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Providing HIV pre-exposure prophylaxis to men who have sex with men and transgender women in hospitals and community-led clinics in Thailand: acceptance, patterns of use, trends in risk behaviors, and HIV incidence

L Cheewanan^a, M Chomnad^b, P Nittaya^c, T Deondara^c, K Thana^d, P Tharee^e, P Supabhorn^c, P Patcharaporn^a, V Prin^b, J Surang^f, L Danai^g, N Thitiyanun^h, J Nuchapong^b, M Michaelⁱ

^aDivision of AIDS and STIs, Ministry of Public Health, Bangkok, Thailand;

^bDivision of Global HIV & Tuberculosis, U.S. Centers for Disease Control and Prevention, Nonthaburi, Thailand;

^cInstitute of HIV Research and Innovation, Bangkok, Thailand;

^dFaculty of Medicine, Thammasat University, Pathumthani, Thailand;

^eDepartment of Medical Services, Ministry of Public Health, Lerdsin hospital, Bangkok, Thailand;

^fService Workers in Group Foundation (SWING), Bangkok, Thailand;

^gRainbow Sky Association of Thailand, Bangkok, Thailand;

^hSisters Foundation, Pattaya, Thailand;

ⁱDivision of Global HIV & Tuberculosis, U.S. Centers for Disease Control and Prevention, Atlanta, GA, USA

Abstract

From May 2015 to June 2018, we conducted a PrEP demonstration project at two hospitals and four community-led clinics in Bangkok and Pattaya. HIV-negative, MSM and TGW aged 18 years old, reporting sex without a condom, were offered daily PrEP. Participants received HIV testing and completed a computer-based questionnaire at enrollment, 6 and 12 months. We collected self-reported PrEP adherence at months 1, 3, 6, 9, and 12. We used logistic regression to determine factors associated with the decision to take PrEP and calculated HIV incidence among baseline HIV-negative participants. Of 803 participants enrolled, 349 (43.5%) started PrEP. Participants were more likely to start PrEP if they were sex workers, had moderate or high self-perceived risk of HIV, or a high PrEP-knowledge score. Participants used PrEP for a

[✉] CONTACT Prin V HQA2@cdc.gov.

Disclaimer

The findings and conclusions in this paper are those of the authors and do not necessarily represent the official position of the U.S. Centers for Disease Control and Prevention.

Competing interests

The authors declared no competing interests.

Disclosure statement

No potential conflict of interest was reported by the author(s).

median of 6.1 months. Reported condom use increased and the number of sex partners decreased during follow-up regardless of PrEP use. Six participants not-taking PrEP acquired HIV (HIV incidence 2.2 per 100 person-years), and five taking PrEP acquired HIV (HIV incidence 2.1 per 100 person-years). All five reported taking <4 pills the weeks before study visits.

Keywords

Pre-exposure prophylaxis; MSM; transgender women; Thailand; HIV incidence

Introduction

Daily use of HIV pre-exposure prophylaxis (PrEP), can reduce the risk of HIV infection (Choopanya et al., 2013; Grant et al., 2010; Martin et al., 2017; Thigpen et al., 2012). The World Health Organization (WHO) and the U.S. Centers for Disease Control and Prevention (CDC) recommend PrEP as part of a combination HIV prevention package (CDC, 2021; WHO, 2019a); however, concerns about potential increases in HIV-associated risk behaviors and poor access to PrEP has limited PrEP use (Bavinton & Grulich, 2021; Blumenthal & Haubrich, 2014; Kazi et al., 2019; UNAIDS, 2016) in many countries.

Two of the randomized trials that demonstrated PrEP safety and efficacy were conducted in Thailand (Choopanya et al., 2013; Grant et al., 2010), and since these trials were completed, fee-based and research-based PrEP programs have been implemented (Zablotska et al., 2016). Thailand's HIV Prevention and Treatment guidelines recommend PrEP (Thailand National Guidelines on HIV/AIDS Treatment and Prevention, 2017, 2017), prioritizing populations at high-risk of HIV infection including men who have sex with men (MSM) and transgender women (TGW). More than half of Thailand's new HIV infections occur among MSM and TGW (Estimation of People Living with HIV, 2020) and survey data has demonstrated a high level of interest in PrEP among MSM and TGW (Wheelock et al., 2013; Yang et al., 2013). We launched this PrEP demonstration project (The PrEP project) to determine if MSM and TGW would choose to take PrEP, what factors supported use, and if risk behaviors would increase while people were using PrEP.

Methods

Study settings

The PrEP project was part of a prospective 18-month cohort study: The Test, Treat, and Prevent HIV among MSM and TGW Study (Ongwandee et al., 2018). Participants for the PrEP study were recruited during May 2015–October 2016 in two public hospitals, one in Bangkok (Lerdsin Hospital, a 500-bed government hospital serving 1700 HIV-positive clients) and one in Pathumthani province (Thammasat Hospital, a 541-bed university hospital 20 miles north of Bangkok, serving 300 HIV-positive clients); and four community-led clinics providing HIV services operated by Rainbow Sky Association of Thailand and Service Workers IN Group (SWING) in Bangkok and by SWING and Sisters Foundation in Pattaya, Chonburi province.

Study enrollment and procedures

Staff recruited participants at the study sites or through a peer-driven-intervention (Ongwande et al., 2018). MSM and TGW who were 18-years-old and older, not known to be HIV-infected, who reported anal intercourse without a condom with men or TGW in the past six months were offered enrollment (Ongwande et al., 2018). Participants in the Test and Treat study received HIV testing following Thailand's three-test algorithm (Guideline on HIV Counseling and Testing for Same Day Result, 2013) every six months and HIV-positive participants were offered immediate antiretroviral therapy (Thailand National Guidelines on HIV/AIDS Treatment and Prevention 2017, 2017). Study participants who tested HIV negative at enrollment, or within the first six months in the study, were offered enrollment in the PrEP project. Interested participants received information about PrEP and could decide to take or not to take PrEP. Trained staff provided information about PrEP and study procedures and obtained written consent from participants who agreed to take part in the PrEP project.

Participants interested in PrEP were assessed for acute HIV infection using a checklist "*Information about Acute HIV Infection and PrEP*" (CDC) and blood was collected to assess renal function (i.e., Creatinine clearance [CrCl]), to test for hepatitis B virus surface antigen (HBsAg) and antibody (anti-HBs), and syphilis (VDRL or RPR with TPHA confirmation, or vice versa). Staff offered PrEP to participants who had a creatinine clearance ≥ 60 ml/min and no acute HIV infection symptoms. Staff advised participants with negative HBsAg and anti-HBs to seek hepatitis B vaccination and provided referrals to vaccination sites. Participants with positive HBsAg results received counseling about the therapeutic effect of tenofovir, the possibility of a hepatitis flare if tenofovir was stopped, and were offered PrEP.

Eligible participants were provided PrEP (i.e., *tenofovir disoproxil fumarate* 300 mg and emtricitabine 200 mg), to take daily for 12-months (Thailand National Guidelines on HIV/AIDS Treatment and Prevention 2017, 2017). Participants were asked to return months 1, 3, 6, 9, and 12 for medicine refills, HIV testing, and risk reduction and adherence counseling. Participants who chose not to take PrEP received HIV testing every 6 months as part of the Test, Treat, and Prevent HIV Study.

Data collection and data management

Participants completed a computer-based demographic, PrEP knowledge, and PrEP attitudes questionnaire at baseline (Table 1); and a risk behavior questionnaire at baseline, months 6 and 12 (Table 4). PrEP knowledge contains 10 knowledge questions with a value of 1. Attitudes towards PrEP were addressed through whether participants feel embarrassed or anxious about taking PrEP and their perceived barriers to PrEP use.

Participants taking PrEP completed a self-reported adherence questionnaire at every follow-up visit. Adherence question addressed the number of days participants took PrEP as planned during the past week (Figure 2). Participants who missed visits could restart PrEP at a follow-up visit. All questionnaires and laboratory results were linked using a unique study identification number. No personal identifiers were collected on study questionnaires.

Statistical analysis

We used SAS version 9.4 (SAS Institute Corporation, Cary, North Carolina) for analyses. For descriptive statistics, we used mean (standard deviation, SD) and median (interquartile range, IQR) to describe continuous variables and frequency and percentage for categorical variables. We compared baseline characteristics of those who decided to take PrEP with those who decided not to take PrEP, using two-sample t-test to compare means, Mann–Whitney two-statistic to compare medians, and Chi-square test and Fisher’s Exact test to compare categorical variables.

PrEP knowledge scores were the sum of correctly answered questions (Han et al., 2019; Niderost et al., 2018; Wheelock et al., 2013; Yang et al., 2013). Participants who scored 8 questions are considered knowledgeable about PrEP. We used multivariate logistic regression to determine factors associated with the decision to take PrEP at enrollment and with retention for 12-months with a self-reported adherence of taking 4 or more tablets of PrEP the week before each study visit (i.e., A dose yielding 96% efficacy (Anderson et al., 2012)). We used trend analysis for proportions to determine trends in risk behaviors for categorical variables and Friedman’s test for trends of continuous variables. We calculated HIV incidence among those testing HIV-negative at baseline per 100 person-years using the number of seroconversions divided by the number of person-years of follow-up and used the exact Poisson method to calculate 95% confidence intervals (CIs).

Ethical review

The PrEP demonstration project was approved by the Ethical Review Committees of the Department of Disease Control, Thai Ministry of Public Health, and the Faculty of Medicine at Chulalongkorn University. The project was also reviewed in accordance with CDC human research protection procedures.

Results

Participant characteristics

Of the 993 HIV-negative Test, Treat, and Prevent HIV Study participants, 803 (80.9%) enrolled in the PrEP project (Figure 1). Their mean age was 27 years, 523 (65.1%) self-identified as MSM, 280 (34.9%) as transgender women, 233 (29.0%) had a bachelor’s degree or more education, and 482 (60.0%) reported more than one sexual partner in the past 6 months. Of the 803 participants, 349 (43.5%) started PrEP; of these, 314 (90.0%) started at enrollment (Figure 1). Among the 444 participants who reported a willingness to take PrEP in the enrollment-willingness questionnaire, 308 (69.4%) started PrEP after counseling. Among the 215 participants who said they were not willing to take PrEP, 9 (4.2%) decided to start after counseling; of the 144 participants who responded that they were not sure if they wanted to take PrEP, 32 (22.2%) started after counseling.

Of the 803 enrolled, 436 (54.3%) enrolled at community-led clinics and 367 (45.7%) at facilities. Participants who enrolled at community-led clinics were younger at first sexual intercourse than participants at the public hospitals (median age 17 vs. 18 years: $p < 0.001$), reported less condom use (100% condom use: 25.7% vs. 31.9%, $p = 0.06$), and more

non-injection drug use (39.7% vs. 10.9%, $p < 0.001$). There was no statistical difference in the self-perceived risk of HIV infection.

At baseline, 14 participants tested HBsAg positive and three had a creatinine clearance result < 60 ml/min.

Factors associated with taking PrEP

A higher proportion of participants enrolled in Pattaya ($n = 245$, 46%) chose to start PrEP than those who enrolled in Bangkok ($n = 558$, 36%) (Table 1). Approximately 36% of those who were 18–25 years old ($n = 409$) and those who identified as MSM ($n = 523$) chose to start PrEP. Among the 399 participants who reported a moderate or high risk of HIV infection, 177 (44.4%) chose to take PrEP and of the 568 who reported $< 100\%$ condom use in the past six months, 216 (38.0%) chose to take PrEP.

The major concerns about taking PrEP were side effects (reported by 405 [50.4%] participants), forgetting to take PrEP (383 [47.7%]), and the cost of PrEP (296 [36.9%]) (Table 1).

Participants from Bangkok were less likely to start PrEP compared with those from Pattaya (aOR 0.5; 95% CI 0.3–0.7). Those who were single were less likely to start PrEP than those who were living with a partner (aOR 0.6; 95% CI 0.5–0.9). Sex workers (aOR 1.7; 95% CI 1.0–2.8), those who perceived they were at a moderate or high risk of HIV infection (aOR 1.7; 95% CI 1.2–2.3), and those with high PrEP knowledge scores (aOR 1.5; 95% CI 1.1–2.0) were more likely to start PrEP (Table 2).

Factors associated with using PrEP for 12 months

The median time of PrEP use was 6.1 months (IQR 2.0–11.0). Of 349 participants who started PrEP, about half ($n = 180$, 51.6%) returned at month one and of 143 (79.4%) who reported taking PrEP 4 days the week before the visit; 107 (30.7%) continued PrEP use through the 6-month visit and 64 (18.3%) through the 12-month visit. Among participants who returned for the 6-month visit, 85 (79.4%) reported taking PrEP 4 days the week prior to the study visit and 60 (93.8%) of those who returned for the 12-month visit reported this level of adherence (Figure 2).

Participants recruited at Bangkok sites (aOR 7.9; 95% CI 2.7–23.2) (Table 3), who were 25 years or older (aOR 2.1; 95% CI 1.1–4.1), had a higher level of education (aOR 2.2; 95% CI 1.2–4.2), or had a moderate to high self-perceived risk of HIV infection (aOR 2.3; 95% CI 1.2–4.4) were more likely to report adherence to PrEP for 12 months (Table 3).

Trends in risk behaviors among PrEP users and non-PrEP users

Among participants who started PrEP or did not start PrEP, condom use increased ($p < 0.001$) and the number of sex partners decreased ($p < 0.001$) (Table 4). Participant's self-perceived risk of HIV infection decreased overtime; participants who used PrEP had a higher perceived risk of infection than those who did not use PrEP. Reported drug use decreased overtime.

HIV seroconversion and HIV incidence

Among 803 participants who were HIV-negative at baseline, 11 seroconverted yielding an HIV incidence of 2.2 (95% CI 1.1–3.9) per 100 person-years (Table 5). Median time to seroconversion was 10.9 (IQR 8.9–12.7) months. Six participants who seroconverted did not start PrEP during the project. Five who seroconverted started PrEP, but all five had reported taking <4 pills the week prior to at least one study visit. All 11 participants who seroconverted enrolled at community-led clinic sites. Nine (81.8%) of the participants who seroconverted were 18–25 years old, 9 (81.8%) self-identified as MSM, 9 (81.8%) reported post-exposure prophylaxis (PEP) use prior to enrollment, and 5 (45.5%) thought their HIV risk was low.

Discussion

In this project that offered PrEP free of charge with visits every 3 months, 43.5% of participants chose to start PrEP, suggesting a relatively high level of interest in PrEP among MSM and TGW. Participants who were sex workers and participants who perceived they had a moderate or high risk of HIV infection were more likely to start PrEP, and those with a moderate or high self-perceived risk of HIV were more likely to continue to PrEP. Reported HIV-associated risk behaviors (i.e., condomless sex and sex partner number) decreased during follow-up.

Interest in using PrEP among MSM and TGW has varied from 13% to 40% in studies in Thailand and elsewhere (Han et al., 2019; Niderost et al., 2018; Wheelock et al., 2013; Yang et al., 2013). In this project, some participants changed their decision to start PrEP after counseling or at a subsequent visit, suggesting that the decision to use PrEP may require time and consideration.

Participants who were sex workers and participants who perceived they had a moderate or high risk of HIV infection were more likely to start PrEP. Other studies have found that health concerns and perceived risk of HIV infection are predictors of PrEP use (Han et al., 2019; Lachowsky et al., 2019; Martin et al., 2017; Plotzker et al., 2017). About half of enrolled participants did not return for the first month visit. Missed visits were commonly observed in PrEP studies in the United States (Chan et al., 2016; Dombrowski et al., 2018; Zucker et al., 2019) and were found to be associated with future discontinuation of PrEP (Spinelli et al., 2019). Strategies to ease the burden of visits and re-engage people in care may increase the appropriate use of PrEP (Zucker et al., 2019). Other PrEP modalities such as event driven PrEP (WHO, 2019b) or cabotegravir (Landovitz et al., 2021) may increase PrEP uptake and adherence, and creative follow-up methods implemented during the COVID-19 pandemic, including off-site and phone visits may support PrEP use (PEPFAR, 2021).

Retention in the PrEP project was low; less than one-fifth (18%) of participants continued PrEP for the entire 12 months. Higher retention has been observed in the United States and Brazil (e.g., 78%–80% follow-up at 48 weeks) (Grinsztejn et al., 2018; Liu et al., 2016). In a community-led free PrEP service program in Thailand in 2016–2017, among 1467 MSM and 230 TGW, 44% were taking PrEP at 12 months (Phanuphak et al., 2018). The length

of time one uses PrEP should be guided by risk of HIV infection, which may vary over time (Haberer, 2016). Participants in our project whose self-perceived risk of HIV infection was moderate or high were more likely to continue to use PrEP. Access to information and counseling to help PrEP users accurately estimate their risk of HIV infection should be included in routine PrEP service.

Concerns about PrEP use leading to an increase in HIV associated risk behaviors and its effect on HIV prevention (Hoorneborg et al., 2018) may pose a barrier to PrEP implementation. The randomized trials that demonstrated PrEP efficacy (Baeten et al., 2012; Choopanya et al., 2013; Grant et al., 2010; Tangmunkongvorakul et al., 2013; Thigpen et al., 2012) did not report increases in risk behaviors. However, some observational cohorts found increases of condomless anal intercourse (Grinsztejn et al., 2018; Hoorneborg et al., 2018; Milam et al., 2019) associated with PrEP use. In this PrEP project, reports of condomless anal intercourse declined among PrEP users and non-users during follow-up. Study participants received risk reduction counseling at each visit. Counseling and support services may be less easily accessed outside of study settings and risk compensation may be more likely (Blumenthal & Haubrich, 2014). If PrEP is used correctly, an increase in condomless sex may not lead to an increase in HIV incidence (Blumenthal & Haubrich, 2014; Jenness et al., 2017), but could lead to an increase in other sexually transmitted infections (STIs) (Adams et al., 2019). For this reason, PrEP programs should offer STI diagnosis and treatment services. Risk compensation is likely a dynamic process influenced by personal, psychosocial, or other health issues (Carlo Hojilla et al., 2016) and understanding this dynamic process can help health care providers provide HIV prevention recommendations and support to clients consistent with CDC and WHO recommendations (CDC, 2017; WHO, 2019a).

Clinical trials, observational studies, and case reports have documented acquisition of HIV among people using PrEP (Adams et al., 2019) (Phanuphak et al., 2018). In our project, all seroconversions among PrEP users occurred in those who reported taking less than 4 pills the week prior to the study visit or missed at least one study visit. The 11 participants who seroconverted had been enrolled at community-led sites, suggesting that community-led sites can have an important role in reaching and providing services to people at high risk of HIV infection. Task shifting, capacity building, and ongoing monitoring of the quality of care can support community-based health care providers and contribute to efforts to end the HIV pandemic (Vannakit et al., 2020). Most seroconverters in our study were young MSM who had used post-exposure prophylaxis prior to starting PrEP and who reported unprotected sex in the past six months. These high-risk characteristics should alert health care providers to support PrEP adherence, counseling, and monitoring.

The overall incidence of HIV among all participants was 2.2 (95% CI 1.2–3.9) per 100 person-years. This is lower than incidence estimates among MSM in Bangkok 2003–2015 which ranged from 4.0–7.7 per 100 person-years (Thienkrua et al., 2018; van Griensven et al., 2010; van Griensven et al., 2013; van Griensven et al., 2015; Wasantioopapokakorn et al., 2018). Additional studies are needed to determine if HIV incidence is declining among MSM, and, if so, what factors are responsible for the decline.

Our analysis has several limitations. The high dropout rate of PrEP participants could bias data interpretation: participants who dropped out may have a higher risk of HIV infection than those who remained in the study. Studies evaluating plasma tenofovir levels found low or undetectable levels among seroconverters, suggesting poor adherence (Choopanya et al., 2013; Grinsztejn et al., 2018; Liu et al., 2016; Sivay et al., 2017). Self-reported adherence at each visit in our study ranged from 79–94%, but this may have been an overestimate of PrEP adherence. The relatively small number of participants and limited geographic areas covered by our project may limit generalization of our results to MSM and TGW outside of Bangkok and Chonburi.

Conclusions

As Thailand prepares to scale-up PrEP service nationally, understanding the interest in, use patterns, and adherence to PrEP, and risk behaviors while using PrEP will be important to organizing PrEP services. PrEP uptake and use data from this project provided insights into PrEP implementation that supported the inclusion of PrEP in the Universal Health Plan in Thailand in October 2019 (NHSO, 2020).

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References

- Adams JL, Shelley K, & Nicol MR (2019). Review of real-world implementation data on emtricitabine-tenofovir disoproxil fumarate as HIV Pre-exposure prophylaxis in the United States. *Pharmacotherapy: The Journal of Human Pharmacology and Drug Therapy*, 39(4), 486–500. 10.1002/phar.2240
- Anderson PL, Glidden DV, Liu A, Buchbinder S, Lama JR, Guanira JV, McMahan V, Bushman LR, Casapia M, Montoya-Herrera O, Veloso VG, Mayer KH, Charialertsak S, Schechter M, Bekker LG, Kallas EG, & Grant RM & iPrEx Study, T (2012). Emtricitabine-tenofovir concentrations and pre-exposure prophylaxis efficacy in men who have sex with men. *Science Translational Medicine*, 4(151), 151ra125. 10.1126/scitranslmed.3004006
- Baeten JM, Donnell D, Ndase P, Mugo NR, Campbell JD, Wangisi J, Tappero JW, Bukusi EA, Cohen CR, Katabira E, Ronald A, Tumwesigye E, Were E, Fife KH, Kiarie J, Farquhar C, John-Stewart G, Kania A, Odoyo J, ... PartnersPrE. P. S. T. (2012). Antiretroviral prophylaxis for HIV prevention in heterosexual men and women. *New England Journal of Medicine*, 367(5), 399–410. 10.1056/NEJMoa1108524 [PubMed: 22784037]
- Bavinton BR, & Grulich AE (2021). HIV pre-exposure prophylaxis: Scaling up for impact now and in the future. *The Lancet Public Health*, 6(7), e528–e533. 10.1016/S2468-2667(21)00112-2 [PubMed: 34087117]

- Blumenthal J, & Haubrich RH (2014). Will risk compensation accompany pre-exposure prophylaxis for HIV? *AMA Journal of Ethics*, 16(11), 909–915. 10.1001/virtualmentor.2014.16.11.stas1-1411
- Carlo Hojilla J, Koester KA, Cohen SE, Buchbinder S, Ladzekpo D, Matheson T, & Liu AY (2016). Sexual behavior, risk compensation, and HIV prevention strategies Among participants in the San Francisco PrEP demonstration project: A qualitative analysis of counseling notes. *AIDS and Behavior*, 20(7), 1461–1469. 10.1007/s10461-015-1055-5 [PubMed: 25835463]
- CDC. Information about acute HIV infection and PrEP. Retrieved July 21, 2021 from https://www.cdc.gov/hiv/pdf/prep_gl_patient_factsheet_acute_hiv_infection_english.pdf
- CDC. (2017). Preexposure prophylaxis for the prevention of HIV infection in the United States 2021–2017 update: A clinical practice guideline. Retrieved from <https://www.cdc.gov/hiv/pdf/risk/prep/cdc-hiv-prep-guidelines-2017.pdf>
- CDC. (2021). Preexposure prophylaxis for the prevention of HIV infection in the United States 2021 update clinical practice guideline. <https://www.cdc.gov/hiv/pdf/risk/prep/cdc-hiv-prep-guidelines-2021.pdf>
- Chan PA, Mena L, Patel R, Oldenburg CE, Beauchamps L, Perez-Brumer AG, Parker S, Mayer KH, Mimiaga MJ, & Nunn A (2016). Retention in care outcomes for HIV pre-exposure prophylaxis implementation programmes among men who have sex with men in three US cities. *Journal of the International AIDS Society*, 19(1), Article 20903. 10.7448/IAS.19.1.20903 [PubMed: 27302837]
- Choopanya K, Martin M, Suntharasamai P, Sangkum U, Mock PA, Leethochawalit M, Chiamwongpaet S, Kitisin P, Natrujirote P, Kittimunkong S, Chuachoowong R, Gvetadze RJ, McNicholl JM, Paxton LA, Curlin ME, Hendrix CW, Vanichseni S, & Bangkok Tenofovir Study G (2013). Antiretroviral prophylaxis for HIV infection in injecting drug users in Bangkok, Thailand (the Bangkok Tenofovir Study): A randomised, double-blind, placebo-controlled phase 3 trial. *The Lancet*, 381(9883), 2083–2090. 10.1016/S0140-6736(13)61127-7
- DDC. (2013). Guideline on HIV counseling & testing for same day result (in Thai). Retrieved from <http://klb.ddc.moph.go.th/dataentry/handbook/form/31>
- Dombrowski JC, Golden MR, Barbee LA, & Khosropour CM (2018). Patient disengagement from an HIV preexposure prophylaxis program in a sexually transmitted disease clinic. *Sexually Transmitted Diseases*, 45(9), e62–e64. 10.1097/OLQ.0000000000000823 [PubMed: 29485544]
- Estimation of People Living with HIV. (2020). <https://hivhub.ddc.moph.go.th/epidemic.php>
- Grant RM, Lama JR, Anderson PL, McMahan V, Liu AY, Vargas L, Goicochea P, Casapia M, Guanira-Carranza JV, Ramirez-Cardich ME, Montoya-Herrera O, Fernandez T, Veloso VG, Buchbinder SP, Chariyalertsak S, Schechter M, Bekker LG, Mayer KH, Kallas EG & ... iPrEx Study, T. (2010). Preexposure chemoprophylaxis for HIV prevention in men who have sex with men. *New England Journal of Medicine*, 363(27), 2587–2599. 10.1056/NEJMoa1011205 [PubMed: 21091279]
- Grinsztejn B, Hoagland B, Moreira RI, Kallas EG, Madruga JV, Goulart S, Leite IC, Freitas L, Martins LMS, Torres TS, Vasconcelos R, De Boni RB, Anderson PL, Liu A, Luz PM, Veloso VG, & Pr, E. P. B. S. T. (2018). Retention, engagement, and adherence to pre-exposure prophylaxis for men who have sex with men and transgender women in PrEP Brasil: 48 week results of a demonstration study. *The Lancet HIV*, 5 (3), e136–e145. 10.1016/S2352-3018(18)30008-0 [PubMed: 29467098]
- Haberer JE (2016). Current concepts for PrEP adherence in the PrEP revolution. *Current Opinion in HIV and AIDS*, 11 (1), 10–17. 10.1097/COH.0000000000000220 [PubMed: 26633638]
- Han J, Bouey JZ, Wang L, Mi G, Chen Z, He Y, Viviani T, & Zhang F (2019). PrEP uptake preferences among men who have sex with men in China: Results from a National Internet Survey. *Journal of the International AIDS Society*, 22(2), e25242. 10.1002/jia2.25242 [PubMed: 30724470]
- Hoorneborg E, Coyer L, van Laarhoven A, Achterbergh R, de Vries H, Prins M, van der Loeff MS, & Amsterdam Pr, E. P. P. t. i. t. H. I. V. T. E. A. I(2018). Change in sexual risk behaviour after 6 months of pre-exposure prophylaxis use: Results from the Amsterdam pre-exposure prophylaxis demonstration project. *Aids (London, England)*, 32(11), 1527–1532. 10.1097/QAD.0000000000001874 [PubMed: 29762169]
- Jenness SM, Sharma A, Goodreau SM, Rosenberg ES, Weiss KM, Hoover KW, Smith DK, & Sullivan P (2017). Individual HIV risk versus population impact of risk compensation after HIV preexposure prophylaxis initiation among Men Who have Sex with Men. *PLoS One*, 12(1), e0169484. 10.1371/journal.pone.0169484 [PubMed: 28060881]

- Kazi DS, Katz IT, & Jha AK (2019). Preparing to End the HIV epidemic — California’s route as a road Map for the United States. *New England Journal of Medicine*, 381 (26), 2489–2491. 10.1056/NEJMp1912293 [PubMed: 31774949]
- Lachowsky NJ, Lawson Tattersall T, Sereda P, Wang C, Edwards J, & Hull M (2019). Community awareness of, use of and attitudes towards HIV pre-exposure prophylaxis (PrEP) among men who have sex with men in Vancouver, Canada: Preparing health promotion for a publicly funded PrEP program. *Sexual Health*, 16(2), 180–186. 10.1071/SH18115 [PubMed: 31040001]
- Landovitz RJ, Donnell D, Clement ME, Hanscom B, Cottle L, Coelho L, Cabello R, Chariyalertsak S, Dunne EF, Frank I, Gallardo-Cartagena JA, Gaur AH, Gonzales P, Tran HV, Hinojosa JC, Kallas EG, Kelley CF, & Losso MH, Madruga JV, ... Team, H. S (2021). Cabotegravir for HIV prevention in cis-gender Men and transgender women. *New England Journal of Medicine*, 385(7), 595–608. 10.1056/NEJMoa2101016 [PubMed: 34379922]
- Liu AY, Cohen SE, Vittinghoff E, Anderson PL, Doblecki-Lewis S, Bacon O, Chege W, Postle BS, Matheson T, Amico KR, Liegler T, Rawlings MK, Trainor N, Blue RW, Estrada Y, Coleman ME, Cardenas G, Feaster DJ, Grant R, ... Kolber MA (2016). Preexposure prophylaxis for HIV infection integrated with municipal- and community-based sexual health services. *JAMA Internal Medicine*, 176(1), 75–84. 10.1001/jamainternmed.2015.4683 [PubMed: 26571482]
- Martin M, Vanichseni S, Suntharasamai P, Sangkum U, Mock PA, Chaipung B, Worrajittanon D, Leethochawalit M, Chiamwongpaet S, Kittimunkong S, Gvetadze RJ, McNicholl JM, Paxton LA, Curlin ME, Holtz TH, Samandari T, Choopanya K, & Bangkok Tenofovir Study G (2017). Factors associated with the uptake of and adherence to HIV pre-exposure prophylaxis in people who have injected drugs: An observational, open-label extension of the Bangkok Tenofovir Study. *The Lancet HIV*, 4(2), e59–e66. 10.1016/S2352-3018(16)30207-7 [PubMed: 27866873]
- Milam J, Jain S, Dube MP, Daar ES, Sun X, Corado K, Ellorin E, Blumenthal J, Haubrich R, Moore DJ, Morris SR, & Team C (2019). Sexual risk compensation in a Pre-exposure prophylaxis demonstration study Among individuals at risk of HIV. *JAIDS Journal of Acquired Immune Deficiency Syndromes*, 80(1), e9–e13. 10.1097/QAI.0000000000001885 [PubMed: 30334877]
- NHSO. (2020). UCS: 10 outstanding accomplishments in 2020. Retrieved from <https://eng.nhso.go.th/view/1/DescriptionNews/UCS-10-outstanding-accomplishments-in-2020/267/EN-US>
- Niderost S, Gredig D, Hassler B, Uggowitz F, & Weber P (2018). The intention to use HIV-pre-exposure prophylaxis (PrEP) among men who have sex with men in Switzerland: Testing an extended explanatory model drawing on the unified theory of acceptance and use of technology (UTAUT). *Zeitschrift Fur Gesundheitswissenschaften = Journal of Public Health*, 26(3), 247–259. 10.1007/s10389-017-0869-1 [PubMed: 29780687]
- Ongwandee S, Lertpiriyasawat C, Khawcharoenporn T, Chetchotisak P, Thiansukhon E, Leerattanapetch N, Leungwaranan B, Manopaiboon C, Phoorisri T, Visavakun P, Jetsawang B, Poolsawat M, Nookhai S, Vasanti-Uppapokakorn M, Karuchit S, Kittinunvorakoon C, Mock P, Prybylski D, Sukkul AC, ... Martin M (2018). Implementation of a test, treat, and prevent HIV program among men who have sex with men and transgender women in Thailand, 2015–2016. *PLoS One*, 13(7), e0201171. 10.1371/journal.pone.0201171 [PubMed: 30044867]
- PEPFAR. (2021). PEPFAR technical guidance in context of COVID-19 pandemic. Retrieved July 7, 20/21 from <https://www.state.gov/wp-content/uploads/2020/09/9.17.2020-PEPFAR-Technical-Guidance-During-COVID.pdf>
- Phanuphak N, Sungsing T, Jantarapakde J, Pengnonyang S, Trachunthong D, Mingkwanrungruang P, Sirisakyot W, Phiayura P, Seekaew P, Panpet P, Meekrua P, Praweprai N, Suwan F, Sangtong S, Brutrat P, Wongsri T, Na Nakorn PR, Mills S, Avery M, ... Phanuphak P (2018). Princess PrEP program: The first key population-led model to deliver pre-exposure prophylaxis to key populations by key populations in Thailand. *Sexual Health*, 15(6), 542–555. 10.1071/SH18065 [PubMed: 30249317]
- Plotzker R, Seekaew P, Jantarapakde J, Pengnonyang S, Trachunthong D, Linjongrat D, Janyam S, Nakpor T, Charoenying S, Mills S, Vannakit R, Cassell M, Phanuphak P, Lertpiriyasawat C, & Phanuphak N (2017). Importance of risk perception: Predictors of PrEP acceptance among Thai MSM and TG women at a community-based health service. *JAIDS Journal of Acquired Immune Deficiency Syndromes*, 76(5), 473–481. 10.1097/QAI.0000000000001536 [PubMed: 28902071]

- Sivay MV, Li M, Piwowar-Manning E, Zhang Y, Hudelson SE, Marzinke MA, Amico RK, Redd A, Hendrix CW, Anderson PL, Bokoch K, Bekker LG, van Griensven F, Mannheimer S, Hughes JP, Grant R, Eshleman SH, & Team HAS (2017). Characterization of HIV seroconverters in a TDF/FTC PrEP Study: HPTN 067/ADAPT. *JAIDS Journal of Acquired Immune Deficiency Syndromes*, 75(3), 271–279. 10.1097/QAI.0000000000001374 [PubMed: 28328548]
- Spinelli MA, Scott HM, Vittinghoff E, Liu AY, Gonzalez R, Morehead-Gee A, Gandhi M, & Buchbinder SP (2019). Missed visits associated With future preexposure prophylaxis (PrEP) discontinuation Among PrEP users in a municipal primary care health network. *Open Forum Infectious Diseases*, 6(4), ofz101. 10.1093/ofid/ofz101 [PubMed: 30949540]
- Tangmunkongvorakul A, Chariyalertsak S, Amico KR, Saokhieo P, Wannalak V, Sangangamsakun T, Goicochea P, & Grant R (2013). Facilitators and barriers to medication adherence in an HIV prevention study among men who have sex with men in the iPrEx study in Chiang Mai, Thailand. *AIDS Care*, 25(8), 961–967. 10.1080/09540121.2012.748871 [PubMed: 23252473]
- Thailand National Guidelines on HIV/AIDS Treatment and Prevention 2017. (2017). Retrieved 29 November 2019 from http://www.thaiaidssociety.org/images/PDF/hiv_thai_guideline_2560.pdf
- Thienkrua W, van Griensven F, Mock PA, Dunne EF, Raengsakulrach B, Wimonasate W, Howteerakul N, Ungsedhapand C, Chiwarakorn A, & Holtz TH (2018). Young men who have sex with men at high risk for HIV, Bangkok MSM cohort study, Thailand 2006–2014. *AIDS and Behavior*, 22(7), 2137–2146. 10.1007/s10461-017-1963-7 [PubMed: 29138981]
- Thigpen MC, Kebaabetswe PM, Paxton LA, Smith DK, Rose CE, Segolodi TM, Henderson FL, Pathak SR, Soud FA, Chillag KL, Mutanhaurwa R, Chirwa LI, Kasonde M, Abebe D, Buliva E, Gvetadze RJ, Johnson S, & Sukalac T, Thomas VT, ... Group, T. D. F. S. (2012). Antiretroviral preexposure prophylaxis for heterosexual HIV transmission in Botswana. *New England Journal of Medicine*, 367(5), 423–434. 10.1056/NEJMoa1110711 [PubMed: 22784038]
- UNAIDS. (2016). Prevention GAP report. Retrieved from https://www.unaids.org/sites/default/files/media_asset/2016-prevention-gap-report_en.pdf
- van Griensven F, Holtz TH, Thienkrua W, Chonwattana W, Wimonasate W, Chaikummao S, Varangrat A, Chemnasiri T, Sukwicha W, Curlin ME, Samandari T, Chitwarakorn A, & Mock PA (2015). Temporal trends in HIV-1 incidence and risk behaviours in men who have sex with men in Bangkok, Thailand, 2006–13: An observational study Bangkok, Thailand, 2006–13: An observational study. *The Lancet HIV*, 2(2), e64–e70. 10.1016/S2352-3018(14)00031-9 [PubMed: 26424462]
- van Griensven F, Thienkrua W, McNicholl J, Wimonasate W, Chaikummao S, Chonwattana W, Varangrat A, Sirivongrangson P, Mock PA, Akarasewi P, & Tappero JW (2013). Evidence of an explosive epidemic of HIV infection in a cohort of men who have sex with men in Thailand. *Aids (london, England)*, 27(5), 825–832. 10.1097/QAD.0b013e32835c546e [PubMed: 23169330]
- van Griensven F, Varangrat A, Wimonasate W, Tanpradech S, Kladsawad K, Chemnasiri T, Suksripanich O, Phanuphak P, Mock P, Kanggarnruea K, McNicholl J, & Plipat T (2010). Trends in HIV prevalence, estimated HIV incidence, and risk behavior among men who have sex with men in Bangkok, Thailand, 2003–2007, estimated HIV incidence, and risk behavior among men who have sex with men in Bangkok, Thailand, 2003–2007. *JAIDS Journal of Acquired Immune Deficiency Syndromes*, 53(2), 234–239. 10.1097/QAI.0b013e3181c2fc86 [PubMed: 19901844]
- Vannakit R, Janyam S, Linjongrat D, Chanlearn P, Sittikarn S, Pengnonnyang S, Janamnuysook R, Termvanich K, Ramautarsing R, Phanuphak N, & Phanuphak P (2020). Give the community the tools and they will help finish the job: Key population-led health services for ending AIDS in Thailand. *Journal of the International AIDS Society*, 23(6), e25535. 10.1002/jia2.25535 [PubMed: 32515869]
- Wasantioopapokakorn M, Manopaiboon C, Phoorisri T, Sukkul A, Lertpiriyasuwat C, Ongwandee S, Langkafah F, Kritsanavarin U, Visavakum P, Jetsawang B, Nookhai S, Kitwattanachai P, Weerawattanayotin W, Losirikul M, Yenyarsun N, Jongchotchatchawal N, & Martin M (2018). Implementation and assessment of a model to increase HIV testing among men who have sex with men and transgender women in Thailand, 2011–2016. *AIDS Care*, 30(10), 1239–1245. 10.1080/09540121.2018.1492697 [PubMed: 29950108]

- Wheellock A, Eisingerich AB, Ananworanich J, Gomez GB, Hallett TB, Dybul MR, & Piot P (2013). Are Thai MSM willing to take PrEP for HIV prevention? An analysis of attitudes, preferences and acceptance. *PLoS One*, 8(1), e54288. 10.1371/journal.pone.0054288 [PubMed: 23342121]
- WHO. (2019a). Guideline on when to start antiretroviral therapy and on pre-exposure prophylaxis for HIV. Retrieved from <https://www.who.int/publications/i/item/9789241509565>
- WHO. (2019b). Technical brief: What's the 2 + 1 + 1? Event-driven oral pre-exposure prophylaxis to prevent HIV for men who have sex with men: Update to who's recommendation on oral PrEP. Retrieved from <https://www.who.int/publications/i/item/what-s-the-2-1-1-event-driven-oral-pre-exposure-prophylaxis-to-prevent-hiv-for-men-who-have-sex-with-men>
- Yang D, Chariyalertsak C, Wongthanee A, Kawichai S, Yotruean K, Saokhieo P, Guadamuz T, Suwanvanichkij V, Beyrer C, & Chariyalertsak S (2013). Acceptability of pre-exposure prophylaxis among men who have sex with men and transgender women in Northern Thailand. *PLoS One*, 8(10), e76650. 10.1371/journal.pone.0076650 [PubMed: 24116132]
- Zablotska I, Grulich AE, Phanuphak N, Anand T, Janyam S, Poonkasetwattana M, Baggaley R, van Griensven F, & Lo YR (2016). PrEP implementation in the Asia-pacific region: Opportunities, implementation and barriers. *Journal of the International AIDS Society*, 19(7 (Suppl 6)), 21119. 10.7448/IAS.19.7.21119. [PubMed: 27760688]
- Zucker J, Carnevale C, Richards P, Slowikowski J, Borsa A, Gottlieb F, Vakkur I, Hyden C, Olender S, Cohall A, Gordon P, & Sobieszczyk ME (2019). Predictors of disengagement in care for individuals receiving Pre-exposure prophylaxis (PrEP). *JAIDS Journal of Acquired Immune Deficiency Syndromes*, 81(4), 104–108. 10.1097/QAI.0000000000002054.

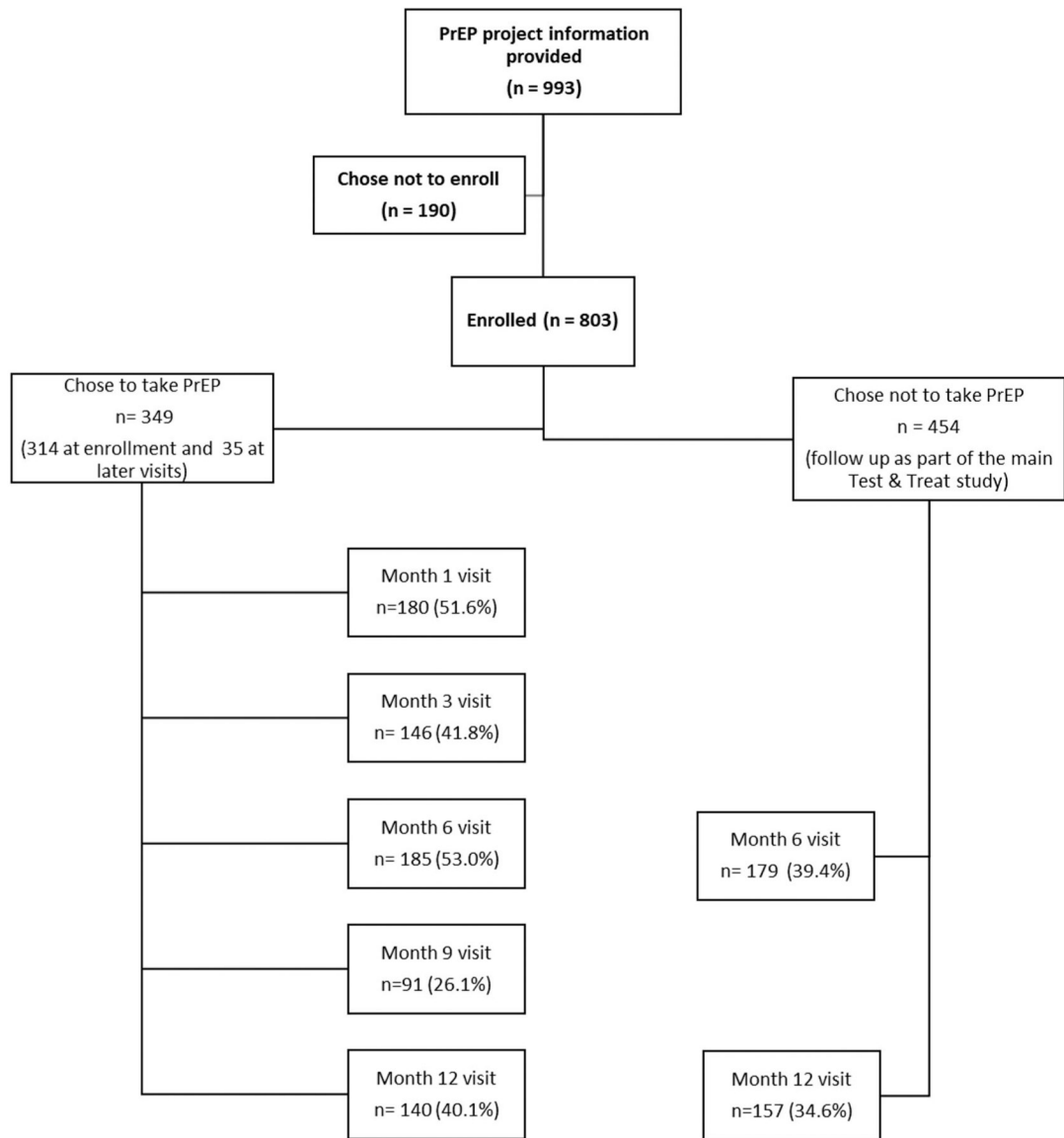


Figure 1. Enrollment and follow up in the HIV pre-exposure prophylaxis (PrEP) project, Thailand 2015–2018.

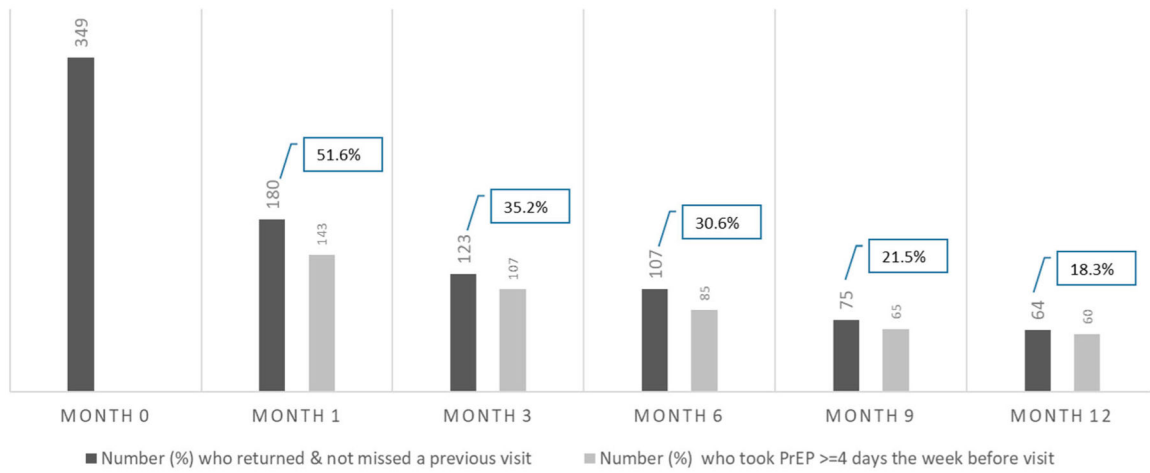


Figure 2. Participant retention and adherence to pre-exposure prophylaxis (PrEP) through 12 months in the PrEP project, Thailand 2015–2018.

Table 1. Baseline characteristics of participants in the HIV pre-exposure prophylaxis (PrEP) project, Thailand 2015–2018.

Characteristics	Overall <i>N</i> = 803	Chose to take PrEP at enrollment <i>n</i> = 314	Chose not to take PrEP at enrollment <i>n</i> = 489	<i>p</i> -value
Recruitment Areas				
Pattaya	245	113 (46.1)	132 (53.9)	0.007 ^c
Bangkok/Perimeter	558	201 (36.0)	357 (64.0)	
Age				
Mean (SD)	26.9 (7.3)	26.8 (6.7)	27.0 (7.7)	0.67 ^a
Median (IQR)	24.9 (21.2–30.6)	25.4 (21.6–29.9)	24.3 (21.1–31.2)	
18–25 years old	409	148 (36.2)	261 (63.8)	0.08 ^c
> 25 years old	394	166 (42.1)	228 (57.9)	
Self-identified as				
Man who has sex with men	523	189 (36.1)	334 (63.9)	0.02 ^c
Transgender woman	280	125 (44.6)	155 (55.4)	
Marital status				
Single	576	216 (37.5)	360 (62.5)	0.01 ^d
Living with male partner	202	93 (46.0)	109 (54.0)	
Divorced or separated from female partner	3	1 (33.3)	2 (66.7)	
Married and living with female partner	20	3 (15.0)	17 (85.0)	
Education				
Less than bachelor's degree	568	231 (40.7)	337 (59.3)	0.55 ^c
Bachelor's or higher degree	233	83 (35.6)	150 (64.4)	
Occupation				
Unemployed/student	254	76 (29.9)	178 (70.1)	<0.001 ^c
Employed	378	150 (39.7)	228 (60.3)	
Sex worker	170	88 (51.8)	82 (48.2)	
Monthly Income (Thai Baht)				
10,000	390	144 (36.9)	246 (63.1)	0.16
>10,000	360	151 (41.9)	209 (58.0)	

Characteristics	Overall N = 803	Chose to take PrEP at enrollment n = 314	Chose not to take PrEP at enrollment n = 489	p-value
Tested for HIV in the past 6 months				
No	445	140 (31.5)	305 (68.5)	<0.001 ^c
Yes	343	170 (49.6)	173 (50.4)	
Data missing	15	4 (26.7)	11 (73.3)	
Diagnosed with syphilis at baseline				
No	755	293 (38.8)	462 (61.2)	0.50 ^c
Yes	48	21 (43.7)	27 (56.3)	
Risk behaviors				
Age at first sexual intercourse (years)				
Median (IQR)	17	17 (15.0–19.0)	17 (15.0–19.0)	0.58 ^b
<17	335	129 (38.5)	206 (61.5)	0.74 ^c
17	451	179 (39.7)	272 (60.3)	
Data missing	17	6 (35.3)	11 (64.7)	
Number of sexual partners in the past 6 months (male, female, and/or TGW partners)				
No partners/single partner	163	64 (39.3)	99 (60.7)	0.70 ^c
Multiple partners	482	181 (37.6)	301 (62.4)	
Information missing	158	69 (43.7)	89 (56.3)	
Self-perceived HIV risk in the past 6 months				
No risk	106	24 (22.6)	82 (77.4)	<0.001 ^c
Mild	293	113 (38.6)	180 (61.4)	
Moderate	244	103 (42.2)	141 (57.8)	
High	155	74 (47.7)	81 (52.3)	
Information missing	5	0 (0)	5 (100.0)	
Condom use in the past 6 months*				
100% condom use/did not have sex	229	98 (42.8)	131 (57.2)	0.21 ^c
Had condomless sex	568	216 (38.0)	352 (62.0)	
Refused to answer/Information missing	6	0 (0)	6 (100)	
Reported use of intravenous drugs				

Characteristics	Overall N = 803	Chose to take PrEP at enrollment n = 314	Chose not to take PrEP at enrollment n = 489	p-value
Never injected illicit drugs	742	293 (39.5)	449 (60.5)	0.82 ^d
Injected illicit drugs but not in the past 6 months	9	4 (44.4)	5 (55.6)	
Injected illicit drugs in the past 6 months but did not share needles with others	12	4 (33.3)	8 (66.7)	
Injected illicit drugs in the past 6 months and shared needles with others	1	0 (0)	1 (100.0)	
Non-injecting drug use* in the past 6 months				
No	556	213 (38.3)	343 (61.7)	0.22 ^c
Yes	213	92 (43.2)	121 (56.8)	
Refused to answer/Information missing	34	9 (26.5)	25 (73.5)	
Amphetamine-type stimulants* used past 6 months				
No	760	292 (38.4)	468 (61.6)	0.06 ^c
Yes	37	20 (54.0)	17 (46.0)	
Information missing	6	2 (33.3)	4 (66.7)	
Circumcised				
No	608	237 (38.9)	371 (61.0)	0.84 ^c
Yes	82	31 (37.8)	51 (62.2)	
Information missing	113	46 (40.7)	67 (59.3)	
Had symptoms or was diagnosed with a sexually transmitted infection in the past 6 months				
No	539	193 (35.8)	346 (64.2)	0.01 ^c
Yes	56	29 (51.8)	27 (48.2)	
Not sure	185	84 (45.4)	101 (54.6)	
Refused to answer	23	8 (34.8)	15 (65.2)	
Summary PrEP knowledge score (10 points)*				
Mean (SD)	7.9 (1.4)	8.2 (1.3)	7.8 (1.5)	0.003 ^b
Median (IQR)	8 (7-9)	8 (7-9)	8 (7-9)	
Score <=8	426	166 (39.0)	260 (61.0)	0.04 ^c
Score >8	304	142 (46.7)	162 (53.3)	
Information missing	73	6 (8.21.9)	67 (91.813.7)	

Characteristics	Overall <i>N</i> = 803	Chose to take PrEP at enrollment <i>n</i> = 314	Chose not to take PrEP at enrollment <i>n</i> = 489	<i>p</i> -value
Attitudes toward PrEP				
Feel embarrassed to take PrEP				
Yes (definitely yes/maybe yes)	55	16 (29.0)	39 (71.0)	0.04 ^c
No (probably not/definitely not)	677	292 (43.1)	385 (56.9)	
Information missing	71	6 (8.5)	65 (91.5)	
Feel anxious to take PrEP				
Yes (definitely/maybe)	257	85 (33.0)	172 (67.0)	<0.001 ^c
No (probably/definitely)	467	220 (47.1)	247 (52.9)	
Information missing	79	9 (11.4)	70 (88.6)	
Reported barriers to PrEP use				
Cost	296	113 (38.2)	183 (61.8)	0.08 ^c
Side effects	405	159 (39.3)	246 (60.7)	0.08 ^c
Do not like to take medicine	135	27 (20.0)	108 (80.0)	<0.001 ^c
Forget to take medicine	383	182 (47.5)	201 (52.5)	0.002 ^c
Concerned family will know (I take an HIV drug)	116	45 (38.8)	71 (61.2)	0.43 ^c
Concerned partner will know (I take an HIV drug)	71	28 (39.4)	43 (60.6)	0.63 ^c
Concerned people will know that I am gay/ TGW	27	12 (44.4)	15 (55.6)	0.80 ^c
Concerned people will think I have HIV	203	99 (48.8)	104 (51.2)	0.02 ^c
Use other HIV prevention tools	33	10 (30.3)	23 (69.7)	0.16 ^c
Others	10	5 (50.0)	5 (50.0)	-
Taking PrEP prevents HIV				
Yes (definitely/maybe)	722	308 (42.7)	414 (57.3)	0.004 ^d
No (probably/definitely)	11	0 (0)	11 (100)	
Information missing	70	6 (8.6)	64 (91.4)	

^aTwo-sample t-test.^bMann-Whitney two-statistic.

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^c Chi-square test.

^d Fisher's exact test.

* Condoms used: consistent condoms use with regular sexual partner, casual sexual partner, commercial sex worker, person who gives you money/goods, sexual partner who is an illicit intravenous drug user in the past 6 months. We combined participants who responded that they did not have sexual intercourse with participants who reported 100% condom use.

Non-injecting drug used: participants who reported at least one of these drugs; alcohol, methamphetamines, ecstasy, ketamine, poppers, heroin, cocaine, marihuana, LSD, barbiturate, Viagra, used drug but unsure of what it is called.

Amphetamine type stimulants used: include participants who reported methamphetamine use (including Ice, crystal meth, speed).

PrEP knowledge score: Participants completed a questionnaire at enrollment to assess their knowledge of PrEP. Each of the 10 questions had a value of one, and we considered answering 8 questions correctly to demonstrate a knowledge of PrEP use.

Table 2. Demographic and behavioral characteristics associated with PrEP use at enrolment, Thailand 2015–2018.

Factor	Chose to take PrEP/Total (%)	Univariate			Multivariate		
		Odds Ratio	95% CI	p-value	Odds Ratio	95% CI	p-value
Recruitment areas							
Pattaya	113/245 (46.1)	1				1	
Bangkok/perimeter	201/558 (36.0)	0.7	0.5–0.9	0.01	0.5	0.3–0.7	<0.001
Age							
18–25 years old	148/409 (36.2)	1					
>25 years old	166/394 (42.1)	1.3	0.9–1.7	0.12			
Self-identified as							
Man who has sex with men	189/523 (36.1)	1					
Transgender woman	125/280 (44.6)	1.2	0.9–1.7	0.19			
Marital status							
Living with male partner, married and living with female partner	96/222 (43.2)	1			1		
Single, divorced, or separated from female partner	217/579 (37.5)	0.7	0.5–1.0	0.06	0.6	0.5–0.9	0.01
Education groups							
Bachelor or higher degree	83/233 (35.6)	1					
Less than Bachelor's degree	231/568 (40.7)	1.1	0.8–1.6	0.47			
Sex worker							
No	226/632 (35.8)	1			1		
Yes	88/170 (51.8)	1.8	1.2–2.7	0.01	1.7	1.0–2.8	0.03
Monthly Income (Thai Baht)							
10,000	144/390 (36.9)	1					
>10,000	151/360 (41.9)	1.2	0.9–1.7	0.16			
Age at first sexual intercourse (years)							
<17	129/335 (38.5)	1					
17	179/451 (39.7)	1.1	0.8–1.5	0.40			
Number of sexual partners in the past 6 months (male, female and/or TGW partners)							
No partner/one partner	64/163 (39.3)	1					
More than one partner	181/482 (37.6)	0.7	0.3–1.8	0.44			

Factor	Chose to take PrEP/Total (%)	Univariate			Multivariate		
		Odds Ratio	95% CI	p-value	Odds Ratio	95% CI	p-value
Perceived HIV risk in past 6 months							
No risk or mild risk	137/399 (34.3)	1			1		
Moderate risk or high risk	177/399 (44.4)	1.6	1.2–2.1	0.002	1.7	1.2–2.3	0.001
Condom use in past 6 months							
Had condomless sex	216/568 (38.0)	1					
100% condom use/did not have sex	98/229 (42.8)	1.2	0.9–1.7	0.21			
Circumcised (male participants)							
Yes	237/608 (39.0)	1					
No	31/82 (37.8)	1.0	0.6–1.6	0.92			
Used illicit drugs in the past 6 months							
No	213/556 (38.3)	1					
Yes	92/213 (43.2)	1.1	0.8–1.5	0.56			
Had symptoms or diagnosis of a sexually transmitted infection in the past 6 months							
No or not sure	277/724 (38.3)	1			1		
Yes	29/56 (51.8)	1.8	1.1–3.2	0.03	1.8	1.0–3.3	0.06
PrEP knowledge score							
Score 8	166/426 (39.0)	1			1		
Score > 8	142/304 (46.7)	1.6	1.1–2.1	0.01	1.5	1.1–2.0	0.02

Note:

-All variables with p-values <0.1 in univariate analysis were included in the multivariate analysis. Pearson correlation coefficient and chi-square test were used to detect multicollinearity amongst explanatory variables and one of a pair of highly correlated variables was removed from multivariate analysis

- Condoms use: consistent condoms use with regular sexual partner, casual sexual partner, commercial sex worker, person who gives you money/goods, sexual partner who is an illicit intravenous drug user in the past 6 months. We defined participants who responded that they did not have sexual intercourse in the past 6 months as part of the safe sex group.

-PrEP knowledge score: Participants completed a questionnaire at enrollment to assess their knowledge of PrEP. Each of the 10 questions had a value of one, and we considered answering 8 questions correctly to demonstrate a knowledge of PrEP use.

-Value may not add up to total due to missing data

- Pearson correlation coefficient and chi-square test were used to detect multicollinearity amongst explanatory variables and one of a pair of highly correlated variables (marital status, education, occupation and income) and marital status was included in the multivariate analysis

Table 3. Factors associated with PrEP retention and adherence through 12 months, Thailand 2015–2018.

Baseline Factor	Number adherent to PrEP through 12 months/Total (%)	Univariate			Multivariate		
		Odds Ratio	95% CI	p-value	Odds Ratio	95% CI	p-value
Recruitment areas							
Pattaya	4/117 (3.4%)	1			1		
Bangkok/Perimeter	56/232 (24.1%)	8.9	3.2–25.5	<0.001	7.9	2.7–23.2	<0.001
Age							
18–25 years old	19/167 (11.4)	1			1		
>25 years old	41/182 (22.5)	2.5	1.4–4.7	0.01	2.1	1.1–4.1	0.02
Self-identified as							
Transgender woman	14/136 (17.6)	1					
Man who has sex with men	46/213 (21.6)	1.5	0.7–2.9	0.28			
Marital status							
Living with male partner, married and living with female partner	20/107 (18.7)	1					
Single, divorced, or separated from female partner	40/241 (16.6)	1.3	0.7–2.3	0.44			
Education							
Less than Bachelor's degree	27/247 (10.9)	1			1		
Bachelor or higher degree	33/102 (32.4)	2.8	1.5–5.1	<0.001	2.2	1.2–4.2	0.01
Sex worker							
No	56/259 (21.6)	1					
Yes	4/90 (4.4)	0.5	0.1–1.6	0.25			
Monthly Income (Thai baht)							
10,000	23/159 (14.5)	1					
>10,000	37/170 (21.8)	1.5	0.8–2.7	0.18			
Age at first sexual intercourse(years)							
<17	16/140 (11.4)	1					
17	44/203 (21.7)	1.6	0.8–3.0	0.18			
Number of sexual partners in the past 6 months							
-No partner/one partner	17/70 (24.3)	1					
-More than one partner	39/203 (19.2)	0.9	0.5–1.7	0.69			

Baseline Factor	Number adherent to PrEP through 12 months/Total (%)	Univariate			Multivariate		
		Odds Ratio	95% CI	p-value	Odds Ratio	95% CI	p-value
Perceived HIV risk in the past 6 months							
-No risk or mild risk	17/147 (11.6)	1			1		
-Moderate or high risk	43/201 (21.4)	2.0	1.1–3.7	0.03	2.3	1.2–4.4	0.02
Condom use in the past 6 months							
Had condomless sex	36/242 (14.9)	1			1		
-100% condom use/ did not have sex	24/107 (22.4)	1.7	0.9–3.1	0.09	1.9	1.0–3.5	0.06
Circumcised (male participants)							
-Yes	6/38 (15.8)	1					
-No	51/260 (19.6)	1.4	0.6–3.7	0.45			
Used illicit drugs in the past 6 months							
-No	47/240 (19.6)	1					
-Yes	13/97 (13.4)	1.1	0.5–2.3	0.77			
Had symptoms or was diagnosed with a sexually transmitted disease in the past 6 months							
-No/ Not sure	51/309 (16.5)	1					
-Yes	8/30 (26.7)	1.4	0.6–3.3	0.48			
PrEP knowledge score							
-Score 8	24/180 (13.3)	1					
-Score >8	36/162 (22.2)	1.3	0.7–2.3	0.40			

Note: -All variables with p-values < 0.1 in univariate analysis were included in the multivariate analysis. Pearson correlation coefficient and chi-square test were used to detect multicollinearity amongst explanatory variables and one of a pair of highly correlated variables was removed from multivariate analysis

-Value may not add up to total due to missing data

Trends in behaviors of participants* in the HIV pre-exposure prophylaxis (PrEP) demonstration project, Thailand 2015–2018

Table 4.

	Baseline	Month 6	Month 12	p-value
	Number (%)	Number (%)	Number (%)	
Condom use in the past 6 months				
<i>Started PrEP (n = 349)</i>				
100% condom use	107/349 (30.7)	94/179 (52.5)	71/135 (52.6)	<0.001 ^Q
<i>Did not start PrEP (n = 454)</i>				
100% condom use	122/448 (27.2)	94/175 (53.7)	74/157 (47.1)	<0.001 ^Q
Number of sexual partners in the past 6 months				
<i>Started PrEP (n = 349)</i>				
Median (IQR)	4 (2–10)	2 (1–6)	2 (1–5)	<0.001 ^J
Multiple partners	203/273 (74.4)	82/135 (60.7)	62/108 (57.4)	<0.001 ^Q
<i>Did not start PrEP (n = 454)</i>				
Median (IQR)	4 (2–6)	2 (1–4)	2 (1–4)	<0.001 ^J
Multiple partners	279/372 (75.0)	75/145 (51.7)	68/128 (53.1)	<0.001 ^Q
HIV risk perception				
<i>Started PrEP (n = 349)</i>				
Moderate/high	201/348 (57.8)	70/180 (38.9)	45/135 (33.3)	<0.001 ^Q
<i>Didn't start PrEP (n = 454)</i>				
Moderate/high	198/450 (44.0)	40/179 (22.3)	33/157 (21.0)	<0.001 ^Q
Used illicit drugs in the past 6 months				
<i>Started PrEP (n = 349)</i>				
Yes	97/337 (28.8)	42/174 (24.1)	27/135 (20.0)	0.12 ^Q
<i>Didn't start PrEP (n = 454)</i>				
Yes	116/432 (26.8)	35/173 (20.2)	30/155 (19.3)	0.08 ^Q
Used amphetamine-type stimulants				
<i>Started PrEP (n = 349)</i>				
Yes	20/346 (5.8)	9/178 (5.1)	6/135 (4.4)	0.83 ^Q

	Baseline	Month 6	Month 12	p-value
<i>Didn't start PrEP (n = 454)</i>				
Yes	17/451 (3.8)	2/178 (1.1)	4/157 (2.5)	0.19 <i>Q</i>

* Data from participants who showed up at month six and twelve and completed behavioral questionnaires

J Jonckheere-Terpstra test;

Q Cochran's Q Test IQR Interquartile range.

-Value may not add up to total number of participants follow up for each month due to missing data

Table 5. HIV incidence among participants in the HIV pre-exposure prophylaxis (PrEP) project, Thailand 2015–2018.

	Number of participants who seroconverted	Person time at risk (years)	HIV incidence per 100 person-years (95% CI)
PrEP project participants ($N = 803$)	11	507.7	2.2 (1.1–3.9)
Participants who did not start PrEP ($n = 454$)	6	273.7	2.2 (0.8–4.8)
Participants who started PrEP ($n = 349$)	5	234.0	2.1 (0.6–5.0)
Incidence for those who retained for 12 months with good adherence ($n = 60$)	0	79.8	0 (0–3.8)*
Incidence for those who started but reported poor adherence the week prior to at least one study visit and/or missed at least one study visit ($n = 289$)	5	154.2	3.2 (1.1–7.6)

* 1-side Confidence Interval.