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HIV Pre-Exposure Prophylaxis Integrated with Municipal and Community Based Sexual Health Services

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Abstract

Importance—Several randomized trials have demonstrated the efficacy of pre-exposure prophylaxis (PrEP) in preventing human immunodeficiency virus (HIV) acquisition. Little is known about adherence, sexual practices, and overall effectiveness when PrEP is implemented in sexual transmitted infection (STI) and community-based clinics.

Objective—To assess PrEP adherence, sexual behaviors, and incidence of STIs and HIV in a cohort of men who have sex with men (MSM) and transgender women initiating PrEP in the United States.

Design, Setting, and Participants—Demonstration project conducted from October 2012 to February 2015, among MSM and transgender women in 2 STI clinics in San Francisco, California and Miami, Florida, and a community health center in Washington, DC.

Intervention—Daily, oral tenofovir disoproxil fumarate/emtricitabine was provided free of charge for 48 weeks. All participants received HIV testing, brief client-centered counseling, and clinical monitoring.

Main Outcomes and Measures—Tenofovir diphosphate (TFV-DP) concentrations in dried blood spots (DBS); self-reported numbers of anal sex partners and episodes of condomless receptive anal sex; STI/HIV incidence.

Results—Overall, 557 participants initiated PrEP, with 78% retained through 48 weeks. Based on 294 participants with DBS testing, 80-86% had protective DBS levels (consistent with 4 doses/week) at follow-up visits. African-Americans (57%, $p=0.003$) and those from the Miami site (65%, $p<0.001$) were less likely to have protective levels, while those with stable housing (87%, $p=0.02$) and reporting 2 condomless anal sex partners in the past 3 months (89%, $p=0.01$) were more likely to have protective levels. Mean anal sex partners declined during follow-up, while the proportion engaging in condomless receptive anal sex remained stable. Overall STI incidence was high (90/100 person-years), but did not increase over time. Two individuals became HIV-infected during follow-up (HIV incidence 0.43%, 95% CI 0.05-1.54); both had TFV-DP levels consistent with <2 doses/week at seroconversion.

Conclusions and Relevance—HIV incidence was extremely low, despite a high incidence of STIs in a large US PrEP demonstration project. Adherence was higher among those with higher reported risk behavior. Interventions that address racial and geographic disparities and housing instability may increase PrEP impact.

Keywords

Pre-exposure prophylaxis (PrEP); HIV prevention; Men who have sex with men (MSM); sexually transmitted diseases (STD); implementation; adherence; retention; disparities

Introduction

In 2010, the iPrEx trial of HIV pre-exposure prophylaxis (PrEP) using daily oral tenofovir disoproxil fumarate/emtricitabine (TDF/FTC) demonstrated an overall 44% reduction in HIV acquisition among men who have sex with men (MSM) and transgender women receiving PrEP, and >90% efficacy among those with detectable drug in blood.¹ Following two additional randomized trials also demonstrating safety and efficacy,^{2,3} this PrEP formulation was approved in the US for the prevention of sexually acquired HIV infection in 2012. Two recent studies of daily or intermittent PrEP among MSM confirmed high PrEP efficacy.^{4,5}

MSM account for over two-thirds of new HIV infections in the US, and are the only risk group in whom infection rates are rising.⁶ Sexually transmitted infection (STI) and community-based clinics serving MSM are promising clinical sites for PrEP delivery,⁷ yet little is known about PrEP use in these settings. Concerns have been raised regarding PrEP implementation, including risk compensation,^{8,9} poor adherence,¹⁰ drug resistance,¹¹ and safety and toxicity.¹² We report results of the Demo Project, a prospective, open-label demonstration project assessing PrEP adherence, sexual practices, safety, and HIV/STI incidence among MSM and transgender women in three US metropolitan areas heavily impacted by HIV.

Methods

Study Design and Participants

The Demo Project enrolled participants from municipal STI clinics in San Francisco and Miami and a community health center in Washington, DC from October 2012 to January 2014. These clinics have access to large populations of at-risk MSM, with annual HIV seroconversion rates of 2.3%-4%.¹³ Participants were eligible if they were male at birth and 18 years or older; fluent in English or Spanish; had a negative rapid HIV antibody test at screening and enrollment and a negative 4th generation antibody/antigen (Ag/Ab) test at screening; had creatinine clearance \geq 60 ml/min and a urine dipstick with negative or trace protein; and reported any of the following in the last 12 months: condomless anal sex with \geq 2 male or transgender female partners; \geq 2 episodes of anal sex with \geq 1 HIV-infected partner; or sex with a male/transgender female partner and having a diagnosis of syphilis or rectal gonorrhea or chlamydia. Individuals with serious active medical conditions, a history of pathologic fracture, hepatitis B surface antigen positivity, or taking nephrotoxic medications were excluded. Written informed consent was obtained at screening, and eligible individuals returned for enrollment and were dispensed one month of TDF/FTC. The sample size allowed us to estimate proportions within margins of sampling error of +/-

– 4.4%, and to detect adjusted odds ratios of 1.7-2.3, depending on predictor and outcome prevalence.

Participants returned for clinic visits at 4, 12, 24, 36, and 48 weeks for HIV/STI testing, clinical monitoring, and PrEP dispensing. Participants were encouraged to return 4 weeks after stopping PrEP for a final evaluation and HIV test. Brief, client-centered counseling was provided at all visits [eMethods1]. Retention procedures were limited, with up to 3 contact attempts after a missed visit. Participants received \$25 for each scheduled visit. PrEP was discontinued in seroconverters, who received counseling, partner services, and linkage to HIV primary care. TDF/FTC PrEP (donated by Gilead Sciences) and HIV/STI testing and safety monitoring (supported by the clinic or study funds) were provided free to participants. Among the 3 study sites, only the DC site offered PrEP outside the Demo Project. The protocol was approved by local institutional review boards.

Measures

PrEP adherence and engagement

PrEP adherence was measured several ways. At each visit, a self-reported adherence rating scale¹⁴ was collected by interviewer-administered questionnaire, pill counts were performed, and the medication possession ratio (MPR), defined as the number of dispensed pills divided by the number of days between visits,¹⁵ was calculated. Dried blood spots (DBS) intended for measurement of tenofovir diphosphate (TFV-DP) concentrations [eMethods2] were collected at all scheduled follow-up visits, and at any visit where PrEP was stopped. TFV-DP concentrations were measured in approximately 100 randomly selected participants per site; in addition, a decision was made after completion of enrollment to perform DBS testing in all Black and transgender participants, who were under-represented in the overall sample.

Engagement with PrEP at each visit was assessed using a 5-level ordinal measure, where the lowest level of engagement was missing the visit, and increasing levels of engagement were identified for those attending the visit based on DBS concentration levels: below limits of quantitation (BLQ), <2 (<350 fmol/punch), 2-3 (350-699 fmol/punch), or 4 (700 fmol/punch) doses/week. This categorization of DBS concentrations was used in iPrEx OLE¹⁶ and derived from previous PK modeling studies.¹⁷

Sexual and drug-use behaviors

Sexual behaviors during the prior 3 months were assessed at screening and every 12 weeks by an interviewer-administered questionnaire, including total number of anal sex partners and number of episodes of insertive and receptive anal sex, with and without condoms. Participants were also asked about use of alcohol, marijuana, poppers, cocaine, amphetamines, heroin, sedatives, Ecstasy, and erectile dysfunction (ED) drugs in the past 3 months. Polysubstance use was defined as using 3 of the following: poppers, cocaine, amphetamines, sedatives, ecstasy, and ED drugs.¹⁸

HIV/STI testing

HIV testing was performed at all visits using a rapid HIV antibody test (Clearview Stat-Pak/Complete) and a fourth generation HIV Ag/Ab test (Architect; Abbott Diagnostics). Additionally, SF participants had pooled HIV RNA (10 samples/pool) conducted for acute HIV screening, as standard practice in that clinic.¹⁹ In Miami and DC, an individual HIV RNA (Aptima; GenProbe or Taq-man V.20; COBAS) was performed at enrollment to screen for acute HIV. HIV seroconverters had HIV RNA viral load and resistance testing performed by genotyping and minor variant assays²⁰ [eMethods3]. Urine specimens and rectal and pharyngeal swabs were tested quarterly for *Neisseria gonorrhoeae* (GC) and *Chlamydia trachomatis* (CT) using the Aptima Combo-2 nucleic acid amplification test (Genprobe Diagnostics). Serologic testing for syphilis was performed quarterly with a VDRL or RPR and confirmed with a fluorescent treponemal antibody-absorption test.

Safety monitoring

A clinical assessment for adverse events was performed at all follow-up visits [eMethods4]. Serum creatinine was measured at screening and quarterly, and creatinine clearance was estimated using the Cockcroft-Gault equation.

Statistical Analyses

All statistical analyses were performed using STATA version 13.1 (College Station, TX). Logistic models were used to assess baseline correlates of retention at 48 weeks. Our primary adherence outcome was having protective DBS levels consistent with 4 doses/week [eMethods5]. A generalized estimating equations (GEE) logistic model was used to evaluate baseline and time-dependent correlates of having protective DBS levels at each follow-up visit. Factors associated with the outcome ($p < 0.10$) after adjustment for site and visit were retained in the final model. For analyses of adherence and PrEP engagement, participants with DBS results were weighted to be representative of all those attending each visit. The association of PrEP engagement at week 4 with engagement at week 48 was assessed using a proportional-odds model. Trends in sexual behavior and drug use were evaluated using GEE logistic and Poisson models. Follow-up for HIV/STI incidence started at enrollment and ended at the last visit with an HIV or STI test, respectively.

Results

PrEP uptake and baseline characteristics of Demo Project participants were previously described.²¹ Overall, 132 (24%) had an HIV-positive primary partner at baseline, including 122 (92%) who were on antiretroviral therapy and 107 (81%) who were virally suppressed. However, 67% of those with a virally suppressed primary partner reported >1 anal sex partner in the past 3 months. At baseline, any recreational drug use was reported by 74%, polysubstance use by 20%, amphetamines by 15%, and injection drugs by 1.6%. Testosterone or anabolic steroid use was rare (2.5%).

Among 557 enrolled participants, 25 (4.5%) had no follow-up visits, while 69% completed all five. Retention at week 48 was 78% overall, and 79% among the 294 selected for DBS testing; total follow-up was 481 person-years. Baseline correlates of retention at week 48 are

shown in Table 1. After adjusting for site, prior PrEP knowledge and reporting condomless receptive anal sex (ncRAI) at baseline were associated with being retained.

PrEP adherence and engagement

Mean PrEP adherence across visits was 82% by pill counts and 86% by MPR. Self-rated adherence was very good or excellent at 87% of visits. Based on 1201 DBS samples provided by 294 participants who attended follow-up visits, DBS TFV-DP concentrations were in the protective range among an estimated 86%, 85%, 82%, 85%, and 80% of participants at weeks 4, 12, 24, 36, and 48 respectively. In multivariable analyses, African-American participants and those from Miami were less likely to have protective DBS levels, while those who had stable housing and reported ≥ 2 condomless anal sex partners in the past 3 months were more likely to have protective levels (Table 2). Trajectories of drug concentrations over time are shown graphically [eFigure]. Among participants with ≥ 2 DBS samples tested, 63% had DBS levels ≥ 4 doses/week at all visits tested and 2.9% always had DBS levels < 2 doses/week.

PrEP engagement (including visit attendance and adherence) varied by site and race/ethnicity (both $p < 0.0005$) (Figure 1). Furthermore, engagement at week 4 strongly correlated with week 48 engagement ($p < 0.0005$, Figure 2). PrEP was interrupted 86 times among 84 (15%) participants for reasons other than loss to follow-up, HIV seroconversion, or study completion, for a mean of 65 days, accounting for 24% of their follow-up; PrEP was restarted in 15 (18%). Interruptions were mostly due to participant preference, including experienced side effects (25 times), concern about long-term side effects (16 times), and low self-perceived HIV risk (21 times). Among participants who stopped PrEP due to low perceived risk, 63% reported ncRAI at that visit.

Sexual and drug use behaviors and STIs

Mean number of anal sex partners in the past 3 months declined from baseline to week 48 (10.9 to 9.3, $p = 0.04$). Two-thirds (66%) reported ncRAI at baseline, which remained stable during follow-up ($p = 0.99$, Figure 3A). Overall numbers of RAI episodes in the past 3 months decreased ($p = 0.007$), driven by a decline in episodes with a condom ($p < 0.0001$); episodes *without* a condom were stable ($p = 0.73$). Site differences in sexual risk trajectories were observed, with increases in ncRAI (71% to 76%) and ncRAI episodes (8.4 to 11) seen only in San Francisco (p for interaction < 0.05 for both). Use of any recreational drugs ($p = 0.42$), amphetamines ($p = 0.41$), heavy alcohol (≥ 5 drinks/day, $p = 0.81$), and poppers ($p = 0.59$) were stable, while use of powder cocaine (20% to 14%, $p = 0.006$) and club drugs (23% to 18%, $p = 0.02$) decreased.

Overall, 26% of participants had early syphilis, GC, or CT at baseline, and 51% were diagnosed with ≥ 1 STI during follow-up. The proportion of participants who had early syphilis or a GC/CT infection at the urethra, rectum, or pharynx during each visit interval is shown in Figure 3B. Rectal and pharyngeal STI positivity decreased from baseline to week 24, then increased ($p < 0.05$). STI incidence per 100 person-years was 48 (95% CI 42-55) for CT, 43 (37-49) for GC, 12 (9.4-16) for syphilis, and 90 (81-99) for any STI; in each case, incidence was stable across quarterly intervals (all $p > 0.10$).

HIV seroconversions and incidence

Three participants had acute HIV infection at enrollment. All had negative rapid and Ag/Ab HIV tests at screening and enrollment and initiated PrEP. Two had a positive pooled HIV RNA at enrollment, and infection was subsequently confirmed by individual quantitative RNA testing. The third had a positive qualitative RNA test at enrollment, confirmed by quantitative HIV RNA. One participant had FTC resistance detected as a mixture with wild-type (M184MI) one week after enrollment, which was not present at enrollment, suggesting acquired resistance; this participant was switched to combination antiretroviral therapy (TDF/FTC/darunavir/ritonavir/raltegravir) and has remained virologically suppressed. Viral load was insufficient to perform resistance testing in a second participant (120 copies/mL), and he has remained suppressed on antiretroviral therapy. The third participant had no evidence of HIV resistance on standard or ultrasensitive minor variant testing, although testing was performed 6 weeks after PrEP discontinuation.

Two participants became HIV-infected during follow-up, yielding an HIV incidence of 0.43 infections/100 person-years (95% CI 0.05-1.5). The first infection was detected approximately 19 weeks after enrollment. This participant reported last taking PrEP 37 days prior to seroconversion and had DBS levels <2 doses/week at his seroconversion and all prior visits. The second seroconversion was detected approximately 4 weeks after the 48 week visit, when study drug was no longer dispensed. This participant had DBS levels consistent with daily dosing only at week 4, dropping to <2 doses/week or BLQ thereafter. Neither participant had evidence of TDF/FTC resistance on standard or ultrasensitive minor variant genotyping assays.

Safety

There were 19 serious adverse events reported, 8 of which were psychiatric (suicidal ideation/attempt, bipolar disorder, or anxiety); none were assessed as related to TDF/FTC. There were 23 creatinine elevations occurring in 13 (2.3%) individuals, including 22 grade 1 and one grade 2 events. Only 3 elevations among 3 participants were confirmed on repeat testing, and all resolved within 2-20 weeks without stopping PrEP. Medication was discontinued in 3 participants due to elevated creatinine, however these were not confirmed, and TDF/FTC was restarted in all cases. Two participants had grade 1 creatinine elevations continuing at the end of study. One was attributed to underlying mild renal disease and assessed as unrelated to TDF/FTC. The other was assessed as related, but the participant chose to continue PrEP with his care provider after study completion. Twelve bone fractures were reported during the study. All but one (tooth fracture) was explained by trauma, and none were related to TDF/FTC.

Discussion

Despite low adherence seen in some placebo-controlled PrEP trials,^{22,23} we observed high adherence among MSM taking PrEP in this open-label demonstration project. Drug was detected in nearly all participants tested, and over three-quarters achieved levels associated with high levels of protection.^{16,17} This higher adherence rate may be attributable to provision of open-label PrEP in a setting of known efficacy,^{24,25} as well as growing

community acceptance.⁷ Higher adherence was observed among those reporting greater sexual risk, a finding that was also seen in iPrEx²⁶ and Partners PrEP²⁷ and is expected to increase the impact and cost-effectiveness of PrEP.^{28,29} PrEP adherence was not diminished among people using alcohol or other recreational drugs.

Despite most achieving protective PrEP levels, lower drug-levels were observed among African-American participants, those with unstable housing, and at the Miami site. These disparities were not explained by other demographic characteristics, depression, or substance use. Racial differences in pharmacokinetics have not been fully evaluated, but small studies have not identified such differences to date.³⁰ Lower medication adherence has been reported among African-Americans including HIV infection,³¹⁻³⁴ diabetes,³⁵ hypertension,³⁶ and heart failure.³⁷ Other factors, including mistrust of providers,³¹ privacy concerns,³⁸ lower health literacy,³⁵ and unmet medical and social-structural needs,³⁹ may explain these disparities, and warrant further exploration in future PrEP programs. Black MSM have high rates of HIV acquisition in the US, highlighting the importance of customizing support for PrEP uptake and adherence for this population. Addressing structural barriers, including lack of insurance and access to supportive healthcare, will also be critical. Several studies are underway evaluating novel PrEP delivery and support approaches in Black MSM, including a care-coordination model in HIV Prevention Trials Network 073 and a mobile-health adherence intervention in Enhancing PrEP in Communities.⁴⁰

Reasons for lower retention and adherence in the Miami site are unclear. While Miami participants were younger, more likely to be Latino, and had lower education,²¹ these variables were not independently predictive in adjusted analyses; likewise, while PrEP awareness was lower in Miami, it did not predict retention there. Unmeasured factors including transportation, social support, health literacy, acculturation, and community acceptability of PrEP may help explain this disparity.

Early engagement, measured by clinic attendance and PrEP adherence at week 4, was highly predictive of engagement at the end of the study, highlighting the importance of early adherence assessment and support. Specifically, early monitoring, such as using drug-level testing could be useful in identifying those needing additional support.⁴¹ Reductions in the cost and turnaround time of DBS testing would facilitate implementation.

A substantial minority of participants reported one or more PrEP interruptions. Side effects were the most common reason, suggesting the need for additional education and support on the safety and tolerability of TDF/FTC. Creatinine elevations were uncommon, mostly unconfirmed, and managed with regular monitoring. While there were 21 discontinuations due to low self-perceived risk, the majority of these participants reported recent sexual risk. Strategies to improve risk perception, including online risk assessment tools⁴² and sexual diaries,⁴³ may improve decisions about starting and stopping PrEP.

Despite high STI incidence and reported risk behaviors, we observed very low HIV incidence (0.43%), with only two incident infections. Both participants had low or undetectable TFV-DP in DBS, a pattern seen in the recent PROUD and IPERGAY PrEP

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Figure 1. PrEP engagement, by visit week and site (Figure 1A) and race/ethnicity (Figure 1B)
A: Distribution of PrEP engagement (visit attendance and adherence by DBS concentrations) by visit week and study site. BLQ=below limit of quantitation. Numbers at top of each bar indicate number of participants contributing data at each time point.
B: Distribution of PrEP engagement (visit attendance and adherence by DBS concentrations) by visit week and race/ethnicity. BLQ=below limit of quantitation. Numbers at top of each bar indicate number of participants contributing data at each time point.

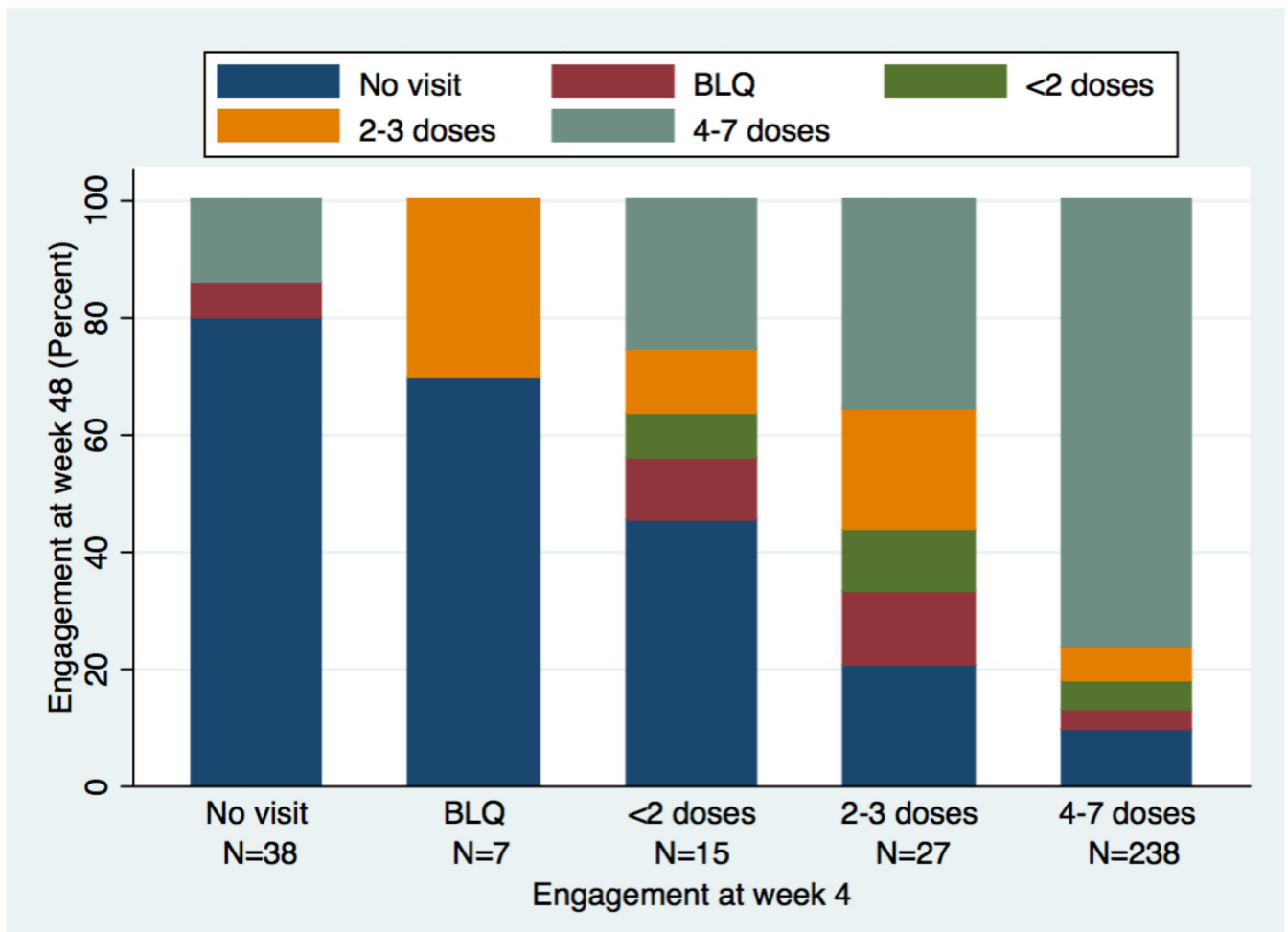


Figure 2. PrEP engagement at week 48, based on engagement at week 4

Proportion of participants with no visit attendance or DBS concentrations in different adherence categories at week 48, stratified by visit attendance and DBS concentrations at week 4. BLQ=below limit of quantitation. This analysis includes 325 participants, 287 of whom had DBS tested at week 4, and 38 who missed the week 4 visit.

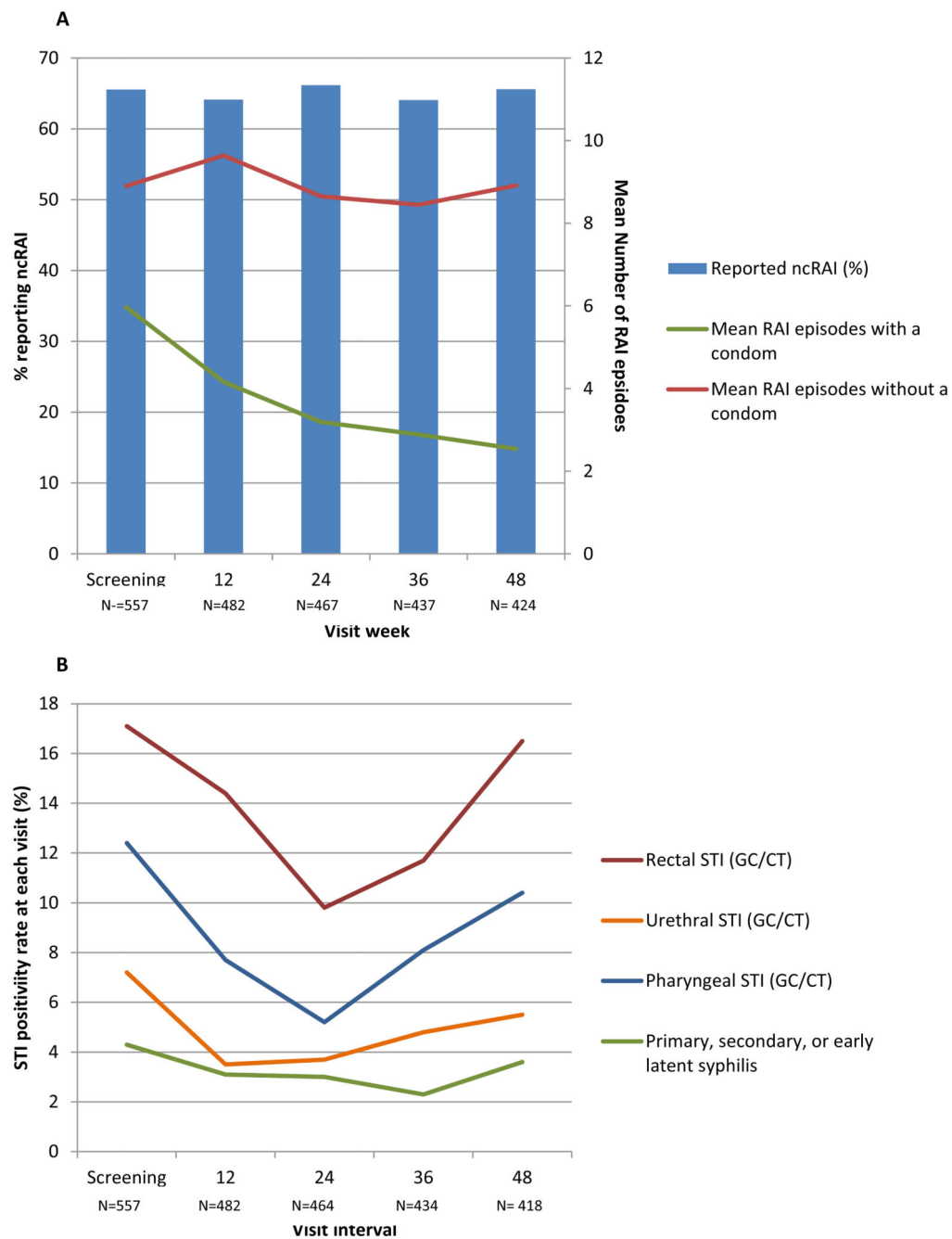


Figure 3. Sexual Behaviors and STIs in the Demo Project

A: Proportion of participants reporting condomless receptive anal sex (ncRAI) and mean number of receptive anal sex episodes with and without a condom.

B: Percent of STI tests that were positive during each visit interval, by anatomic site. The week 48 visit interval includes testing performed at the optional follow-up visit 4 weeks after week 48.

Table 1
Baseline characteristics of participants retained through the end of study

| Characteristic | Retained N (%) [†] (n=437) | Not retained N (%) (n=120) | Unadj. p value | Adj. p value* |
|--|--|-------------------------------|-------------------|------------------|
| Site | | | | |
| San Francisco | 253 (84.3) | 47 (15.7) | <0.001 | N/A |
| Miami | 98 (62.4) | 59 (37.6) | | |
| Washington DC | 86 (86.0) | 14 (14.0) | | |
| Age, No. (%) | | | | |
| 18-25 | 77 (68.8) | 35 (31.3) | 0.009 | 0.12 |
| 26-35 | 161 (77.0) | 48 (23.0) | | |
| 36-45 | 115 (85.8) | 19 (14.2) | | |
| >45 | 84 (82.4) | 18 (17.7) | | |
| Race/ethnicity, No. (%) | | | | |
| White | 226 (85.0) | 40 (15.0) | 0.002 | 0.53 |
| Latino | 139 (72.4) | 53 (27.6) | | |
| Black | 25 (62.5) | 15 (37.5) | | |
| Asian | 21 (80.8) | 5 (19.2) | | |
| Other | 26 (81.3) | 6 (18.8) | | |
| Gender | | | | |
| Male | 430 (78.5) | 118 (21.5) | 0.65 | 0.49 |
| Transgender woman | 5 (71.4) | 2 (28.6) | | |
| Other | 2 (100) | 0 (0) | | |
| Education level, No. (%) | | | | |
| High School | 55 (67.1) | 27 (32.9) | 0.04 | 0.41 |
| Some college | 119 (78.8) | 32 (21.2) | | |
| College graduate | 156 (79.6) | 40 (20.4) | | |
| Any post graduate | 107 (83.6) | 21 (16.4) | | |
| Income, No. (%) | | | | |
| <\$20,000 | 128 (69.6) | 56 (30.4) | <0.001 | 0.07 |
| \$20,000-\$59,999 | 158 (81.0) | 37 (19.0) | | |
| \$60,000 | 139 (87.4) | 20 (12.6) | | |
| Health insurance, No. (%) | | | | |
| No | 149 (71.6) | 59 (28.4) | 0.002 | 0.28 |
| Yes | 288 (82.8) | 60 (17.2) | | |
| Living situation, No. (%) | | | | |
| Rent or own housing | 362 (81.2) | 36 (32.4) | 0.002 | 0.07 |
| Other (live with friends/family, public housing, homeless) | 75 (67.6) | 84 (18.8) | | |

| Characteristic | Retained N (%) [†] (n=437) | Not retained N (%) (n=120) | Unadj. p value | Adj. p value [*] |
|--|--|-------------------------------|-------------------|------------------------------|
| Referral status, No. (%) | | | | |
| Self-referred | 252 (84.6) | 74 (28.6) | <0.001 | 0.08 |
| Clinic-referred | 185 (71.4) | 46 (15.4) | | |
| Prior PrEP knowledge, No. (%) | | | | |
| No | 91 (64.1) | 51 (35.9) | <0.001 | 0.01 |
| Yes | 346 (83.4) | 69 (16.6) | | |
| ncRAI, past 3 mo, at baseline, No.(%) | | | | |
| No | 125 (68.3) | 58 (31.7) | <0.001 | 0.002 |
| Yes | 312 (83.4) | 62 (16.6) | | |
| Post-exposure prophylaxis (PEP) use at baseline visit, No. (%) | | | | |
| No | 422 (78.4) | 116 (21.6) | 0.96 | 0.63 |
| Yes | 15 (79.0) | 4 (21.1) | | |
| Alcohol: 5 drinks/day when drinking, past 3 mo | | | | |
| No | 388 (79.2) | 102 (20.8) | 0.29 | 0.58 |
| Yes | 47 (73.4) | 17 (26.6) | | |
| Any recreational drug use, past 3 mo | | | | |
| No | 111 (77.6) | 32 (22.4) | 0.79 | 0.56 |
| Yes | 325 (78.7) | 88 (21.3) | | |
| Amphetamine use, past 3 mo | | | | |
| No | 365 (77.3) | 107 (22.7) | 0.10 | 0.36 |
| Yes | 71 (85.5) | 12 (14.5) | | |
| Polysubstance use, past 3 mo [‡] | | | | |
| No | 342 (77.0) | 102 (23.0) | 0.11 | 0.36 |
| Yes | 94 (83.9) | 18 (16.1) | | |
| Injection drug use, past 3 mo | | | | |
| No | 429 (78.4) | 118 (21.6) | 0.96 | 0.55 |
| Yes | 7 (77.8) | 2 (22.2) | | |
| Use of testosterone or anabolic steroids, past 3 mo | | | | |
| No | 425 (78.3) | 118 (21.7) | 0.51 | 0.48 |
| Yes | 12 (85.7) | 2 (14.3) | | |

[†]Retained participants include those who completed their 48 week visit, regardless of prior missed visits.

^{*}Adjusted for site; unadj = unadjusted; adj. = adjusted. No.= number. ncRAI = condomless receptive anal sex; N/A = not applicable

[‡]Polysubstance use defined as use of 3 or more of the following substances in the past 3 months: poppers, ecstasy, GHB, cocaine, methamphetamine, erectile dysfunction drugs.

Table 2
Correlates of DBS levels consistent with protective DBS levels (4 or more doses per week)[‡]
(N=294)

| Characteristic | # subjects tested [†] | 4 doses/week (%) [‡] | OR (95% CI) [*] | P value | AOR (95% CI) | P value |
|--------------------------------------|--------------------------------|-------------------------------|--------------------------|------------------|-------------------------|------------------|
| Site | | | | | | |
| San Francisco | 103 | 90 | Reference | | Reference | |
| Miami | 95 | 65 | 0.21 (0.12-0.37) | <0.001 | 0.32 (0.17-0.60) | <0.001 |
| Washington DC | 96 | 88 | 0.89 (0.47-1.70) | 0.73 | 1.08 (0.54-2.19) | 0.82 |
| Age, No. (%) | | | | | | |
| 18-25 | 62 | 78 | Reference | | | |
| 26-35 | 109 | 85 | 1.41 (0.78-2.56) | 0.25 | | |
| 36-45 | 70 | 83 | 1.28 (0.64-2.55) | 0.49 | | |
| >45 | 53 | 87 | 1.97 (0.91-4.28) | 0.09 | | |
| Race/ethnicity, No. (%) | | | | | | |
| White | 130 | 91 | Reference | | Reference | |
| Latino | 98 | 77 | 0.68 (0.35-1.30) | 0.24 | 0.81 (0.41-1.61) | 0.55 |
| Black | 33 | 57 | 0.22 (0.10-0.47) | 0.0001 | 0.28 (0.12-0.64) | 0.003 |
| Asian | 16 | 84 | 0.48 (0.13-1.80) | 0.28 | 0.72 (0.17-3.03) | 0.65 |
| Other | 17 | 82 | 0.43 (0.13-1.35) | 0.15 | 0.42 (0.13-1.38) | 0.15 |
| Education level, No. (%) | | | | | | |
| High School | 37 | 72 | Reference | | | |
| Some college | 79 | 80 | 1.08 (0.57-2.07) | 0.81 | | |
| College graduate | 178 | 88 | 1.76 (0.94-3.31) | 0.08 | | |
| Income, No. (%) | | | | | | |
| <\$20,000 | 99 | 77 | Reference | | | |
| \$20,000-\$59,999 | 96 | 87 | 1.72 (0.97-3.06) | 0.06 | | |
| \$60,000 | 88 | 87 | 1.12 (0.55-2.29) | 0.75 | | |
| Health insurance, No. (%) | | | | | | |
| No | 108 | 74 | Reference | | | |
| Yes | 185 | 88 | 1.71 (1.03-2.85) | 0.04 | | |
| Living situation, No. (%) | | | | | | |
| Rent or own housing | 68 | 87 | 2.32 (1.39-3.88) | 0.001 | 2.02 (1.14-3.55) | 0.02 |
| Other | 226 | 70 | Reference | | Reference | |
| Referral status, No. (%) | | | | | | |
| Clinic-referred | 150 | 77 | Reference | | | |
| Self-referred | 144 | 89 | 1.65 (0.97-2.83) | 0.07 | | |
| Prior PrEP knowledge, No. (%) | | | | | | |

| Characteristic | # subjects tested [†] | 4 doses/ week (%) [‡] | OR (95% CI) [*] | P value | AOR (95% CI) | P value |
|--|--------------------------------|--------------------------------|--------------------------|--------------|-------------------------|-------------|
| No | 88 | 76 | Reference | | | |
| Yes | 206 | 86 | 0.98 (0.57-1.68) | .95 | | |
| Depression, No. (%) | | | | | | |
| PHQ-2 score <2 | 261 | 83 | Reference | | | |
| PHQ-2 score ≥ 2 | 33 | 85 | 0.96 (0.57-1.63) | 0.89 | | |
| Condomless receptive anal sex, past 3 mo | | | | | | |
| No | 107 | 79 | Reference | | | |
| Yes | 187 | 86 | 1.22 (0.79-1.89) | 0.37 | | |
| # condomless anal sex partners, past 3 mo | | | | | | |
| 0-1 | 105 | 75 | Reference | | Reference | |
| ≥ 2 | 189 | 89 | 1.95 (1.26-3.01) | 0.003 | 1.82 (1.14-2.89) | 0.01 |
| Alcohol: ≥ 5 drinks/day when drinking, past 3 mo | | | | | | |
| No | 265 | 84 | Reference | | | |
| Yes | 29 | 82 | 1.02 (0.54-1.92) | 0.95 | | |
| Recreational drug use, past 3 mo | | | | | | |
| No | 89 | 79 | Reference | | | |
| Yes | 205 | 86 | 1.29 (0.83-2.00) | 0.26 | | |
| Amphetamine use, past 3 mo | | | | | | |
| No | 253 | 83 | Reference | | | |
| Yes | 41 | 91 | 1.88 (0.85-4.18) | 0.12 | | |
| Testosterone/anabolic steroid use, past 3 mo | | | | | | |
| No | 288 | 84 | Reference | | | |
| Yes | 6 | 69 | 0.57 (0.10-3.37) | 0.53 | | |
| Injection drug use, past 3 mo | | | | | | |
| No | 289 | 84 | Reference | | | |
| Yes | 5 | 76 | 0.40 (0.10-1.56) | 0.19 | | |
| Erectile Dysfunction drug use, past 3 mo | | | | | | |
| No | 204 | 80 | Reference | | | |
| Yes | 90 | 90 | 1.77 (1.02-3.06) | 0.04 | | |

[‡]Analysis includes all participants who had DBS tested at a given visit.

[†]For time dependent covariates, distribution of participants reflects the first visit where DBS was tested.

^{*}Unadjusted prevalence of having DBS levels consistent with ≥ 4 doses/week, weighted by site to reflect the full cohort and averaged across weeks.

[‡]ORs only adjusted for site; DBS=dried blood spots; No.=number; mo.= month; OR=odds ratio; AOR=adjusted odds ratio. Multivariable model included site, race/ethnicity, education, health insurance, housing status, referral status, number of condomless anal sex partners, and erectile dysfunction drug use.