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Knowledge of Pre-exposure Prophylaxis (PrEP) for HIV Prevention Among Men Who Have Sex with Men in Denver, Colorado

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Abstract

As part of the National HIV Behavioral Surveillance System among men who have sex with men (MSM) in Denver, Colorado, we assessed knowledge of pre-exposure prophylaxis (PrEP); willingness to use PrEP; and potential changes in risk behaviors among HIV-negative participants reporting sexual activity with a male partner in the preceding 12 months. We examined knowledge of PrEP before (2008) and after (2011) results of the iPrEx trial were available. Of the 425 participants in the 2008 sample, 91 (21 %) were aware of PrEP compared to 131 (28 %) of the 461 participants in the 2011 sample (adjusted prevalence ratio: 1.43, 95 % confidence interval: 1.18, 1.72). Despite the increase in 2011, few MSM in Denver were aware of PrEP. Educating high-risk MSM about the potential utility of PrEP as an adjunct to other effective prevention methods is needed when considering the addition of PrEP to the HIV prevention arsenal.

Keywords

Behavioral surveillance; Men who have sex with men; Pre-exposure prophylaxis

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Introduction

Pre-exposure prophylaxis (PrEP) with antiretroviral therapy has emerged as a promising biomedical strategy for preventing human immunodeficiency virus (HIV) infection [1–7]. Recently completed clinical trials evaluating the safety and efficacy of daily oral doses of tenofovir disoproxil fumarate (TDF), marketed as Viread, and a combination of TDF and emtricitabine (FTC), marketed as Truvada, in men who have sex with men (MSM) and heterosexually active men and women have shown the benefit of tenofovir-based PrEP for preventing new HIV infection [8–10]. The iPrEx trial was the first of these trials to release results (November 2010) and showed that once daily oral TDF–FTC provided a 44 % reduction in HIV incidence among MSM [10]. In July 2012, the U.S. Food and Drug Administration approved the TDF–FTC combination pill for PrEP [11]. The Centers for Disease Control and Prevention (CDC) has issued interim guidance for the safe and effective use of PrEP among MSM, heterosexually active adults, and persons who inject drugs [12–14].

The effectiveness of PrEP for HIV prevention is dependent on people's awareness of PrEP, its uptake, and behaviors related to taking PrEP (e.g. medication adherence, change in risk behaviors) [15, 16]. In the United States, MSM are disproportionately affected by HIV and are, therefore, a priority population for PrEP. Several surveys of MSM, conducted before the iPrEx trial results were available, showed that knowledge and use of PrEP were limited among MSM [17–20]. In a sample of high-risk substance-using MSM from four major U.S. cities, non-prescribed PrEP use was reported by 2 % of HIV-negative respondents, and less than 3 % of HIV-positive respondents reported giving the drug to their sex partners [21]. Among 227 HIV-negative MSM surveyed in Boston, 74 % reported a willingness to use PrEP in the future after being educated about its potential for HIV prevention [19]. An equally important question is whether MSM who are willing to take PrEP might alter their HIV risk behaviors and engage in risk compensation (e.g., decrease condom use or increase number of sex partners). In a sample of 180 HIV-negative high-risk MSM in New York City, 35 % of those who would use PrEP reported that they would likely decrease condom use while using PrEP [22].

To add to the knowledge base regarding awareness of and possible future uptake of PrEP, we assessed knowledge of, and attitudes towards, daily oral PrEP for HIV prevention in two samples of urban MSM recruited through the National HIV Behavioral Surveillance System (NHBS) in Denver, Colorado. One sample was recruited in 2008 prior to the release of the iPrEx trial results and the second sample was recruited in 2011, after the iPrEx results were made public. Our goal was to characterize those likely to accept PrEP and to examine differences in PrEP knowledge and acceptance during the two time periods.

Methods

National HIV Behavioral Surveillance System (NHBS)

NHBS is a CDC-funded behavioral surveillance system conducted through annual rotating cycles of surveys and HIV testing targeting one of three populations at high risk for acquiring HIV: MSM, persons who inject drugs, and heterosexuals at increased risk for HIV

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infection. NHBS data are used to monitor prevalence and trends in HIV-related risk and testing behaviors and access to HIV prevention services [23]. During the MSM cycles, local surveillance staff conduct venue-based, time-space sampling following the national NHBS protocol, which organizes sampling activities into three components. First, staff conduct formative research to identify the venues, times, and methods to recruit MSM. Next, staff construct sampling frames of eligible venues and venue-specific, daytime periods that meet MSM attendance, logistical, and safety eligibility criteria. A calendar of sampling events is constructed by randomly selecting venues and day-time periods from the sampling frame. CDC is in the process of developing weights to account for variations in venue attendance and likelihood of being selected for NHBS participation. The final component of venue-based time-space sampling involves recruiting and interviewing men during sampling events.

In Denver, sampling events were conducted between August and November 2008 for the second NHBS cycle among MSM (NHBS-MSM2) and between August and November 2011 for the third cycle of MSM (NHBSMSM3). During each 4-h sampling event, NHBS field staff approached men at selected venues to assess eligibility. Selected venues included bars, dance clubs, bathhouses, parks, and local grocery stores. The venues at which sampling events took place remained largely unchanged between the 2008 and 2011 MSM cycles. For both cycles, all potential participants had to be: (1) born male (2) approached by study staff at the sampled venues, (3) 18 years or older, (4) residents of the Denver metropolitan statistical area, (5) not previously completed an interview for the current NHBS-MSM cycle, (6) able to complete the survey in English or Spanish, and (7) able to provide informed consent. Neither sexual orientation nor same-sex behaviors were eligibility criteria. All NHBS activities were voluntary and anonymous. Verbal informed consent was obtained from eligible participants. Participants were also offerred HIV testing.

Pre-Exposure Prophylaxis (PrEP) Supplement

Participants completed an interviewer-administered behavioral risk survey using handheld computers. The behavioral risk survey included questions about sexual behaviors, substance use, STI history, and HIV testing. In addition to the behavioral risk survey, which is a standardized questionnaire used across all NHBS sites, participants completed a shorter local questionnaire. In Denver, a PrEP-specific supplemental questionnaire was included during the 2008 (NHBS-MSM2) and 2011 (NHBS-MSM3) cycles to assess knowledge of PrEP; willingness to use PrEP if the clinical trials showed few or no side effects; willingness to use PrEP if the clinical trials showed PrEP prevents HIV infection in 75 and 50 % of people who take it daily; and potential risk compensation, including intentions to have sex with more partners or use condoms less frequently if PrEP were found to be effective.

To introduce the concept of PrEP, the following statement was read to participants: “Scientists are currently doing studies to find new ways of preventing people from becoming infected with HIV. In these studies, people take a pill every day that contains the same medicine that is used to treat people who are infected with HIV. Scientists want to know if taking this medicine will prevent people exposed to HIV from becoming infected with it. They call this method pre-exposure prophylaxis or PrEP.” Participants were then asked if

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they had ever heard of PrEP. This was followed by the question: “imagine that PrEP was available today. If studies showed that PrEP has few or no side effects, would you be willing to take PrEP pills every day to try to protect yourself from becoming infected with HIV?” If participants responded in the affirmative to this question, they were asked “If these studies also showed that PrEP prevents HIV infection in three-quarters or 75 % of the people who take it daily, would you be willing to take PrEP pills every day to try to protect yourself from becoming infected with HIV?” If their response was in the affirmative, they were asked the same question but specifying 50 % rather than 75 % effectiveness. The wording of the questions remained the same during both cycles.

Statistical Analysis

The current analysis was restricted to participants who reported having had oral or anal sex with a man in the preceding 12 months and who did not report being HIV-positive. Descriptive frequencies are presented for each sample. χ^2 statistics were calculated to compare the two samples from 2008 and 2011. We also generated a multivariable model using a generalized linear model with log link and binomial error distribution to assess the primary association between knowledge of PrEP and year of data collection, controlling for characteristics that differed significantly between the two samples. To account for potential correlation of observations within venues, a robust variance estimator was calculated [24]. Unadjusted and adjusted prevalence ratios (PR) and associated 95 % confidence intervals (CI) are presented. As a final step, comparisons between participants who reported knowledge of PrEP and those who did not were made using Chi square (χ^2) statistics separately for each sample. Fisher's exact test was calculated when minimum expected frequency requirements were not met. All analyses were conducted using Stata Version 12.0 (StataCorp, College Station, TX).

Results

2008 NHBS-MSM2 Results

Between August and November 2008, 735 men were screened for the NHBS-MSM2 survey in Denver, Colorado. Of these men, 503 were eligible for NHBS and completed the PrEP supplemental questionnaire. After excluding men who did not have sex with a man in the previous 12 months and those who reported being HIV positive, the resulting sample size was 425. Of the 425 participants included in the analysis, almost two-thirds (63 %) described their race/ethnicity as non-Hispanic white, 3 % identified as non-Hispanic black, 26 % as Hispanic, and the remaining 7 % described themselves as Asian, Pacific Islander, American Indian/Alaskan Native or other race/ethnicity (Table 1, NHBS-MSM2). Almost two-thirds (66 %) of participants were over the age of 30 years, 73 % had more than a high school education, and 52 % reported an annual income of $40,000 or more. A little less than one-fourth (22 %) of participants reported living with a man they considered to be a boyfriend, spouse, significant other, or life partner. More than three-quarters of participants (77 %) reported two or more male sexual partners during the past 12 months and 37 % reported at least one act of unprotected anal intercourse during the past 12 months.

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A total of 91 (21 %) participants reported that they had ever heard of PrEP before their interview (Table 2, NHBSMSM2). Two-thirds of participants (66 %) reported that they would take PrEP every day if studies showed no side effects. The proportion of men in Denver reporting their willingness to take PrEP daily if shown to be 75 and 50 % effective was 60 and 45 %, respectively. Prior to the release of the iPrEX trial results, the majority of participants did not anticipate changing either their condom use (85 %) or the number of sex partners (92 %) if they were taking PrEP every day.

2011 NHBS-MSM3 Results

Between August and November 2011, 678 men were screened for NHBS-MSM3. Of these men, 527 were eligible for NHBS and completed the PrEP supplemental questionnaire. After excluding men who did not have sex with a man in the previous 12 months and those who reported being HIV positive, the resulting sample size was 461. Slightly more than half (54 %) of the 461 participants described their race/ethnicity as non-Hispanic white, 11 % identified as non-Hispanic black, 27 % as Hispanic, and the remaining 8 % described themselves as Asian, Pacific Islander, American Indian/Alaskan Native or other race/ethnicity (Table 1, NHBS-MSM3). Almost two-thirds (62 %) of participants were over the age of 30 years, 76 % had more than a high school education, and 43 % reported an annual income of $40,000 or more. In the 2011 sample, one-fifth (20 %) of participants reported living with a man they considered to be a boyfriend, spouse, significant other, or life partner. A large majority (80 %) of participants reported two or more male sexual partners during the past 12 months and 36 % reported at least one act of unprotected anal intercourse during the past 12 months.

In the 2011 sample, a total of 131 (28 %) participants reported that they had heard of PrEP before their interview (Table 2, NHBS-MSM3). Compared to 66 % of the sample in 2008, 62 % of participants in the 2011 sample reported that they would take PrEP every day if studies showed no side effects. In 2011, the proportions of men reporting their willingness to take PrEP at different levels of effectiveness was also slightly lower with 56 % of men reporting willingness to take PrEP every day if shown to be 75 % effective and 44 % willing to take daily PrEP if shown to be 50 % effective. Post iPrEx trial results being released, a slightly higher proportion of men in the 2011 sample reported some anticipated changes in behavior with 11 % reporting less frequent condom use and 10 % reporting more condom use. Similarly, a higher proportion of the 2011 sample reported a change in anticipated number of partners with 8 % anticipating fewer partners and 6 % anticipating more partners. This increase is compared to the 2008 sample where 3 % anticipated having fewer partners and 4 % anticipated having more partners ($\chi^2 = 12.59$, $P = 0.002$).

Multivariable Modeling Results

Among participants in the 2011 sample, 131 (28 %) had heard of PrEP compared with 91 (21 %) participants in the 2008 sample (crude PR: 1.32, 95 % CI: 1.07, 1.65; Table 3). Accounting for potential clustering within each venue and the potentially confounding effects of race/ethnicity, age, income, anticipated changes in condom use and number of partners as these factors differed between the two samples, participants in the 2011 sample were 43 % more likely to have heard of PrEP (adjusted PR: 1.43, 95 % CI: 1.18, 1.72).

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Within Sample Comparison Results

In both samples, knowledge of PrEP differed significantly by income level (Table 4). In the 2008 sample, among participants who had heard of PrEP 65 % reported an annual income of $40,000 or more, 24 % reported an annual income between $20,000 and $39,000, and 11 % reported an annual income of $19,999 or less ($\chi^2 = 9.23$, $P = 0.01$). In the 2011 sample, among participants who had heard of PrEP 55 % reported an annual income of $40,000 or more, 21 % reported an annual income between $20,000 and $39,000, and 24 % reported an annual income less of $19,999 or less ($\chi^2 = 10.66$, $P = 0.005$).

Discussion

PrEP's potential impact on averting new HIV infections will depend on several factors including knowledge of, access to, and adherence to daily medication. We measured knowledge of, attitudes towards, and intentions to use daily oral PrEP for HIV prevention under hypothetical conditions of efficacy in two samples of MSM in Denver, Colorado before and after the iPrEx trial results were released. Similar to other surveys of MSM conducted before iPrEx trial results became available, we found limited knowledge of PrEP among NHBS-MSM participants in 2008, with higher levels of knowledge among NHBS-MSM participants in 2011 [17–20]. Our results are also similar to more recent surveys of MSM regarding PrEP awareness after the release of the iPrEx trial results that continue to show limited awareness of PrEP among those most likely to benefit from its uptake [25–27].

Our findings show that, even under hypothetical conditions of few or no side effects and high effectiveness, nearly half of participants would be opposed to taking PrEP on a daily basis. Willingness to consider using PrEP varied by level of protection provided, with less than half of MSM in both the 2008 and 2011 samples willing to use PrEP if it was only shown to prevent HIV infection in 50 % of those who took it daily. This level is only slightly higher than the average efficacy found in the iPrEx trial. Higher proportions of MSM in both the 2008 and 2011 Denver samples reported being willing to use PrEP daily if it was shown to prevent HIV infection in 75 % of those who took it daily. The iPrEx trial demonstrates that efficacy greater than 90 % would be possible if PrEP is taken as prescribed [10].

Though our study was not specifically designed to measure gains in knowledge of PrEP as a result of the release of the iPrEx results and publicity, our findings confirm that knowledge of PrEP remains low among those most likely to benefit from its preventative potential, high risk MSM. Furthermore, our findings provide a longitudinal perspective on the change in awareness of PrEP among a convenience sample of MSM and underscore the fact that knowledge of PrEP did not dramatically increase with the release of findings from the definitive PrEP trials. Studies describing potential uptake of PrEP in an era where PrEP is no longer a hypothetical prevention tool are just beginning to amass [28–30]. Gaining a better understanding of reasons why those likely to benefit from PrEP might be reluctant to take daily PrEP will be integral to understanding how to maximize PrEP's contribution to HIV prevention outside of clinical trials. In addition, similar to other recent studies [26], our data suggest that community-level education must be at the heart of any plan to implement or expand the utilization of PrEP in MSM.

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Against the backdrop of CDC's new High-Impact Prevention approach which prioritizes the interventions with the greatest potential to prevent the most new infections and directs efforts to the populations most affected by HIV, it is imperative to continue to monitor attitudes towards new interventions such as PrEP in key populations like MSM. NHBS is a robust national system critical in monitoring trends in HIV risk behavior and can also be leveraged to identify emerging trends by incorporating relevant questions into the local questionnaire. The ability to gather data that are relevant to the local HIV epidemic in a timely and efficient manner across the 20 participating NHBS sites enhances the value of the national system. To continue to monitor knowledge of and attitudes towards PrEP, we plan to include the same questions (with some minor adjustments to the question wording) during NHBSMSM4 which is scheduled to occur in 2014.

Our study is not without limitations. First, because the survey was administered by an interviewer, some participants might not have accurately reported their knowledge or behaviors. Furthermore, asking people to respond to hypothetical scenarios and predict future behaviors or reasons for future behaviors is cognitively difficult and may not correlate well with what happens in practice. However, given that PrEP has demonstrated efficacy to reduce the risk of HIV infection among MSM, our study may provide some insight into how MSM might behave if PrEP becomes more widely available and thus could serve as an aid to providers or prevention practitioners when developing counseling messages. Second, our study was limited to respondents in one city and cannot be generalized to represent the views of all MSM in the United States. Third, given the design of NHBS which does not preclude participation in multiple cycles of NHBS there was no assessment of repeated participation in 2008 and 2011, making it impossible to adjust for repeated observations. Finally, the data included in this report are not weighted to account for variations in venue attendance or likelihood of being selected to participate in the survey. This may lead to an inaccurate measurement of some behaviors due to the fact that responses of men who attended venues more frequently would be over-represented while those who do not attend frequently would be under-represented.

If PrEP is made available to, and its use adopted by, MSM at high risk of acquiring HIV, and if it is provided along with routine HIV and STI screening as well as behavioral risk-reduction and medication adherence, PrEP could contribute substantially to reducing new HIV infections. Interim guidance for health care providers in the United States recommends that PrEP only be considered for MSM at high risk of HIV infection [12]. However, given the groundbreaking results of the HPTN 052 trial [31], it is likely that “test and treat” strategies will focus on providing antiretrovirals to infected individuals to reduce HIV transmission rather than focusing on providing antiretrovirals to uninfected individuals to prevent HIV acquisition. Still, PrEP is an important addition to the HIV prevention armamentarium.

At the time of the survey in 2011, only 28 % of MSM in our study were aware of PrEP. Much work remains to be done to educate high-risk MSM about the potential utility of PrEP as an adjunct to other effective prevention methods. Given that a key component of PrEP's effectiveness is awareness of PrEP, it is imperative to develop educational messages targeting those most likely to benefit from PrEP and empowering them to initiate the

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conversation with their provider. As with any comprehensive prevention plan, an educational component targeting the populations most at risk must be included when considering the addition of PrEP to the HIV prevention arsenal. Now that the efficacy and safety of PrEP for MSM have been demonstrated, and the importance of adherence to medication defined, additional surveys of MSM need to be conducted to determine levels of interest in using PrEP, preferred sources of PrEP delivery, and barriers to access.

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Table 1

Demographic and behavioral characteristics of two samples of men who have sex with men, National HIV Behavioral Surveil-lance System, Denver, Colorado, 2008 and 2011

	NHBS- MSM2 (*n* = 425) *n* (%)	NHBS- MSM3 (*n* = 461) *n* (%)	χ^2(*P* value)
Race/ethnicity			21.31 (<0.001)
White, non-Hispanic	267 (63)	250 (54)	
Black, non-Hispanic	14 (3)	51 (11)	
Hispanic	112 (26)	122 (27)	
Other	32 (7)	38 (8)	
Age (years)			8.27 (0.041)
18-20	19 (4)	10(2)	
21-29	124 (29)	166 (36)	
30-39	115 (27)	127 (28)	
40+	167 (39)	158 (34)	
Education			1.13 (0.567)
Less than high school	19 (4)	15 (3)	
High school	95 (22)	98 (21)	
More than high school	311 (73)	348 (76)	
Annual income			8.69 (0.013)
$0-$19,999	89 (21)	129 (28)	
$20,000-$39,999	113 (27)	133 (29)	
$40,000 or more	222 (52)	199 (43)	
Currently live with a boyfriend/significant other			0.73 (0.393)
Yes	94 (22)	91 (20)	
No	331 (78)	369 (80)	
Number of sex partners in past 12 months			3.17 (0.205)
1 partner	100 (23)	93 (20)	
2 or 3 partners	131 (31)	130 (28)	
4 or more partners	194 (46)	237 (52)	
Unprotected anal sex in past 12 months			0.09 (0.765)
Yes	159 (37)	168 (36)	
No	266 (63)	293 (64)	

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Table 2

Knowledge of and attitudes towards pre-exposure prophylaxis (PrEP) and anticipated behavior change in two samples of men who have sex with men, National HIV Behavioral Surveillance System, Denver, Colorado, 2008 and 2011

	NHBS-MSM2 (*n* =425) *n* (%)	NHBS-MSM3 (*n* =461) *n* (%)	χ^2(*P* value)
Ever heard of PrEP?			5.78 (0.016)
Yes	91 (21)	131 (28)	
No	334 (79)	330 (72)	
Willing to take daily PrEP, if shown to have few or no side effects?			1.47 (0.225)
Yes	280 (66)	286 (62)	
No	141 (33)	171 (37)	
Willing to take daily PrEP, if shown to prevent new HIV in 75 %?			0.97 (0.325)
Yes	253 (60)	260 (56)	
No	171 (40)	201 (44)	
Willing to take daily PrEP, if shown to prevent new HIV in 50 %?			0.33 (0.566)
Yes	193 (45)	201 (44)	
No	231 (55)	260 (56)	
Anticipated condom use if taking daily PrEP			5.16 (0.076)
Less frequently	43 (10)	52 (11)	
More frequently	26 (6)	47 (10)	
About as frequently as before	350 (82)	361 (78)	
Anticipated number of sex partners if taking daily PrEP			12.59 (0.002)
Fewer partners	14 (3)	38 (8)	
More partners	17(4)	29 (6)	
Same number of partners	390 (92)	392 (85)	

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Table 3

Association between knowledge of pre-exposure prophylaxis (PrEP) and year of data collection among men who have sex with men, National HIV Behavioral Surveillance System, Denver, Colorado, 2008 and 2011

	Heard of PrEP	Crude prevalence ratio (95 % CI)	Adjusted prevalence ratio (95 % CI)*
Year of data collection			
2011 (post-iPrEx results)	131 (28)	1.33 (1.07, 1.65)	1.43 (1.18, 1.72)
2008 (pre-iPrEx results)	91 (21)	1.0 (ref)	1.0 (ref)

*Adjusted for race, age, income, anticipated change in condom use, and anticipated change in number of partners

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Table 4

Within sample comparisons of awareness of pre-exposure prophylaxis (PrEP) among men who have sex with men, National HIV Behavioral Surveillance System, Denver, Colorado, 2008 and 2011

	NHBS-MSM2 in 2008			NHBS-MSM3 in 2011		
	Heard of PrEP (n = 91) n (%)	**Not heard of PrEP (n = 334)**	**χ^2(P value)**	**Heard of PrEP (n = 131) n(%)**	**Not heard of PrEP (n = 330) n(%)**	**χ^2 (P value)**
Race/ethnicity						
White, non-Hispanic	65 (71)	202 (60)	5.86	83 (63)	167 (51)	6.63
Black, non-Hispanic	4(4)	10 (3)	(0.118)	10 (7)	41 (12)	(0.085)
Hispanic	19 (21)	93 (28)		28 (21)	94 (28)	
Other	-	29 (9)		10 (7)	28 (8)	
Age (years)						
18–20	-	19 (6)	6.19	-	10 (3)	4.15
21–29	27 (30)	97 (29)	(0.102)	47 (36)	119 (36)	(0.246)
30–39	29 (32)	86 (26)		38 (29)	89 (27)	
40+	35 (38)	132 (39)		46 (35)	112 (34)	
Income						
$0–$19,999	10(11)	79 (24)	9.23	31 (24)	98 (30)	10.66
$20,000–$39,999	22 (24)	91 (27)	(0.01)	28 (21)	105 (32)	(0.005)
$40,000 or more	59 (65)	163 (49)		72 (55)	127 (38)	
Anticipated condom use if taking daily PrEP						
Less frequently	6 (7)	37 (11)	7.07	16 (12)	36 (11)	3.40
More frequently	-	25 (7)	(0.029)	8 (6)	39 (12)	(0.182)
About as frequently as befoi	e 82 (92)	268 (81)		107 (82)	254 (77)	
Anticipated number of sex partners if taking daily PrEP						
Fewer partners	-	14(4)	3.91	5 (4)	33 (10)	8.57
More partners	4 (4)	13 (4)	(0.141)	4 (3)	25 (8)	(0.014)
Same number of partners	85 (96)	305 (92)		121 (93)	271 (82)	

Column numbers may not sum to total due to missing data, small cell size numbers suppressed