AIDS and Behavior (2024) 28:2089–2100
https://doi.org/10.1007/s10461-024-04308-z

ORIGINAL PAPER

Continuing Low Awareness and Use of Pre-exposure Prophylaxis (PrEP) for HIV among People Who Inject Drugs (PWID), San Francisco, 2022

Bow Suprasert[1] · Moranda Tate[1] · Danyion Reagan[1] · Raul Ruiz[1] · Katherine Gao[1] · Katherine McNaughton[1] · Kassandra Miller[1] · Alexander Marr[3] · Kelly D. Taylor[3,4] · Erin C. Wilson[1,2] · Willi McFarland[1,2]

Accepted: 4 March 2024 / Published online: 25 March 2024

Abstract

Clinical trials provide evidence that pre-exposure prophylaxis (PrEP) prevents HIV acquisition including through sharing of injection equipment among people who inject drugs (PWID). However, uptake among many populations at risk for HIV has been slow, particularly among PWID. We examined data from the National HIV Behavioral Surveillance (NHBS) from San Francisco in 2022 to measure PrEP uptake and identify factors associated with PrEP awareness among PWID. Of 479 PWID with HIV-negative or unknown HIV status, 54.9% were aware of PrEP, 5.9% had discussed PrEP with a healthcare provider, and 1.5% had used PrEP in the past year. Lack of PrEP awareness was associated with being age 50 years and older (adjusted odds ratio [aOR] 0.40, 95% CI 0.27–0.60), being men who have sex with women (vs. men who have sex with men, aOR 0.47, 95% CI 0.24–0.92), having a disability (aOR 0.58, 95% CI 0.35–0.95), using heroin as their most frequently injected drug (aOR 0.51, 95% CI, 0.34–0.78), not having tested for HIV, HCV, or an STD in the past year (aOR 0.43, 95% CI 0.28–0.64), and not having access to new sterile needles in the past year (aOR 0.28, 95%CI 0.08–1.00). We found negligible change in the awareness and uptake of PrEP among PWID since previously measured in NHBS in 2018. Low PrEP use among PWID may be addressed by increasing provider discussion of PrEP with their PWID patients and clients during routine care, expanding testing for injection-related infections among PWID, and integrating PrEP access into harm reduction programs.

Keywords People who inject drugs (PWID) · HIV prevention · Pre-exposure prophylaxis (PrEP) · PrEP awareness · PrEP uptake

Introduction

San Francisco has made progress toward the goal of ending the HIV epidemic by 2030 [1, 2] for some populations [3, 4]. Over the ten years between 2012 and 2021, new diagnoses of HIV among men who have sex with men (MSM) decreased by 78% [3]. Unfortunately, similar gains have not materialized for people who inject drugs (PWID). The same period saw only a 14% decrease in new HIV diagnoses among PWID, with a worrisome *increase* in new diagnoses from 2019 to 2021. PWID now account for 25% of new HIV diagnoses in San Francisco.

Rapid scale-up of HIV pre-exposure prophylaxis (PrEP) has been a pillar of San Francisco's effort to end the HIV epidemic over the past several years [1–4]. Daily oral PrEP can reduce the risk of HIV acquisition from sexual exposure

✉ Bow Suprasert
bow.suprasert@sfdph.org

1 Department of Public Health, Center for Public Health Research, San Francisco, CA 94102-6033, USA

2 Department of Epidemiology and Biostatistics, University of California San Francisco, San Francisco, CA, USA

3 Institute of Global Health Sciences, School of Medicine, University of California San Francisco, San Francisco, CA, USA

4 Department of Medicine, Division of Prevention Science, University of California San Francisco, San Francisco, CA, USA

by as much as 99% when taken as prescribed according to a synthesis of data from the Centers for Disease Control and Prevention (CDC) [5]. While there are fewer studies available for exposure through sharing injection equipment [6, 7], the CDC estimates the risk of HIV can be reduced by as much as 74% among PWID [5]. Unfortunately, PrEP use appears to be lagging behind for PWID compared to communities at risk for HIV through sexual transmission. In 2020, PrEP coverage, defined as prescriptions for persons with indications for PrEP, was estimated at 75% in San Francisco overall [3]. However, PrEP use among PWID was measured at only 3.0% in the National HIV Behavioral Surveillance (NHBS) survey conducted in San Francisco in 2018 [8].

Low PrEP use among PWID may be due to a low level of engagement across several steps of the PrEP care continuum [9]. The NHBS study conducted in 2018 showed slightly more than half (56.7%) of PWID were aware of PrEP [8]. Fewer PWID (38.9%) reported that PrEP can protect against HIV transmission through sharing injection equipment, and only 13.6% had discussed PrEP with a healthcare provider in the past year [8]. Vigilant tracking of the uptake of PrEP among PWID is necessary to close gaps in HIV prevention efforts for this population. We therefore assessed data from the most recent round of NHBS for PWID in San Francisco, conducted in 2022, to update information on the level of use and potential barriers to uptake among PWID across the PrEP continuum. We also examined associations with PrEP awareness to identify which specific populations among PWID may be experiencing greater barriers to PrEP.

Methods

Sampling Design and Recruitment

The present report used cross-sectional survey data from San Francisco's 2022 round of the National HIV Behavioral Surveillance (NHBS). The primary purpose of NHBS is to track HIV prevalence and related risk and preventive behaviors among key populations on a periodic cycle using comparable methods. NHBS is led nationally by the Centers for Disease Control and Prevention (CDC) in multiple cities in the US with annual rounds of surveys that rotate by key population, including MSM, PWID, trans women, and high-risk heterosexuals. The 2022 round recruited PWID from June to December 2022. The methods for NHBS overall have been detailed elsewhere [10]. The methods used for the present report were the same as those used in the previous NHBS round for PWID in San Francisco in 2018 [8]. In brief, the PWID round of NHBS uses respondent-driven sampling (RDS) to recruit approximately 500 eligible participants. RDS is a peer-referral recruitment strategy in which eligible participants are enrolled and asked to refer other eligible persons from their social networks using a study-specific coupon. Eligibility criteria were (1) age 18 years or older, (2) able to complete the interview in English or Spanish, (3) residing in San Francisco or San Mateo counties, (4) presenting a valid NHBS recruitment coupon, (5) not having previously participated in the current survey, and (6) injecting drugs without a prescription in the past 12 months. The last criterion was validated by using answers to a series of questions demonstrating knowledge of how to inject drugs, where to obtain them locally, and terminology in current use by PWID.

Recruitment began with consenting and enrolling 10 non-randomly selected PWID as "seeds" who were referred to the study by service providers. After completing all study procedures, these seeds were given five coupons and instructed to use them to recruit up to five individuals in their network circle who met the eligibility criteria. Referred, eligible PWID completed the same study procedures, and were in turn given five coupons to refer other eligible PWID. These waves of recruitment continued until the target sample size was achieved and the composition of the total sample stabilized on key demographic and risk characteristics. Participants were given $75 upon completion of the survey, $25 for the collection of blood specimens for rapid HIV testing, and $15 for each successful peer referral. Referrals were made to HIV prevention services, harm reduction programs, substance use treatment, and HIV care.

Measures

Data were collected through face-to-face interviews conducted at the study site. The NHBS survey instrument included sociodemographic characteristics, sexual and drug use behaviors, and awareness and use of HIV prevention services. Variables in the present analysis included age, sex, sexual orientation, race/ethnicity, education, employment, income, disabilities, residence, housing situation, incarceration, drugs injected, health insurance, and engagement with health care and preventive services.

Our outcomes of primary interest in the present analysis were indicators of engagement with PrEP. Because persons who know they are HIV positive would not be eligible for PrEP, we excluded participants who self-reported as having a prior HIV-positive test result. Participants who self-reported as HIV negative or of unknown serostatus were asked about their awareness and use of PrEP. Questions were adapted from the framework of the "PrEP care continuum" and were identical to those asked in 2018 [8, 9]. The framework comprised (1) PrEP awareness, (2) discussion of PrEP with a healthcare provider (HCP), and (3) PrEP use in

the past 12 months. PrEP awareness was asked in the following manner: "Pre-exposure prophylaxis, or PrEP, is an antiretroviral medicine, such as Truvada, taken for months or years by a person who is HIV-negative to reduce the risk of getting HIV. Before today, have you ever heard of PrEP?" PrEP discussion with a healthcare provider was asked as "In the past 12 months, have you had a discussion with a healthcare provider about taking PrEP?" PrEP use was asked as "In the past 12 months, have you taken PrEP to reduce the risk of getting HIV?"

Analysis

Results are presented as unweighted as in prior reports using NHBS data [8, 11, 12]. Sample characteristics, including indicators for the PrEP cascade, are described as proportions of the sample with non-missing data for each variable. We conducted further analysis to characterize factors associated with awareness of PrEP within the sample. The χ^2 or Fisher's exact test was first used to assess bivariate differences in awareness of PrEP across groups defined by demographic and behavioral characteristics. Variables that suggested an association with PrEP awareness at $p < 0.2$ were considered for inclusion in multivariable logistic regression analysis. Candidate variables were assessed for collinearity and confounding. After examining the patterns of PrEP awareness across variables, several transformations were made. First, PrEP awareness was complex with respect to sex/gender identity (e.g., men, women, and non-binary/transgender) and sexual behavior (e.g., having sex with men or women). Namely, men who have sex with men (hereafter "MSM") had the highest level of PrEP awareness while men who do not have sex with men had the lowest, and women had intermediate levels of awareness. The effect was that neither sex/gender identity nor sexual behavior was associated with PrEP awareness when examined individually or in multivariable analysis. We therefore created five categories defined by sex/gender identity and sexual behavior to include in the multivariable model (equivalent to interaction terms) as: cis men who have sex with women, cis MSM, cis women who have sex with men, cis women who have sex with women, and other gender identity. Second, several variables with multiple response categories were collapsed into two categories based on only one category being associated with PrEP awareness. These were age above vs. below 50 years, heroin vs. other drug as the most often injected, and testing for any infectious disease vs. not testing for an infectious disease in the past 12 months. Lastly, we combined disabilities into one dichotomous variable (i.e., any vs. no disability). The criterion for retention in the final multivariable model was being independently associated with PrEP awareness at $p < 0.05$. Akaike's criterion of the final multivariate model was 597.9 and df = 10. Adjusted odds ratios (aOR) and 95% confidence interval were reported adjusting for all variables included in the model. Analyses were conducted using STATA 17 software [13].

Ethical Considerations

The study was reviewed and approved by the Internal Review Board (IRB) of the University of California San Francisco (IRB#19-29460). Data were collected anonymously. Participants provided verbal informed consent.

Results

A total of 527 eligible PWID were enrolled over a maximum of 19 recruitment waves, of whom 48 reported previously testing HIV positive, leaving 479 with HIV negative or unknown serostatus for analysis of PrEP awareness. Nearly half (46.2%) were 50 years or older, 67.2% were male sex at birth, and 76.3% identified as heterosexual (Table 1). By sex/gender identity and sexual behavior, the majority (55.8%) were men who have sex with women, 11.4% were MSM, 23.6% were women who have sex with men, 7.4% were women who have sex with women, and 1.9% had other gender identity. A plurality (47.4%) identified as non-Hispanic White, while 32.6% identified as Black/African American, and 10.5% as Hispanic/Latino/a. Fewer than half (41.9%) completed high school or received a general education degree (GED); 60.5% were unemployed; and 83.9% had an income that was below the federal poverty level. Reported disabilities were common and overlapping with more than half reporting cognitive disability (56.6%), followed by difficulty doing errands (32.6%), disability with vision (24.3%), hearing (21.4%), and self-care (17.5%). Two-thirds (67.2%) resided in the inner-city neighborhoods of SOMA and Tenderloin. Four-fifths (80.8%) experienced homelessness in the past 12 months and 69.7% reported currently experiencing homelessness. Methamphetamine was the drug most often injected (37.6%), followed by heroin (34.9%).

Table 1 also shows health-related variables as measured in the preceding 12 months during the second half of 2022. Most PWID (91.2%) had health insurance, with Medicaid (i.e., Medi-Cal in California) being most common (75.6%). The majority (76.6%) had a usual source of health care, and 75.3% saw a healthcare provider within the past 12 months. More than half (55.0%) reported experiencing discrimination and 56.0% delayed seeking healthcare services due to perceived stigma they attributed to injecting drugs. Most (94.2%) PWID had ever tested for HIV. Fewer than half of PWID had tested for HIV (44.5%), HCV (44.9%), or an

Table 1 Characteristics of people who inject drugs (PWID) of HIV negative or unknown serostatus, National HIV Behavioral Surveillance (NHBS), San Francisco, 2022 ($N=479$)

Characteristics	N (%)
Total HIV-negative or unknown HIV serostatus	**479 (100)**
Age group in years	
18–29	25 (5.2)
30–39	98 (20.5)
40–49	135 (28.2)
50+	221 (46.2)
Sex[a]	
Male	322 (67.2)
Female	148 (30.9)
Non-binary/transgender	9 (1.9)
Sexual orientation[a,b]	
Heterosexual	360 (76.3)
Homosexual	16 (3.4)
Bisexual	96 (20.3)
Sex/gender identity and sexual behavior[a,b]	
Cis men who have sex with women	265 (55.8)
Cis men who have sex with men (MSM)	54 (11.4)
Cis women who have sex with men	112 (23.6)
Cis women who have sex with women	35 (7.4)
Other gender identity	9 (1.9)
Race/ethnicity[b]	
White	225 (47.4)
Black/African American	155 (32.6)
Hispanic/Latino/a	50 (10.5)
Multiracial	31 (6.5)
Other	14 (3.0)
Education[b]	
Less than high school	76 (15.9)
High school or general education degree (GED)	200 (41.9)
Some college	172 (36.1)
Bachelor's degree or higher	29 (6.1)
Employment status[b]	
Unemployed	289 (60.5)
Unable to work for health reasons	98 (20.5)
Employed full-time	15 (3.1)
Employed part-time	43 (9.0)
Retired	19 (4.0)
Other	14 (2.9)
Household income[b]	
Under federal poverty level ($0–24,999)	379 (83.9)
Up to supplemental poverty level ($25,000–39,999)	42 (9.3)
Above supplemental poverty level (≥$40,000)	31 (6.9)
Disability[b,c]	
Cognition	270 (56.6)
Ambulation	186 (39.0)
Difficulty doing errands	155 (32.6)
Vision	114 (24.3)
Hearing	102 (21.4)
Self-care	84 (17.5)
ZIP Code of residence or where most commonly slept[b]	
SOMA or the Tenderloin	317 (67.2)
Other	155 (32.8)
Experienced homelessness in the past 12 months	387 (80.8)
Currently experiencing homelessness[b]	333 (69.7)

Table 1 (continued)

Characteristics	N (%)
Experienced incarceration in the past 12 months	102 (21.3)
Drug most often injected in the past 12 months	
Methamphetamine	180 (37.6)
Heroin	167 (34.9)
Painkiller	39 (8.1)
Speedball (heroin and cocaine)	24 (5.0)
Fentanyl	23 (4.8)
New speedball (methamphetamine and fentanyl)	17 (3.6)
Goofball (heroin and methamphetamine)	10 (2.1)
Cocaine	9 (1.9)
Other	10 (2.1)
Overall injection frequency in the past 12 months	
More than once a day	271 (56.6)
Once a day	45 (9.4)
More than once a week	100 (20.9)
Once a week or less	63 (13.1)
Sterile needle injection frequency in the past 12 months	
Never/rarely	6 (1.3)
About half the time	18 (3.8)
Most of the time	124 (25.9)
Always	330 (69.0)
Used needle injection frequency in the past 12 months	
Never	435 (91.0)
Rarely	35 (7.3)
About half the time	6 (1.3)
Most of the time	1 (0.2)
Always	1 (0.2)
Had health insurance in the past 12 months	437 (91.2)
Type of health insurance[b]	
Medicaid (Medi-Cal)	357 (75.6)
Medicare	23 (4.9)
Both Medicaid/Medi-Cal and Medicare	15 (3.2)
Private	7 (1.5)
Other	28 (5.9)
None	42 (8.9)
Had a usual source of health care in the past 12 months	367 (76.6)
Saw a healthcare provider in the past 12 months[b]	360 (75.3)
Felt discriminated against when seeking health care or other services because of drug injection, past 12 months[b]	259 (55.0)
Delayed or avoided seeking health care or other services due to perceived stigma around drug injection, past 12 months[b]	265 (56.0)
Ever tested for HIV	451 (94.2)
Tested for HIV in the past 12 months	213 (44.5)
Location of HIV test in the past 12 months	
Public health clinic or community health center	70 (33.5)
Hospital (inpatient)	36 (17.2)
Correctional facility (jail or prison)	26 (12.4)
HIV/AIDS street outreach program or mobile unit	20 (9.6)
HIV counseling and testing site	12 (5.7)
Private doctor's office (including HMO)	10 (4.8)
Drug treatment program	10 (4.8)
Needle or syringe exchange program	7 (3.4)
Other	18 (8.6)
Ever tested for HCV	415 (86.6)
Tested for HCV in the past 12 months	215 (44.9)
Tested for an STD in the past 12 months	169 (35.3)

Table 1 (continued)

Characteristics	N (%)
Had one-on-one conversation with an outreach worker, counselor, or prevention program worker about ways to prevent HIV, past 12 months[b]	81 (17.0)
Participated in any organized session involving a small group of people to discuss ways to prevent HIV, past 12 months[b]	31 (6.5)
Received free condoms (not from friends or partners), past 12 months[b]	303 (63.4)
Received new sterile needles in the past 12 months	465 (97.1)
Received new injection supplies (e.g., cookers, cotton, water), past 12 months	450 (94.0)

[a]Sex/gender identity and sexual behavior were coded as five mutually exclusive categories because PrEP awareness co-varied by these two variables which are not independent of each other (e.g., by definition men who have sex with men [MSM] are men). These categories show the effect that PrEP awareness was lowest among cis men who have sex with women and highest among MSM (Tables 2 and 3), while gender identity and sexual behavior separately were not associated with PrEP. The effect is equivalent to an interaction term between gender identity and sexual behavior

[b]All percentages were reported on non-missing values. Don't know, refuse, or not applicable coded as missing

[c]Number and percentage may exceed total due to multiple responses allowed

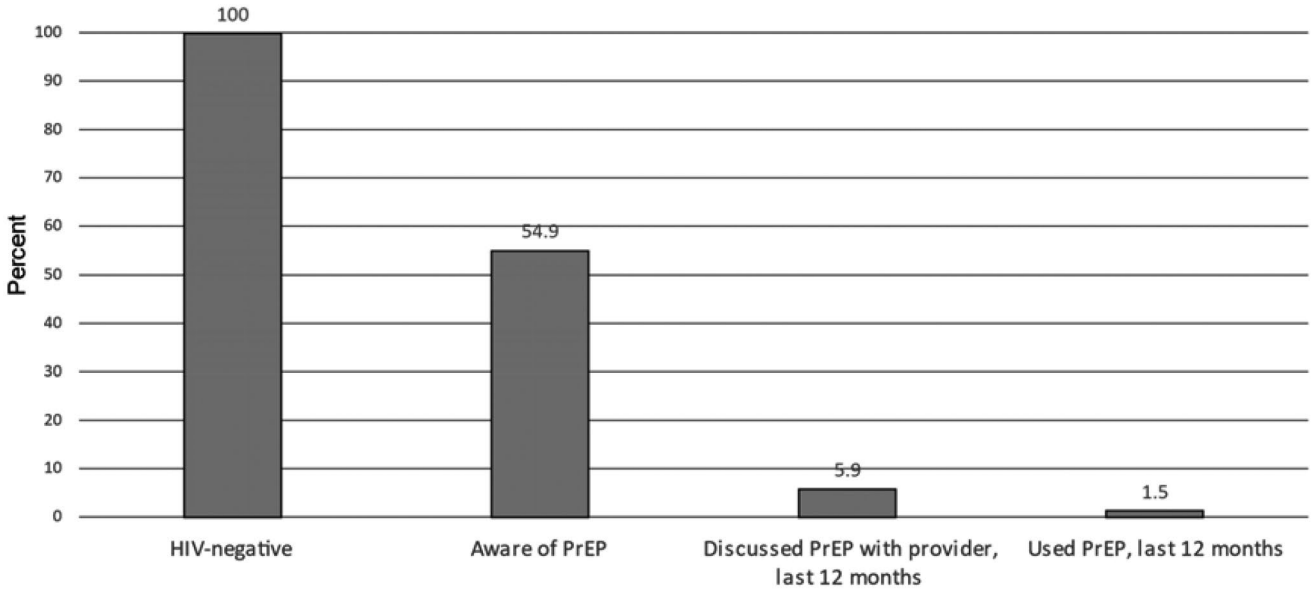

Fig. 1 Continuum of engagement with pre-exposure prophylaxis (PrEP) among people who inject drugs (PWID), San Francisco, 2022

STD (35.3%) in the past 12 months. Of PWID who received an HIV test in the past 12 months, commonly reported locations were public health clinics or community health centers (33.5%), hospitals (17.2%), and correctional facilities (12.4%). Most (97.1%) PWID had received new sterile needles in the past 12 months; 69.0% reported always injecting with sterile needles.

Figure 1 illustrates indicators of engagement with PrEP, or the PrEP continuum. Slightly over half (54.9%) of PWID with HIV-negative or unknown serostatus had heard of PrEP. Only 5.9% discussed PrEP with a healthcare provider in the past 12 months. Few (1.5%) had taken any PrEP in the past 12 months. Of the seven PWID who took PrEP in the past 12 months, five were men who have sex with women.

Table 2 shows PrEP awareness among PWID by demographic and behavioral characteristics. Several variables were significantly associated with awareness of PrEP at the $p < 0.05$ level. Awareness of PrEP was significantly higher among PWID who were aged 18–49 years (66.7% aware), were employed full-time (66.7%), earned above poverty level (77.4%), had health insurance (56.3%), and had tested for HIV, HCV, or an STD in the past 12 months (62.3%). PrEP awareness was significantly lower among PWID who were Black/African American (43.9%), had any disability (52.0%), and had heroin as the drug most frequently injected (40.1%). Other variables considered as candidates for the multivariate analysis ($p < 0.2$) were the sex and sexual orientation categories, education, Zip Code of residence, experiencing homelessness in the past 12 months, seeing a healthcare provider in the past 12 months, and receiving new sterile needles in the past 12 months.

Table 3 shows the final multivariable logistic regression model, retaining factors significantly and independently associated with PrEP awareness at $p < 0.05$ after adjusting

Table 2 PrEP awareness by demographic and behavioral characteristics of people who inject drugs (PWID) of HIV negative or unknown serostatus, National HIV Behavioral Surveillance (NHBS), San Francisco, 2022 ($N=479$)

Characteristics	Not aware of PrEP N (%)	Aware of PrEP N (%)	X^2 Value	P-value
Total	216 (45.1)	263 (54.9)	–	–
Age group in years			31.2	< 0.00
18–49	86 (33.3)	172 (66.7)	4	1
50+	130 (58.8)	91 (41.2)		
Sex/gender identity and sexual behavior			–	0.172
Cis men who have sex with women	132 (49.8)	133 (50.2)		
Cis men who have sex with men (MSM)	18 (33.3)	36 (66.7)		
Cis women who have sex with men	47 (42.0)	65 (58.0)		
Cis women who have sex with women	15 (42.9)	20 (57.1)		
Other gender identity	ns[a]	ns[a]		
Race/ethnicity			–	0.005
White	88 (39.1)	137 (60.9)		
Black/African American	87 (56.1)	68 (43.9)		
Hispanic/Latino/a	24 (48.0)	26 (52.0)		
Multiracial	10 (32.3)	21 (67.7)		
Other racial	ns[a]	ns[a]		
Education			6.35	0.096
Less than high school	40 (52.6)	36 (47.4)		
High school or GED	94 (47.0)	106 (53.0)		
Some college	72 (41.9)	100 (58.1)		
Bachelor's degree or higher	8 (27.6)	21 (72.4)		
Employment status			12.2	0.032
Unemployed	117 (40.5)	172 (59.5)	0	
Unable to work for health reasons	54 (55.1)	44 (44.9)		
Employed full-time	5 (33.3)	10 (66.7)		
Employed part-time	21 (48.8)	22 (51.2)		
Retired	13 (68.4)	6 (31.6)		
Other	5 (35.7)	9 (64.3)		
Household income			6.38	0.041
Under federal poverty level ($0–24,999)	173 (45.7)	206 (54.4)		
Up to supplemental poverty level ($25,000–39,999)	17 (40.5)	25 (59.5)		
Above supplemental poverty level (≥$40,000)	7 (22.6)	24 (77.4)		
Any disability			5.89	0.015
No	36 (34.6)	68 (65.4)		
Yes	180 (48.0)	195 (52.0)		
ZIP Code of residence or where most commonly slept			3.66	0.056
SOMA or Tenderloin (inner city)	132 (41.6)	185 (58.4)		
Other	79 (51.0)	76 (49.0)		
Experienced homelessness in the past 12 months			2.31	0.129
No	48 (52.2)	44 (47.8)		
Yes	168 (43.4)	219 (56.6)		
Currently experiencing homelessness			1.20	0.274
No	71 (49.0)	74 (51.0)		
Yes	145 (43.5)	188 (56.5)		
Experienced incarceration in the past 12 months			0.20	0.654
No	172 (45.6)	205 (54.4)		
Yes	44 (43.1)	58 (56.9)		
Drug most often injected in the past 12 months			22.6	< 0.00
Other than heroin	116 (37.2)	196 (62.8)	4	1
Heroin	100 (59.9)	67 (40.1)		
Had health insurance in the past 12 months			3.87	0.049
No	25 (59.5)	17 (40.5)		

Table 2 (continued)

Characteristics	Not aware of PrEP N (%)	Aware of PrEP N (%)	X^2 Value	P-value
Yes	191 (43.7)	246 (56.3)		
Type of health insurance[1]			7.27	0.201
Medicaid/Medi-Cal	152 (42.6)	205 (57.4)		
Medicare, by itself	11 (47.8)	12 (52.2)		
Both Medicaid/Medi-Cal and Medicare	8 (53.3)	7 (46.7)		
Private	ns[a]	ns[a]		
Other	11 (39.3)	17 (60.7)		
None	25 (59.5)	17 (40.5)		
Had a usual source of care in the past 12 months			1.42	0.233
No	56 (50.0)	56 (50.0)		
Yes	160 (43.6)	207 (56.4)		
Saw a healthcare provider in the past 12 months			2.18	0.140
No	60 (50.9)	58 (49.2)		
Yes	155 (43.1)	205 (56.9)		
Felt discriminated against when seeking health care or other services because of drug injection, past 12 months			1.50	0.221
No	102 (48.1)	110 (51.9)		
Yes	110 (42.5)	149 (57.5)		
Delayed or avoided seeking health care or other services due to stigma around drug injection, past 12 months			0.39	0.535
No	97 (46.6)	111 (53.4)		
Yes	116 (43.8)	149 (56.2)		
Had tested for HIV, HCV, or an STD, past 12 months			19.18	< 0.001
No	99 (58.6)	70 (41.4)		
Yes	117 (37.7)	193 (62.3)		
Had one-on-one conversation with an outreach worker, counselor, or prevention program worker about ways to prevent HIV, past 12 months			0.81	0.367
No	183 (46.2)	213 (53.8)		
Yes	33 (40.7)	48 (59.3)		
Participated in any organized session(s) involving a small group of people to discuss ways to prevent HIV in the past 12 months			0.00	0.989
No	202 (45.3)	244 (54.7)		
Yes	14 (45.2)	17 (54.8)		
Received free condoms (not from friends or sex partners) in the past 12 months			0.31	0.577
No	82 (46.9)	93 (53.1)		
Yes	134 (44.2)	169 (55.8)		
Received new sterile needles in the past 12 months			–	0.056
No	ns[a]	ns[a]		
Yes	206 (44.3)	259 (55.7)		
Received new injection supplies (e.g., cookers, cotton, and water) in the past 12 months			1.27	0.260
No	16 (55.2)	13 (44.8)		
Yes	200 (44.4)	250 (55.6)		

[a]Not shown (ns) due to small cell sizes (i.e., < 5) to preserve confidentiality

P-value based on χ^2 or Fisher's exact test

for all variables included in the table. Reference categories were chosen to consistently show which groups were likely to lack awareness of PrEP; that is, all risk factors are shown with odds ratios < 1.00. PrEP awareness was significantly lower for PWID who were aged 50 years or older (aOR 0.40, 95% CI 0.27, 0.60), were men who have sex with women (aOR 0.47, 95% CI 0.24, 0.92), had any disability (aOR 0.58, 95% CI 0.35, 0.95), reported heroin as their most frequently injected drug (aOR 0.51, 95% CI 0.34, 0.78), had not tested for HIV, HCV, or an STD in the past 12 months (aOR 0.43, 95% CI 0.28, 0.64), and had not received new sterile needles in the past 12 months (aOR 0.28, 95% CI 0.08, 1.00).

Table 3 Associations with PrEP awareness among people who inject drugs of HIV negative or unknown serostatus, National HIV Behavioral Surveillance (NHBS), San Francisco, 2022 ($N=479$)

	Adjusted odds ratio[a,b](295% CI)
Age group in years	
18–49	Ref
50+	0.40*** (0.27–0.60)
Sex/gender identity and sexual behavior	
Cis men who have sex with women	0.47* (0.24, 0.92)
Cis men who have sex with men (MSM)	Ref
Cis women who have sex with men	0.73 (0.35, 1.54)
Cis women who have sex with women	0.57 (0.22, 1.48)
Other gender identity	1.16 (0.24, 5.73)
Any disability	
No	Ref
Yes	0.58* (0.35, 0.95)
Drug most often injected in the past 12 months	
Other than heroin	Ref
Heroin	0.51** (0.34, 0.78)
Tested for HIV, HCV, or an STD in the past 12 months	
No	0.43*** (0.28, 0.64)
Yes	Ref
Received new sterile needles in the past 12 months	
No	0.28* (0.08, 1.00)
Yes	Ref

[a]Odds ratios < 1.0 correspond to likelihood of not being aware of PrEP

[b]Adjusted for the other variables listed in the table

*$p<0.05$; **$p<0.01$; ***$p<0.001$ based on Wald's χ^2 test

Discussion

We observed low (1.5%) PrEP use among PWID sampled for NHBS in San Francisco in 2022, with no increase, or possible decrease, since measured at 3.0% four years earlier using the same methods [8]. This low proportion of PrEP use among PWID is alarming given that we observed 12 new HIV-positive diagnoses in our current PWID sample. Moreover, PWID have been the only group with a substantial increase in newly reported HIV cases in surveillance data in San Francisco in recent years [3]. Such a slow trajectory of uptake of PrEP among PWID stands in contrast to other populations at risk for HIV. For example, the 2021 NHBS survey of MSM in San Francisco recorded PrEP use in the past year at 67.8% [14], increasing from 43.4% in 2017, [15], and from 9.9% in 2014 [16]. Although lagging a few years behind MSM, PrEP use among trans women increased to 44.8% in the past 12 months in the NHBS survey conducted in 2020 [17], up from no detected use (0%) in a comparable survey conducted in 2013 [15, 17]. PrEP coverage measured as receiving a prescription for PrEP among all persons meeting eligibility criteria was estimated at 75% in San Francisco in 2020, considerably higher than for California as a whole (26%) and the US (25%) [3] and above the Ending the Epidemic target of 50% [18]. Our finding of low PrEP use for PWID is unfortunately consistent with other cities in the US, ranging from 0 to 3% in a recent review that included 10 studies from 2013 to 2020, with the upper figure from San Francisco in 2018 [19]. In the aggregate national data for the PWID NHBS in 2018, use of PrEP in the past year was 1.1% [12]. Given the past few years have seen no decrease, or a possible increase, in the number of new cases of HIV among PWID reported to the city health department [3], the low and stagnant level of PrEP use among PWID highlight a worsening inequity in HIV prevention. If unaddressed, our data point to a looming failure in achieving the goal of getting to zero new HIV infections in San Francisco by 2030 [1, 2, 4].

Data on steps of the PrEP continuum show substantial upstream barriers to PrEP use among PWID, beginning with any awareness of PrEP at all. We found that only somewhat more than half (54.9%) of PWID were aware of PrEP. As with PrEP use, PrEP awareness among PWID has not improved and possibly worsened since it was measured at 56.7% in San Francisco's NHBS in 2018 [8]. The level of awareness of PrEP among PWID also stands in contrast to high levels of awareness among other populations at risk for HIV. PrEP awareness was 96.7% among MSM in San Francisco in 2017 and 94.0% among trans women in 2020 [17, 20]. It is possible that many PWID perceive PrEP as an HIV prevention method that is for MSM and trans women due to how it has been promoted; that is, campaigns may have been designed to appeal to and reach LGBT communities [8, 21, 22]. In support of this hypothesis, the 2018 NHBS noted that all seven of seven PWID who had used PrEP were also MSM [8]. In the current NHBS, PWID who were MSM had the highest level of awareness (66.7%) and men who have sex with women had the lowest (50.2%). Although in the current NHBS five of seven PWID who had used PrEP in the past 12 months were men who have sex with women, the absolute numbers are manifestly small. Despite the slight difference in the sex/gender identity and sexual behavior variable that we used, our findings are consistent with a study conducted in New York City, which found that gay or bisexual male PWID were more likely to be aware of PrEP than heterosexual male PWID [23]. Aggregate PrEP awareness among PWID in the national data for the 2018 NHBS was 25.7% [12]. While not the only barrier, low awareness of PrEP must be addressed by messages specifically

reaching PWID before appreciable improvement in the use of PrEP can be achieved.

Low PrEP use may also stem from apparent uncertainty about PrEP's efficacy for PWID, given that only 38.9% of PWID were aware that PrEP can prevent HIV transmission through sharing needles when asked in 2018 [8]. This may also be a concern for clinicians given that there are fewer empirical data on the efficacy of PrEP in preventing HIV transmission through sharing injection equipment, including only one clinical trial [7]. The one clinical trial among PWID found the relative risk of acquiring HIV with PrEP use to be 0.51 (or a 49% reduction in risk). Moreover, there is uncertainty in whether the prevention effect was achieved by reducing sexual or parenteral transmission. In comparison, a recent meta-analysis of six clinical trials including MSM found the combined relative risk of acquiring HIV with PrEP use to be 0.25 (or a 75% reduction in risk) [6]. Unfortunately, the question on whether PrEP can prevent transmission from sharing injection equipment was not asked in 2022. Nonetheless, based on available evidence, the meta-analysis concluded that PrEP is safe and effective for PWID [6] and the WHO and CDC recommend PrEP as an HIV prevention method for PWID [24, 25].

Despite the evidence and guidelines, the offering of PrEP to PWID from healthcare providers is low. Only 5.9% of PWID had discussed PrEP with a provider in the present NHBS in 2022. Again, this PrEP continuum indicator shows no improvement, or a possible decline, since measured at 13.6% in 2018 [8]. For comparison, 64.7% of trans women discussed PrEP with a healthcare provider in San Francisco in the 2020 NHBS [17]. The same study found the odds of discussing PrEP with a provider to be 10.5 times higher among trans women who received healthcare [17]. We found no similar association among PWID in the present NHBS study. This is of particular concern, considering our data found over 90% of PWID have health insurance, 77% have a regular source of healthcare, and 75% had a healthcare visit in the past year. The aggregated NHBS data from 22 US cities in 2018 found that 74% of PWID had health insurance, 48% had a regular source of healthcare, and 80% had a healthcare visit in the past year [26]. Given our indicators of comparatively high healthcare engagement among PWID in our present NHBS, the lack of PrEP discussion between healthcare providers and their PWID patients is a substantial missed opportunity. The perception of weaker evidence for PrEP's efficacy to prevent HIV acquisition through sharing injection equipment may be a reason for some healthcare providers being less willing or less confident in discussing PrEP with PWID patients [21]. An assumption that PWID would have poor PrEP adherence might also affect healthcare providers' willingness to offer PrEP [27]. Guise et al. proposed other hypotheses to explain lower engagement of PWID with PrEP, including discrimination ("addictophobia"), apathy, and inattention to HIV prevention needs [28]. Notable majorities of PWID in our survey said they experienced discrimination when seeking healthcare or delayed seeking healthcare due to perceived stigma they attributed to injecting drugs, echoing calls for much-needed interventions to destigmatize injection drug use in healthcare settings [22]. Building and strengthening patient-provider trust, open communication, and positive rapport are needed first steps in initiating and continuing PrEP conversations with PWID [29–32].

We also found multiple demographic and behavioral factors associated with low PrEP awareness, pointing to HIV prevention inequities within HIV disparities. By age group, PWID 50 years and older were least likely to be aware of PrEP, consistent with a prior study in California [33]. Older PWID may be overlooked in HIV prevention, perhaps due to mistaken beliefs that older adults are not at risk for HIV [34, 35]. In bivariate analysis, we observed the lowest level of PrEP awareness among Black/African American PWID among racial/ethnic groups. In multivariable analysis, heroin as the drug most frequently injected confounded the association between low PrEP awareness and Black/African-American race/ethnicity. This result is consistent with a study from Stein et al. that reported very low (7.4%) awareness of PrEP among people who use opioids [36]. Whether the effect is due to higher heroin use or other cause, lower PrEP use among Black/African Americans is consistent with a national trend in PrEP inequity [37]. A similar racial/ethnic disparity in PrEP use has been observed for Black/African American women [38] and Black/African American MSM [39]. The inequity in PrEP will fuel a vicious cycle in that effective HIV prevention is not reaching the population where the burden and risk for HIV are highest [40]. A unique insight from our study was low PrEP awareness among PWID living with disabilities. The finding may be a result of providers prioritizing other needs, such as mental health, or inattention to the risk for HIV among persons with disabilities [41]. On a positive note, connection to health and harm reduction services were associated with increased awareness of PrEP. For example, PWID in our survey who had been screened for HIV, HCV, or any STI in the past year were significantly more likely to be aware of PrEP. Similar to our results, Taggart et al. found greater PrEP awareness among adolescents who received HIV testing [42]. Sexual health-related testing and harm reduction programs are therefore poignant opportunities to discuss and offer PrEP to PWID.

There are limitations to our study that should be noted when interpreting findings. First, while RDS is held to produce representative samples of hidden and hard-to-reach populations, this is difficult to prove without a gold standard

survey of the population of PWID. Several theoretical assumptions are required by RDS [43] that are difficult to meet or prove, particularly that participants recruit randomly from their social networks of other eligible PWID. Second, assessing changes in the PrEP continuum between 2018 and 2022 is challenged by the reproducibility of the samples in NHBS [43] given possible external factors (e.g., the COVID-19 pandemic) [3]. Third, we acknowledge weaknesses inherent in cross-sectional surveys, such as limited causal inference, social desirability response bias, and temporality of associations. Fourth, questions that could enhance our understanding of awareness, interest, willingness, acceptability, and use of long-acting injectable PrEP were not asked in the NHBS in 2022. Finally, we recognize that PWID in San Francisco may be different from PWID elsewhere in the US and worldwide. Given high levels of PrEP use among other populations in our city, we might expect the level of use among PWID in San Francisco to be higher than other places, as suggested by the national NHBS data [12]. The situation may therefore be more dire in other cities.

Conclusion

In summary, our data point to a current level PrEP use among PWID that is not likely to have a meaningful impact on HIV transmission in this population. Compared to similar data from 2018, there is no evidence of any improvement in the PrEP continuum in the past four years. If the downward trajectory of new HIV infections overall in San Francisco continues (or resumes post-COVID-19), PWID will become an increasingly larger proportion of our epidemic and the primary challenge in getting to zero HIV by 2030. We also note discouraging disparities in PrEP engagement for groups of PWID who may fall further behind. Encouragingly, we see pragmatic opportunities to reach a large proportion of PWID who access other services. However, studies with healthcare providers who treat PWID are needed to effectively increase PrEP awareness, uptake, and retention among their patients [28, 44].

Acknowledgements We wish to thank the people who inject drugs who gave their time, information, and insights reported here.

Funding Funding for the National HIV Behavioral Surveillance survey was provided by the Centers for Disease Control and Prevention (CDC), grant #NU62PS924778.

Declarations

Ethical Approval The study protocol was reviewed and approved by the Internal Review Board of the University of California San Francisco (IRB#19-29460).

Informed Consent All participants provided verbal informed consent.

Conflict of Interest The authors declare they have no conflicts of interest including financial or non-financial.

References

1. Fauci AS, et al. Ending the HIV Epidemic. JAMA. 2019;321(9):844.
2. Buchbinder SP, Havlir DV. Getting to Zero San Francisco: a collective Impact Approach. J Acquir Immune Defic Syndr. 2019;82(Suppl 3):S176–82.
3. SFDPH, HIV EPIDEMIOLOGY Annual Report 2021 San Francisco. 2021, San Francisco Department of Public Health: https://www.sfdph.org/dph/comupg/oprograms/HIVepiSec/HIVepiSecReports.asp.
4. GTZSF, Getting to Zero SF. 2023 [cited 2023 June 30]; Available from: https://gettingtozerosf.org/.
5. CDC. PrEP effectiveness. 2022 June 6, 2022 [cited 2023; Available from: https://www.cdc.gov/hiv/basics/prep/prep-effectiveness.html#:~:text=How%20effective%20is%20PrEP%3F,99%25%20when%20taken%20as%20prescribed.
6. Murchu O. Oral pre-exposure prophylaxis (PrEP) to prevent HIV: a systematic review and meta-analysis of clinical effectiveness, safety, adherence and risk compensation in all populations. BMJ Open. 2022;12(5):e048478.
7. Choopanya K, et al. 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. Lancet. 2013;381(9883):2083–90.
8. McFarland W, et al. Low PrEP awareness and use among people who inject drugs, San Francisco, 2018. AIDS Behav. 2020;24(5):1290–3.
9. Nunn AS, et al. Defining the HIV pre-exposure prophylaxis care continuum. AIDS. 2017;31(5):731–4.
10. CDC. National HIV Behavioral Surveillance (NHBS). 2023 June 27, 2023 [cited 2023 June 29]; Available from: https://www.cdc.gov/hiv/statistics/systems/nhbs/index.html.
11. Roth A, et al. Factors Associated with awareness of pre-exposure Prophylaxis for HIV among persons who inject drugs in Philadelphia: National HIV behavioral surveillance, 2015. AIDS Behav. 2019;23(7):1833–40.
12. CDC HIVI, Risk, Prevention, Testing Behaviors among Persons Who Inject Drugs—National HIV Behavioral Surveillance. Injection Drug Use, 23 U.S. Cities, 2018, in HIV Surveillance Special Report 24. Centers for Disease Control and Prevention; 2020.
13. StataCorp SS, Software. Release 17. College Station, TX: StataCorp LLC; 2021.
14. CDC HIVI, Risk, Prevention, and Testing Behaviors Among Men Who Have Sex With Men—National HIV Behavioral Surveillance., 13 U.S. Cities, 2021, in HIV Surveillance Special Report 31. 2021: Centers for Disease ControlPrevention.
15. Raymond HF, et al. Community levels of PrEP Use among men who have sex with men by Race/Ethnicity, San Francisco, 2017. AIDS Behav. 2019;23(10):2687–93.
16. Snowden JM, et al. Prevalence and characteristics of users of pre-exposure prophylaxis (PrEP) among men who have sex with men, San Francisco, 2014 in a cross-sectional survey: implications for disparities. Sex Transm Infect. 2017;93(1):52–5.
17. Wilson EC, et al. Improved PrEP awareness and use among Trans women in San Francisco, California. AIDS Behav. 2022;26(2):596–603.

18. CDC. Ending the HIV Epidemic in the U.S. Progress. 2023 June 9, 2023 [cited 2023 June 30]; Available from: https://www.cdc.gov/endhiv/ehe-progress/index.html.
19. Mistler CB, Copenhaver MM, Shrestha R. The pre-exposure Prophylaxis (PrEP) Care Cascade in people who inject drugs: a systematic review. AIDS Behav. 2021;25(5):1490–506.
20. Wilson EC, et al. Disparities in the PrEP continuum for trans women compared to MSM in San Francisco, California: results from population-based cross-sectional behavioural surveillance studies. J Int AIDS Soc. 2020;23(S3):e25539–n/a.
21. Vincent W, McFarland W. Missed opportunities for healthcare providers to discuss HIV preexposure prophylaxis with people who inject drugs. Int J drug Policy. 2022;110:103873–103873.
22. Carter G, et al. Living at the confluence of stigmas: PrEP awareness and feasibility among people who inject drugs in two predominantly Rural States. AIDS Behav. 2021;25(10):3085–96.
23. Walters SM, et al. The role of syringe exchange programs and sexual identity in awareness of pre-exposure prophylaxis (PrEP) for male persons who inject drugs. Int J drug Policy. 2020;77:102671–102671.
24. CDC. HIV Prevention. 2023 February 15, 2023 [cited 2023 30]; Available from: https://www.cdc.gov/hiv/clinicians/prevention/index.html.
25. WHO, Brief T. Differentiated and simplified pre-exposure prophylaxis for HIV prevention: update to WHO implementation guidance. World Health Organization; 2022. p. 48.
26. Lewis R, et al. Healthcare Access and utilization among persons who inject drugs in Medicaid Expansion and Nonexpansion States: 22 United States cities, 2018. J Infect Dis. 2020;222(Suppl 5):S420–8.
27. Bazzi AR et al. Limited knowledge and mixed interest in Pre-exposure Prophylaxis for HIV Prevention among people who inject drugs. AIDS patient care and STDs, 2018. 32(12): p. 529–37.
28. Guise A, Albers ER, Strathdee SA. PrEP is not ready for our community, and our community is not ready for PrEP': pre-exposure prophylaxis for HIV for people who inject drugs and limits to the HIV prevention response: PrEP for PWID and the limits to HIV prevention. Addiction (Abingdon England). 2017;112(4):572–8.
29. Heidari O et al. Understanding healthcare engagement for people who inject drugs. Res Nurs Health, 2023.
30. Dion K, et al. Exploration of the unmet health care needs of people who inject drugs. J Am Assoc Nurse Pract. 2020;32(1):60–9.
31. Biello KB, et al. Perspectives on HIV pre-exposure prophylaxis (PrEP) utilization and related intervention needs among people who inject drugs. Harm Reduct J. 2018;15(1):55–55.
32. King AR, et al. Acceptability of injectable pre-exposure prophylaxis among people who inject drugs in three urban U.S. settings. BMC Infect Dis. 2022;22(1):1–737.
33. Walters SM, et al. HIV Pre-exposure Prophylaxis Prevention Awareness, willingness, and Perceived barriers among people who inject drugs in Los Angeles and San Francisco. Volume 55. Substance use & misuse; 2020. pp. 2016–8. 14.
34. Negin J, Rozea A, Martiniuk AL. HIV behavioural interventions targeted towards older adults: a systematic review. BMC Public Health. 2014;14(1):507.
35. Small LFF. What older adults know about HIV/AIDS: lessons from an HIV/AIDS Education Program. Educ Gerontol. 2010;36(1):26–45.
36. Stein M, Thurmond P, Bailey G. Willingness to Use HIV Pre-exposure Prophylaxis among Opiate users. AIDS Behav. 2014;18(9):1694–700.
37. Samuel K. PrEP inequities have worsened in the US over the last decade, both racially and regionally. 2022.
38. Ojikutu BO, et al. HIV-Related mistrust (or HIV Conspiracy theories) and willingness to Use PrEP among Black women in the United States. AIDS Behav. 2020;24(10):2927–34.
39. Raifman J, et al. Racial and ethnic disparities in HIV Pre-exposure Prophylaxis Awareness among men who have sex with men. AIDS Behav. 2019;23(10):2706–9.
40. 2021, N.C.f.H. Division of HIV Prevention, Viral Hepatitis, STD, and CDC, Diagnoses of HIV Infection in the United States and Dependent Areas, Prevention TB. Editor. 2023: Centers for Disease Control and Prevention.
41. Maroney MR, McGinley M, Rothblum ED. 2020, Oxford University Press. 0.
42. Taggart T, et al. Awareness of and willingness to use PrEP among Black and Latinx adolescents residing in higher prevalence areas in the United States. PLoS ONE. 2020;15(7):e0234821–0234821.
43. Khatib A, et al. Reproducibility of Respondent-Driven Sampling (RDS) in repeat surveys of men who have sex with men, Unguja, Zanzibar. AIDS Behav. 2017;21(7):2180–7.
44. Sullivan PS, Siegler AJ. Getting pre-exposure prophylaxis (PrEP) to the people: opportunities, challenges and emerging models of PrEP implementation. Sex Health. 2018;15(6):522.