 2012, yet remain suboptimal. About 1 out of 3 BMSM are unaware of the availability of PrEP, and only 1-2 out of 10 are accessing PrEP. With awareness and use remaining below ideal rates of coverage, it is evident that public health approaches to improving PrEP implementation need to be expanded upon and are insufficient for population-level reductions in HIV incidence[17,18].

Of strong concern is the rate of HIV prevalence among individuals reporting PrEP use. Thirty-two percent of participants self-reporting current PrEP use tested HIV positive during study procedures. It is imperative to recognize that our findings reflect challenges to maintaining

proper usage of PrEP rather than biological failure of PrEP to protect against HIV[19,20]. A preponderance of evidence, including multiple randomized controlled trials[21] with MSM and evaluations of PrEP in clinical practice settings[22] indicates that PrEP is highly effective in reducing likelihood of HIV infection when drug concentration levels consistent with high levels of adherence are maintained. Furthermore, extremely few breakthrough infections have been documented among adherent PrEP users[23]. Thus, HIV infections that have occurred among PrEP users are the result of suboptimal levels of drug concentrations due to challenges in adhering to PrEP medical regimens.

Addressing adherence related concerns must be at the forefront of PrEP delivery. In particular for BMSM, concerns regarding structural and health-system level barriers to PrEP, such as inadequate health care coverage, and stigma and medical mistrust[24], must be integrated into efforts to improve adherence to PrEP regimens[25-28]. Programs to support health care linkage, engagement, and retention while addressing ongoing barriers to adherence are necessary if PrEP benefits are to be fully realized[29]. Emerging forms of PrEP delivery, including injectable antiretrovirals, appear to be preferred to daily dosing among MSM[30], and likely circumvent multiple adherence barriers.

In the current study and similar to prior work[31], PrEP users reported greater sexual risk taking behavior compared with PrEP non-users. This finding is consistent with the aims of prescribing PrEP and suggests that PrEP is reaching those in greatest need among our sample. Further, although it is possible that risk compensation is occurring in response to PrEP use, prior research has not substantiated strong concerns in this area[32-34]. Moreover, individuals not taking PrEP reported, on average, multiple male sex partners and inconsistent condom in the past year. It is, therefore, likely that many BMSM in our sample are potential candidates for PrEP, but are

not accessing this prevention option. Finally, regardless of individual-level sex behaviors, the HIV prevalence rates alone demonstrate the need for widespread, highly adherent PrEP use among the current sample[35].

Of concern in the current study are findings related to STI diagnoses. The presence of a STI is one of the strongest predictors of subsequent HIV seroconversion[36]. Rates of STI were elevated among PrEP users, in particular. It is likely that rates of self-reported STI are high, in part, due to increased likelihood of STI testing that is inclusive of PrEP care. It is, however, also possible that STI rates were elevated among PrEP users due to their relatively greater likelihood of engaging in sex behaviors, and therefore, increased potential exposure to STI. Current CDC guidelines advise testing for STIs every six months for individuals on PrEP[37]. Given the high rates of STIs reported and the relationship between STI and HIV seroconversion, more frequent STI testing must be considered as part of standard PrEP care[38].

Current PrEP users were more likely to report residential instability and recent drug use than non-PrEP users, with stimulants (*i.e.*, cocaine, methamphetamines, and ecstasy) being of particular concern. The negative impact of drug use, in particular stimulant use[39,40], on medication adherence among people living with HIV (PLWH) is well established[41]. Less is known, however, about the impact of drug use on PrEP use behavior, and patterns of use may or may not be similar to what we have observed among PLWH. Of note, recent substance use, but not necessarily substance abuse disorders has been associated with poor medication adherence among PLWH[42]. This pattern is potentially noteworthy in understanding PrEP use, as PrEP users were more likely than non-users to report recent substance use (*e.g.*, drug use), but equally likely to report a history of substance use dependency (*i.e.*, CAGE screening scores). Residential instability is related to substance use, sexual risk taking, and HIV transmission among MSM[43,44],

and residential instability has been found in prior work to be related to increased PrEP awareness[45]. Although the exact nature of the relationship between residential instability and higher likelihood of PrEP use is unknown, it is possible that residential instability is part of a broader pattern of greater risk for HIV, and therefore, increased need for PrEP.

Although a majority of the sample reported receipt of PrEP via prescription from a health care provider, a substantial minority of participants reported other avenues of receipt. These other avenues included receiving PrEP from a sex partner or friend, purchasing PrEP online, and from other, unspecified sources. With around 1 out of 4 PrEP users, in the current study, reporting receipt of PrEP outside of a healthcare provider, concerns regarding the monitoring of various health markers consistent with standard PrEP care (e.g., routine HIV/STI testing and kidney function) are great. Likewise, receipt of PrEP from a health care provider does not necessarily denote adequate engagement in health care.

Our understanding of how individuals are using PrEP outside of clinical trials is limited. Although findings regarding prevalence of current PrEP use are similar to other large sampling studies of PrEP behaviors among MSM[46,47], our study is among the first to link these patterns of PrEP use to biological outcomes in an ecologically valid environment. The current findings, in sum, should be interpreted as a call-to-action for public health and medical officials to carefully monitor the roll-out and impact of PrEP[48]. Likewise, inability to afford health care and less frequent HIV testing were associated with testing HIV positive among PrEP users. Without addressing health care access related barriers to PrEP, we will observe a sharper increase[49] in HIV-related health disparities. On the whole, our findings demonstrate that comprehensive care engagement among individuals accessing PrEP must be prioritized in order to seek the greatest benefit from this prevention tool[4].

Limitations

The current study offers multiple strengths for providing an understanding of PrEP use among individuals who are at highest risk for HIV in the US. Results, however, must be interpreted in light of limitations. Our methodology relied on recruitment of participants from Black Gay Pride events across the US, and therefore, findings may not be generalizable to BMSM who would not attend such events. It is, however, important to note that many events occurred in expansive urban green spaces where attendance does not necessarily confer participation in Black Gay Pride. Data were collected from 6 US cities, and although cities varied in size, HIV epidemiology, and US regions, the selected cities may not be generalizable across US cities. With the exception of HIV testing, all data relied on a self-report assessment which is prone to social desirability bias and errors in recall.

Conclusions

Overall, the findings demonstrate that strong attention needs to be given to how PrEP is being taken-up by individuals at-risk for HIV. Moreover, among individuals testing HIV positive, concerns about drug resistance, viral mutation, and delayed seroconversion when continuing PrEP use during acute HIV infection exist[50]. Based on our data, it is evident that in order to optimize PrEP, comprehensive strategies to following patients prescribed PrEP are needed. Trials of PrEP efficacy and delivery typically include well-resourced approaches to patient engagement including high levels of patient monitoring. In practice, as opposed to research, implementing a comprehensive plan for providing PrEP (*e.g.*, quarterly check-ins, adherence support, sexual risk reduction counseling) poses greater challenges;[48] the barriers to implementing CDC guidelines for PrEP administration must be addressed. PrEP has tremendous

potential to slow the HIV epidemic, but the monitoring of PrEP delivery and uptake must be prioritized in order to maximize its impact.

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Table 1. Sociodemographic variables by PrEP use among BMSM (*N*=4,184) from multiple US cities.

	Current PrEP User				
	No (*N*=3,804)		**Yes (*N*=380)**		
Variable	**N**	**%**	**N**	**%**	**aOR (95%CI)**
Sexual Orientation					
Gay/Same Gender Loving	2950	77.6	303	79.9	
Heterosexual	55	1.4	2	0.5	0.34 (0.08-1.43)
Bisexual	735	19.3	68	17.9	0.91 (0.69-1.21)
Other	63	1.7	6	1.6	0.99 (0.42-2.32)
Employed (yes)	2974	79.2	297	78.2	0.90 (0.69-1.18)
Residential instability in past 12 months (yes)	350	9.3	127	33.4	5.25 (4.10-6.72)***
Income					
<$30,000	1744	46.7	148	39.3	
≥$30,000	1992	53.3	229	60.7	1.31 (1.04-1.64)
Currently have health care coverage? (yes)	3152	82.9	342	90.0	1.84 (1.30-2.62)**
Do you have a place to go for health care needs? (yes)	2961	88.2	331	94.6	2.35 (1.46-3.79)***
In past 12 months, was there a time you needed health care but couldn't afford it? (yes)	696	18.5	120	31.7	2.05 (1.62-2.60)***
Tested for HIV in past 6 months (yes)	2270	59.7	325	85.8	4.20 (3.12-5.65)***
In-field HIV testing (subsample electing to test, *N*=3,512)					
HIV positive	639	20.0	103	32.3	
HIV negative	2554	80.0	216	67.7	1.68 (1.31-2.15)***
Relationship Status					
Partnered	808	21.5	118	31.1	
Single	2881	76.6	254	66.8	0.58 (0.45-0.73)***
Other	74	2.0	8	2.1	0.75 (0.35-1.60)
Monogamous Relationship (only have sex with each other) (yes)	629	77.9	99	84.6	1.51 (.88-2.58)
Number of times tested for HIV in the past two years					
0	674	17.7	37	9.7	
1-2	1304	34.3	89	23.4	1.69 (1.51-1.89)***
3-4	1009	26.5	74	19.5	
5+	817	21.5	180	47.4	
Depression (CESD Score 10≥)	865	22.8	123	32.4	1.56 (1.24-1.97)***
Education level					
High school or less	1047	28.0	130	34.2	1.36 (1.08-1.71)**
Some college or more	2711	72.0	250	65.8	
	M	**SD**	**M**	**SD**	
Age	30.59	10.41	30.04	9.85	0.99 (0.98-1.01)
Note: All analyses controlled for city and year of assessment.					

Table 2. Associations between demographic, health care, sex behavior, substance use, and HIV status test results among PrEP users (*N*=216 tested HIV negative, *N*=103 tested HIV positive).

	HIV test results among PrEP Users (*N*=319) (HIV negative=0, HIV positive=1)
Variable	**aOR (95%CI)**
Employed	1.09 (.59-2.02)
Residential instability in past 12 months	1.11 (.65-1.90)
Income	.81 (.49-1.35)
Current health care coverage	1.51 (.63-3.62)
Have a place to go for health care needs	1.69 (.51-5.61)
Can't afford health care costs	2.10 (1.24-3.56)**
Tested for HIV in past 6 months	.48 (.25-.92)*
Number of times tested for HIV in the past two years	.70 (.55-.88)*
Drug Use	
Marijuana	.96 (.56-1.65)
Amyl nitrates	1.05 (.50-2.21)
Stimulants (crack, cocaine, meth, ecstasy)	1.24 (.63-2.46)
Erectile dysfunction medications	.61 (.21-1.78)
Heroin	.74 (.22-2.52)
Opiates	.93 (.33-2.62)
Alcohol Use	
Problematic alcohol use (CAGE ≥2)	1.06 (.62-1.82)
Heavy Episodic Drinking (12 months)	.78 (.48-1.26)
Sex Behavior (past 12 months)	
Number of male anal sex partners	1.02 (.98-1.02)
Number of partners receptive anal sex	1.01 (.97-1.06)
Condom use during receptive anal sex Always/mostly Sometimes/never	 .94 (.57-1.55)
Number of partners insertive anal sex	.99 (.95-1.03)
Condom use during insertive anal sex Always/mostly Sometimes/never	 1.58 (.93-2.67)
STI (past 12 months)	
Gonorrhea	1.09 (.65-1.83)
Chlamydia	1.03 (.60-1.76)
Syphilis	1.74 (.98-3.07)
Other STI	1.25 (.69-2.28)
Mental Health	
Depression	1.04 (.61-1.77)
Note: All analyses controlled for city and year of assessment.	

Table 3. Sex behavior, substance use, and STI variables by PrEP use among BMSM (*N*=4,184) from multiple US cities.

	Current PrEP User				
	No (*N*=3,804)		Yes (*N*=380)		
Variable	**M**	**SD**	**M**	**SD**	**aOR (95%CI)**
Sex Behavior (past 12 months)					
Number of male anal sex partners	3.77	6.52	6.48	11.03	1.04 (1.03-1.05)***
Number of partners receptive anal sex	1.78	3.56	2.81	5.39	1.05 (1.03-1.07)***
Number of partners insertive anal sex	2.50	4.74	4.04	6.78	1.05 (1.03-1.06)***
	N	**%**	**N**	**%**	
Condom use during receptive anal sex					
Always/mostly	2856	75.1	240	63.2	.60 (.48-.75)***
Sometimes/never	946	24.9	140	36.8	
Condom use during insertive anal sex					
Always/mostly	2823	74.2	250	65.8	.71 (.57-.89)***
Sometimes/never	981	25.8	130	34.2	
Received goods for sex with male partner	196	5.2	32	8.4	1.65 (1.10-2.45)
Drug use (past 3 months)					
Marijuana	836	22.1	113	29.8	1.48 (1.16-1.87)**
Amyl nitrates	154	4.1	49	13.0	3.79 (2.67-5.36)***
Stimulants (crack, cocaine, meth, ecstasy)	215	5.7	60	15.8	3.58 (2.60-4.92)***
Erectile dysfunction medications	77	2.0	32	8.4	4.99 (3.22-7.75)***
Heroin	50	1.3	24	6.3	5.57 (3.34-9.29)***
Opiates	83	2.2	28	7.4	4.14 (2.62-6.52)***
Alcohol Use					
Problematic alcohol use (CAGE ≥2)	699	18.4	120	31.6	2.11 (1.66-2.67)***
Heavy Episodic Drinking (12 months)	2067	54.5	194	51.1	0.91 (.74-1.13)
STI (past 12 months)	N	%	N	%	
Gonorrhea	345	9.1	138	36.3	5.66 (4.45-7.20)***
Chlamydia	246	6.5	121	31.8	6.90 (5.33-8.92)***
Syphilis	189	5.0	97	25.5	6.42 (4.86-8.49)***
Other STI	159	4.2	88	23.2	7.13 (5.32-9.57)***
[a]*Note*: All analyses controlled for city and year of assessment.					

Table 4. Multivariable analyses with PrEP use outcome among BMSM (*N*=4,184) from multiple US cities.

Variable	**PrEP Use aOR (95%CI)**
Education	.94 (.85-1.01)
Residential instability in past 12 months	3.28 (2.42-4.45)***
Currently have health care coverage?	2.41 (1.64-3.56)***
Tested for HIV in past 6 months	3.83 (2.79-5.25)***
CESD Score	1.00 (0.97-1.02)
Number of male anal sex partners	1.02 (1.01-1.04)***
Condom use during receptive anal sex	1.22 (0.91-1.63)
Condom use during insertive anal sex	1.01 (0.75-1.34)
Any STI	2.43 (1.88-3.15)***
Marijuana	0.89 (0.65-1.20)
Amyl nitrates	1.44 (0.83-2.50)
Stimulants (crack, cocaine, meth, ecstasy)	2.01 (1.18-3.39)*
Erectile dysfunction medications	1.57 (0.74-3.33)
Heroin	0.86 (0.33-2.22)
Opiates	0.76 (0.33-1.74)
Problematic alcohol use (CAGE ≥2)	1.09 (0.81-1.48)
Note: All analyses controlled for city and year of assessment.	