Exposing the gaps: HIV prevention perspectives, use, and preferences among priority populations in Seattle, Washington

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Abstract

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While the rate of new HIV diagnoses has decreased over the past decade in Seattle and King County, Washington, HIV incidence remains high among gay, bisexual, and other men who have sex with men (GBMSM), transgender persons, and people who inject drugs (PWID). Biomedical HIV prevention, including daily oral and long-acting injectable pre-exposure prophylaxis (PrEP), has the potential to address these disparities but several individual, interpersonal, and structural barriers can impede uptake and optimal use. To better contextualize HIV incidence in the era of PrEP, it is imperative to understand the population-specific barriers and facilitators to use, the utilization of other behavioral risk reduction methods in the absence of PrEP, and the preferences for different prevention products and delivery models of PrEP-eligible populations.

In the following dissertation, we explore HIV prevention perspectives, use, and preferences among high-incidence populations in Seattle, Washington. In **Chapter II**, we conducted a convergent parallel mixed-methods study among women who inject drugs (WWID) accessing community-based services in North Seattle to explore PrEP uptake, interest, and

facilitators and barriers to use. In **Chapter III**, we described the individual- and partnership-level correlates of the non-use of HIV prevention strategies among GBMSM not on PrEP and seeking HIV testing. In **Chapter IV**, we conducted a discrete choice experiment among GBMSM, transgender persons, and non-binary individuals to estimate preference for different PrEP products and delivery models.

We found that (**Chapter II**) among WWID, interest in PrEP was high but use was low and met with significant misconceptions about PrEP and complex, intersecting barriers to uptake and persistence. (**Chapter III**) Among GBMSM who were not using PrEP, non-use of HIV prevention strategies was significantly higher among participants who used methamphetamine or had never previously tested for HIV. At the partnership level, not knowing a partner's age, meeting a partner in a sex venue, reporting a one-time sexual relationship, and perceptions of non-commitment were associated with non-use of HIV prevention strategies. (**Chapter IV**) Finally, among a similar sample with mixed PrEP experience, we found that product efficacy drove decision-making, and participants preferred highly efficacious long-acting products delivered in non-clinical spaces with a hybrid approach to follow-up PrEP monitoring.

Taken together, our findings reinforce that there is no single solution to HIV prevention that currently meets the needs of all who may benefit. A combination of community-specific HIV prevention messaging and low-barrier, preference-centered PrEP programs could engage a greater proportion of the population and ultimately decrease HIV incidence.

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Dedication

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Chapter I: Introduction

HIV and pre-exposure prophylaxis (PrEP)

In 2012, pre-exposure prophylaxis (PrEP) for HIV prevention was approved for use in the United States (US) after it was found to be a safe and efficacious method of reducing HIV acquisition.[1-3] Currently, tenofovir disoproxil fumarate/emtricitabine and tenofovir alafenamide/emtricitabine are available as oral PrEP medications in the US, and an extended-release injectable form of PrEP, cabotegravir, received approval from the US Food and Drug Administration in December 2021.[4-7] As of 2022, 36% of the estimated 1.2 million people in the US who could benefit from PrEP were prescribed it.[8] Locally in Seattle and King County, Washington, data show approximately 51% of gay, bisexual, and other men who have sex with men (GBMSM), the largest priority group for PrEP in the US, were currently using PrEP.[9] Uptake among other priority groups, including women who inject drugs (WWID), remains low.[9] Since widespread scale-up of oral PrEP, there has been a steady decline in the rate of new HIV diagnoses, but stark disparities in incidence remain.[10]

Women who inject drugs

People who inject drugs accounted for approximately 7% of new HIV infections diagnosed in 2022 in the US.[10,11] Incidence differs by sex and gender; between 2014 and 2018, the rate of new HIV cases in the US remained stable for men who inject drugs but increased by 7% among WWID.[11,12] Compared to men who inject drugs or those who do not inject drugs, WWID are disproportionately exposed to HIV due to intersecting social, behavioral, and structural factors. Data from the National HIV Behavioral Surveillance (NHBS) system show that WWID are more likely to engage in transactional or survival sex (i.e., exchange of money, goods, services, or other survival needs for sex), with city-based estimates nearing up to 70% of those surveyed, and were more likely to living with undiagnosed HIV.[13,14] In addition to having more sexual partners, WWID experience higher rates of receptive syringe sharing, introducing

an additional route of exposure to HIV.[3,13-16] Unstable housing, violence, stigma, and competing priorities also make WWID more likely to acquire HIV while proving to be barriers to care.[13,17-24]

Though the absolute number of WWID diagnosed with HIV each year is low in Seattle and King County, incidence for women remains steady while HIV transmission has largely declined among cisgender men.[9] A 2018 cluster of linked HIV cases in North Seattle exposed a clear lack of HIV prevention services available for WWID.[25] Among the 14 cases detected, 79% were among cisgender women, of whom 91% reported injection drug use and 72% reported exchange sex, with substantial overlap.[25] The 300% increase in incidence led to concentrated efforts to improve uptake of HIV prevention strategies including PrEP.[25]

Local estimates show that PrEP awareness among WWID is high compared to other jurisdictions in the US. Data from the 2021 NHBS cycle found that 36% of WWID in Seattle were aware of PrEP (unpublished data). Meta-analyses found similar estimates of PrEP awareness among WWID: ranging from 7 to 66% in various studies across the US.[26-28] While PrEP awareness and knowledge varies, uptake has been dismal. Estimates of PrEP among WWID range from 0-3% in most US cities and was less than 1% in the 2019 Washington State Syringe Exchange Health Survey (unpublished data).[29-30]

A recent dramatic increase in syphilis cases among cisgender women in Seattle could hint at the possibility of an impending increase in HIV among WWID, especially in the context of low PrEP use.[31] It is crucial to address the shortcomings of our current HIV prevention system and find ways to adapt our approaches before local epidemics shift and become more concentrated among WWID.

Gay, bisexual, and other men who have sex with men

After more than forty years, GBMSM remain disproportionately impacted by HIV. In the US, the estimated lifetime risk for HIV infection among GBMSM is one in six and increases to

one in two and one in four for Black GBMSM and Latinx GBMSM, respectively.[32] Increases in PrEP use among GBMSM has contributed to an overall decline of HIV incidence over the past decade but GBMSM are still overrepresented in the HIV epidemic.

Among GBMSM in King County with the highest likelihood of acquiring HIV, 62% were on PrEP as of 2022.[9] Gaps in PrEP initiation indicate that currently available PrEP options do not meet the needs of all GBMSM. Further, PrEP persistence is important to consider if we expect HIV incidence to continue to decrease. An analysis of data from GBMSM diagnosed with HIV between 2020 and 2021 in King County found that 25% had previously been on PrEP but either discontinued or were not using it effectively.[33] Reasons for discontinuation may be addressed through the introduction of different PrEP products.

To meet the needs of all people exposed to HIV, trials of various PrEP modalities including dermal implants, rectal gels, longer-acting pills, and injectables are currently in progress.[5,34] Newer products that rely less on daily adherence, lead to reduced interaction with the healthcare system, and allow for more discretion are needed to address the disadvantages of currently available PrEP formulations.[35,36]

PrEP is just one HIV prevention option. Other risk reduction methods, especially in the context of sub-optimal PrEP adherence, are important to contextualize HIV incidence. Seroadaptive strategies, including serosorting (choosing sexual partners with the same HIV serostatus), have been used by GBMSM to mitigate HIV risk.[37,38] Data from the Public Health – Seattle & King County (PHSKC) Sexual Health Clinic (SHC) showed that use of non-medication based HIV risk reduction strategies on a population-level had decreased since 2013, as use of antiretroviral treatment (ART) and PrEP increased.[39]

As more biomedical and behavioral options become available in the HIV prevention toolkit, it is imperative to better understand how these products and strategies meet the unique needs of populations for whom disparities in incidence still exist.

Included research

With qualitative and quantitative methods, the included research in this dissertation aims to provide a comprehensive overview of the perceptions and use of different HIV prevention strategies among high priority populations in Seattle, Washington. In **Chapter II**, we conducted a mixed-methods study using a convergent parallel design among WWID to describe insights about HIV, PrEP uptake and interest, and facilitators and barriers to use. In **Chapter III**, we explored associations between individual- and partnership-level characteristics of GBMSM not on PrEP and the non-use of HIV prevention strategies within recent sexual partnerships. In **Chapter IV**, we estimated preference for various PrEP products and delivery models with a discrete choice experiment among GBMSM, transgender persons, and non-binary individuals. Our findings can help contextualize persistent disparities in HIV incidence and further prioritize prevention efforts for communities overrepresented in the HIV epidemic.

Chapter II: PrEP Awareness, Interest, and Use Among Women Who Inject Drugs in Seattle, Washington: A Mixed Methods Study

PrEP Awareness, Interest, and Use Among Women Who Inject Drugs in Seattle, Washington: A Mixed Methods Study

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Abstract

Background: Women who inject drugs (WWID) are disproportionately affected by HIV and experience multiple barriers to PrEP use. We assessed PrEP awareness, interest, and use, and determinants of PrEP utilization among WWID in Seattle, WA.

Setting: We conducted a mixed-methods study among WWID at three community sites in Seattle, Washington from March-May 2023.

Methods: Participants were ≥18 years, spoke English, identified as women, had a history of injecting drugs, and self-reported a negative or unknown HIV status. We describe survey participant characteristics (n=30) by PrEP candidacy based on behaviors associated with HIV acquisition. We concurrently recruited 16 WWID for semi-structured interviews, which were analyzed using Rapid Assessment Process. Survey and interview data were triangulated to enhance interpretations.

Results: Among 30 WWID, 25 (83%) were PrEP candidates, of whom 19 (76%) had heard about PrEP; only 2 (8%) were currently using PrEP. Among PrEP candidates, 13 (57%) reported interest in daily oral PrEP and almost half (n=12, 48%) reported interest in injectable PrEP. Qualitative data revealed cursory PrEP knowledge and a strong interest in daily oral and injectable PrEP among those who perceived they were at risk for HIV. Several barriers to PrEP use were noted including housing instability, adherence challenges, limited perceived risk, and competing priorities like safety and substance use.

Conclusion: While most WWID were aware of PrEP, qualitative data suggested significant misconceptions about PrEP, and many described complex, intersecting barriers to use. Our findings highlight the need for increased low-barrier, population-specific interventions to improve uptake and sustained use of PrEP among WWID.

Introduction

People who inject drugs are disproportionately impacted by HIV, and account for up to 10% of new HIV diagnoses each year.[12] Between 2014 and 2018, the rate of new HIV cases in the United States (US) remained stable for those assigned male sex at birth who inject drugs but increased by 7% among those assigned female sex at birth who inject drugs.[12] WWID experience added HIV risk through sexual contact, including high rates of transactional or survival sex (i.e., exchange of money, goods, services, or other survival needs for sex), and research has shown that individual, interpersonal, and structural factors make WWID more vulnerable to HIV acquisition compared to men who inject drugs.[13,15,16,40,41]

Biomedical HIV prevention, including PrEP, has the potential to address this disparity, and as part of the US' Ending the HIV Epidemic effort, WWID have been named as a PrEP priority population.[3,42,43] However, several barriers to PrEP use have been noted among WWID including lack of awareness, accurate knowledge, accessibility, adherence challenges, stigma, and incongruent risk perception.[21,26,27,41,42,44-46] As of 2022, it was estimated that only 10% of the women living in the US who could benefit from PrEP were using it, and estimates are likely to be lower among WWID specifically.[47]

In Seattle and King County, Washington, HIV transmission has largely declined among gay, bisexual, and other men who have sex with men (GBMSM) in the era of PrEP; similar declines have not been seen among women.[9] A 2018 HIV outbreak among people who inject drugs in King County, 79% (11/14) of whom were cisgender women, exposed the ongoing HIV risk faced by this population and highlighted major gaps in access to care.[25] If PrEP use among cisgender women, including WWID, does not increase, local epidemics could shift and become more concentrated among key populations of women, including those who are living homeless, exchanging sex, and using drugs. To that end, we sought to describe PrEP uptake and interest,

and explore facilitators and barriers to PrEP use among WWID accessing services in North Seattle.

Methods

Study Sample

We conducted a convergent parallel mixed-methods study as formative work for a larger project to deliver community-based pop-up HIV prevention care to WWID in Seattle. Between March and May 2023, we recruited a convenience sample of WWID at three community sites in Seattle for surveys (N=30) and in-depth interviews (IDIs) (N=16). Sites included a day-shelter that provides basic needs for unhoused individuals, a syringe service program, and a mobile opioid treatment program. Participants were ≥18 years old, English-proficient, identified as women, reported a lifetime history of injection drug use, and self-reported a negative or unknown HIV status. A subset of participants (n=4) completed both the survey and the IDI.

Quantitative Data

Participants completed an electronic survey in REDCap that asked about demographics; experiences with medical care; barriers and facilitators to daily medication use; characteristics of drug use including type, frequency, and route; sexual behaviors; sexually transmitted infection (STI) and hepatitis history; and PrEP use and interest (Online Resource 1).[48] The survey was approved by a Community Advisory Board (CAB) consisting of individuals with both professional and lived experience.

We defined PrEP candidacy based on adaptations of the US Public Health Service 2021 PrEP Guidelines.[49] Participants were considered PrEP candidates if they reported no condom use at last penetrative sex, or if in the previous six months they shared injection equipment (e.g., needles or works), had a sexual partner living with HIV, or a bacterial STI diagnosis. We adapted these criteria to include anyone with a sexual partner of unknown HIV status and lifetime diagnosis of a bacterial STI. We also included report of transactional sex as a criterion

for PrEP candidacy. Any participant who reported at least one of these criteria was considered a PrEP candidate. Participants with missing data on PrEP candidacy were omitted from the analysis.

We ran descriptive statistics and compared demographics, sexual and drug use behaviors, and use and interest in PrEP by PrEP candidacy. All quantitative analyses were completed using SAS version 9.4 (SAS Institute, Cary, NC, USA)

Qualitative Data

Semi-structured interviews were conducted in person by two cisgender women (LRV and MAC) who have extensive experience working with populations at risk for HIV, including WWID. The interview guide included questions about overall health and perspectives on healthcare, HIV risk, and PrEP (Online Resource 2). The guide was approved by the CAB. Interviews were audio recorded and transcribed. Participants also completed a brief REDCap survey on demographics, past PrEP use, and recent drug use behaviors.[48]

Interview transcripts were analyzed (LRV, MAC, and EJA) using a Rapid Assessment Process, an intensive and iterative review process intended to rapidly summarize themes using codes and quotations.[50,51] Each IDI transcript was double-coded using an analysis template with *a priori* codes developed using the interview guide and allowing for emergent codes as analysis unfolded. Disagreements in coding were discussed until consensus was reached with the coding team. Templated coding summaries were combined into a matrix to identify cross-cutting themes. Analysis unfolded in multiple, iterative coding rounds, and analysts made use of qualitative coding memos to capture data interpretations and emerging themes at each round.[52]

Data Integration

Data were summarized and triangulated to enhance interpretations of overlapping constructs. Quantitative and qualitative data were presented together for each construct to provide a comprehensive description of PrEP experience and perceptions among our sample of WWID. Final study learnings were verified with the full study team and CAB.

Ethical Considerations

All participants provided verbal informed consent and were reimbursed $25 USD for completion of the survey and/or $50 USD for completion of an IDI. Study activities were approved by the University of Washington Human Subjects Division (STUDY00015337).

Results

The median age of survey participants was 35 years (interquartile range [IQR]: 32-38), 28 (93.3%) identified as cisgender women, and 19 (63.3%) were unstably housed (i.e., on the street, in a car, transitional housing, in a shelter, or other unstable housing) (Table 1). The median age of IDI participants was 43 (IQR: 32-49), all were cisgender women, and half (n=8) were unstably housed. PrEP experience was limited to 4 survey participants (13.3%) and 2 IDI participants (12.5%). About half (n=16, 53.3%) of survey participants had injected at least once in the past six months compared to 43.8% (n=7) of IDI participants. Integration of survey and interview data identified 4 themes, described below.

Table 1. Characteristics of Participants

	Survey Participants N=30	IDI Participants N=16
	n (%)	n (%)
Median age in years [IQR]	35 [32-38]	43 [32-49]
Gender identity		
Cisgender woman	28 (93.3%)	16 (100%)
Transgender woman	2 (6.7%)	0 (0%)
Race and/or ethnicity		
American Indian or Alaska Native	2 (6.7%)	0 (0%)
Asian	0 (0%)	0 (0%)
Black or African American	3 (10.0%)	1 (6.3%)
Hispanic or Latinx	1 (3.3%)	0 (0%)
Multiracial	8 (26.7%)	6 (37.5%)
White	16 (53.3%)	8 (50.0%)
Refuse to answer	0 (0%)	1 (6.3%)
Current living situation		
At own house or apartment	8 (26.7%)	5 (31.3%)
With friends or family	3 (10.0%)	3 (18.8%)
On the street or in a car	6 (20.0%)	3 (18.8%)
Overnight shelter	2 (6.7%)	1 (6.3%)
Transitional housing	4 (13.3%)	4 (25.0%)

Other unstable housing	7 (23.3%)	0 (0%)
PrEP use		
Former or current	4 (13.3%)	2 (12.5%)
Never	24 (80.0%)	13 (81.3%)
Don't know	1 (3.3%)	1 (6.3%)
Missing	1 (3.3%)	0 (0%)
Injection drug use in past six months		
Yes	16 (53.3%)	7 (43.8%)
No	14 (46.7%)	8 (50.0%)
Don't know	0 (0%)	1 (6.3%)

Incongruency Between HIV Risk Behaviors and HIV Risk Perception

Of the 30 survey participants, 25 (83.3%) were considered PrEP candidates using our analysis definition (Table 2). The median age of PrEP candidates was younger compared to non-candidates (33 years vs 35 years). Over half (n=14, 56%) of PrEP candidates reported recent injection drug use. Approximately 16.0% (n=4) of PrEP candidates had shared injection equipment and 64.0% (n=16) had exchanged sex in the previous 6 months, both criteria for meeting PrEP candidacy in our analysis. The median number of recent sex partners was higher among PrEP candidates (9 vs 1).

Table 2. Characteristics of Survey Participants, by PrEP Candidacy

	PrEP Candidate N=25	**Not a PrEP Candidate N=5**
Median age in years [IQR]	33 [32-45]	35 [35-54]
Gender identity		
Cisgender woman	23 (92.0%)	5 (100%)
Transgender woman	2 (8.0%)	0 (0%)
Race and/or ethnicity		
American Indian or Alaska Native	1 (4.0%)	1 (20.0%)
Asian	0 (0%)	0 (0%)
Black or African American	3 (12.0%)	0 (0%)
Hispanic or Latinx	1 (4.0%)	0 (0%)
Multiracial	7 (28.0%)	1 (20.0%)
White	13 (52.0%)	3 (60.0%)
Current living situation		
At own house or apartment	6 (24.0%)	2 (40.0%)
With friends or family	3 (12.0%)	0 (0%)
On the street or in a car	4 (16.0%)	2 (40.0%)
Overnight shelter	2 (8.0%)	0 (0%)
Transitional housing	4 (16.0%)	0 (0%)

Other unstable housing	6 (24.0%)	1 (20.0%)
Injection drug use in past six months		
Yes	14 (56.0%)	2 (40.0%)
No	10 (40.0%)	2 (40.0%)
Missing	1 (4.0%)	1 (20.0%)
Main drug/drug of choice		
Fentanyl by itself or with another drug	10 (40.0%)	2 (40.0%)
Crack cocaine by itself	3 (12.0%)	2 (40.0%)
Marijuana	6 (24.0%)	0 (0%)
Methamphetamine by itself or with another drug	2 (8.0%)	0 (0%)
Benzodiazepines	1 (4.0%)	0 (0%)
Alcohol	1 (4.0%)	0 (0%)
Missing	2 (8.0%)	1 (20.0%)
Shared injection equipment in past 6 months		
Yes	4 (16.0%)	0 (0%)
No	14 (56.0%)	3 (60.0%)
Missing or did not inject in past 6 months	7 (28.0%)	2 (40.0%)
Median number of sex partners in last 6 months [IQR]	9 [2-50]	1 [0-2]
Exchange sex in last 6 months		
Yes	16 (64.0%)	0 (0%)
No	9 (36.0%)	4 (80.0%)
Missing	0 (0%)	1 (20.0%)
Chemsex in last 6 months		
Yes	20 (80.0%)	2 (40.0%)
No	4 (16.0%)	2 (40.0%)
Don’t know	1 (4.0%)	0 (0%)
Missing	0 (0%)	1 (20.0%)
Ever diagnosed with bacterial STI		
Yes	14 (56.0%)	0 (0%)
No	11 (44.0%)	4 (80.0%)
Missing	0 (0%)	1 (20.0%)
Ever diagnosed with hepatitis C virus (HCV)		
Yes	8 (32.0%)	0 (0%)
No	17 (68.0%)	4 (80.0%)
Missing	0 (0%)	1 (20.0%)

Despite being at risk of acquiring HIV, most IDI participants perceived themselves as being unlikely to acquire HIV in the future.

“I’m not a working girl so I don’t have those issues.” [PrEP-naïve, 47 years old]

“It just seems like too much to worry about […] all the HIV stuff, I use condoms and stuff.” [Unknown PrEP use, 42 years old]

Fear of HIV was rooted in concern for others. While one participant cited the 2018 outbreak of HIV among women in the North Seattle area, few believed they would be exposed to HIV in the future.[25]

> *"For me, not so much. But maybe for people I know out here that walk the streets or shoot up with other people. That's something that I've worried for them." [PrEP-naïve, 52 years old]*

High Awareness of and Misconceptions about PrEP

A higher proportion of PrEP candidates had heard of PrEP compared to non-candidates (n=19, 76.0% vs n=2, 40.0%, Table 3). Similarly, IDI participants had a high degree of awareness regarding HIV, and some knew of PrEP as a form of HIV prevention. However, accurate knowledge about PrEP was limited, and many had misconceptions or gaps in understanding that further deterred them from using PrEP. Of those who had heard of PrEP, only a few participants recalled that it was a daily pill and some confused PrEP with HIV treatment.

> *"It's just a pill that you take every day, and if you have it, so that you don't pass it on to somebody else." [PrEP-naïve, 31 years old]*

> *"How accessible is the pill. […] Can anybody get a prescription? Do you just walk in and ask for it? Or do you have to have some kind of requirements?" [PrEP-naïve, 44 years old]*

Table 3. Awareness, Interest, and Use in PrEP among Survey Participants, by PrEP Candidacy

	PrEP Candidate N=25	**Not a PrEP Candidate N=5**

Ever heard of PrEP		
Yes	19 (76.0%)	2 (40.0%)
No	4 (16.0%)	2 (40.0%)
Don't know	2 (8.0%)	0 (0%)
Missing	0 (0%)	1 (20.0%)
PrEP use		
Current	2 (8.0%)	0 (0%)
Former	2 (8.0%)	0 (0%)
Never	20 (80.0%)	4 (80.0%)
Unknown	1 (4.0%)	1 (20.0%)
Interest in daily oral PrEP (among those not currently on PrEP)	N=23	
Not at all interested	7 (30.4%)	0 (0%)
Not very interested	3 (13.0%)	0 (0%)
Somewhat interested	7 (30.4%)	3 (60.0%)
Very interested	6 (26.1%)	1 (20.0%)
Missing	0 (0%)	1 (20.0%)
Willing to use PrEP if available (among those not currently on PrEP)	N=23	
Yes	12 (52.2%)	4 (80.0%)
No	6 (26.1%)	0 (0%)
Don't know	4 (17.4%)	0 (0%)
Missing	1 (4.3%)	1 (20.0%)
Interest in bimonthly injectable PrEP		
Not at all interested	9 (36.0%)	0 (0%)
Not very interested	3 (12.0%)	0 (0%)
Neither	0 (0%)	0 (0%)
Somewhat interested	4 (16.0%)	3 (60.0%)
Very interested	8 (32.0%)	1 (20.0%)
Missing	1 (4.0%)	1 (20.0%)

Some had seen information about PrEP on TV or on posters in public restrooms but several thought PrEP was not for them to use, either because PrEP was for other groups of people (e.g., MSM) or because they did not perceive themselves at risk of acquiring HIV.

"[There is a focus on] gay couples who look super happy" [PrEP-naïve, 43 years old]

Overall, there was an overwhelming curiosity about side effects and efficacy.

“How does it affect me or being able to have kids, and does it change anything in my offspring? […] How does it prevent? How do we have something that prevents HIV? We don’t have something that cures it” [PrEP-naïve, 31 years old]

Interest in PrEP Varied and Was Stymied by Stigma and Barriers to Care

Almost all IDI participants had positive attitudes about how PrEP could prevent HIV, but few were interested in pursuing PrEP for themselves. Interest in daily oral PrEP among survey participants not currently using PrEP varied; just over half (n=13, 56.5%) of PrEP candidates were interested in using daily oral PrEP, and 80.0% (n=4) of non-candidates were interested in use.

IDI participants who did express interest in PrEP had a strong desire to keep their PrEP use private, as stigma is still prevalent in their communities.

“Just having them know your business and then they go tell someone, and then you’re embarrassed of it” [PrEP-naïve, 39 years old]

“I still think there’s a stigma. I probably wouldn’t tell anybody.” [PrEP-naïve, 44 years old]

One IDI participant mentioned concerns about medications, which was rooted in mistrust of the medical system. This was supported by other participants, who made it clear they wanted to know more about PrEP, especially given the high efficacy for prevention of HIV.

“They call it big pharma or whatever. Usually, money is their fucking goal and so. And so, in history, there's documented things that have been fucked up. And so, that makes me not trust this new, magic drug because in the past it's been that same new, magic thing and then now you're addicted to dope for the rest of your life.” [PrEP-naïve, 32 years old]

Interest in bimonthly injectable PrEP differed between study samples. Among PrEP candidates, less were interested in bimonthly injectable PrEP (n=12, 48.0%) than daily oral PrEP (n=13, 56.5%). IDI participants were more interested in injectable PrEP than in daily oral PrEP. Some expressed concerns about possible side effects or the composition of injectables, citing misinformation about the COVID-19 vaccine.

> *"I'll start thinking about all those people that talk about what they put in things that are preventative like COVID shots and the flu shot. I'll start thinking about their arguments and I'll be like, maybe they're right." [PrEP-naïve, 47 years old]*

Despite concerns regarding the composition of injectables, the majority believed that getting an injection would be more discrete, and not having to keep track of their medication or worry about daily adherence would far exceed any disadvantages noted with an injectable option.

> *"People don't see you taking that. I think pills they see lying around or see you take every day, it's more visible for others, I think. […] It takes something of the privacy away." [PrEP-naïve, 44 years old]*

> *"That might be a lot easier for them. Because being out here, keeping track of medication, people steal your stuff all the time. […] So, out here homeless, it's easier if they have injectables or oral medication that would last" [PrEP-naïve, 52 years old]*

Needed Supports for PrEP Use

The majority of both cohorts were unstably housed. IDI participants, of which half were

unstably housed, noted that a crucial element to PrEP use was a stable indoor living environment. Many noted that daily oral PrEP would not be a good option because of increased stress from chaotic environments and issues with theft that could interfere with use.

> *“I have too many problems with theft around me. […] Too many people take everything of mine. So, whenever I have prescriptions or anything like that, they take it.” [Unknown PrEP use, 42 years old]*

> *“I guess, maybe it has a lot to do with me being in a stable place where I can put my pills in one spot and I know they're there.” [PrEP-naïve, 32 years old]*

The need to take a daily pill to ensure effectiveness of PrEP posed a huge barrier for most participants. Daily adherence became more of an issue with competing priorities including “being in the life,” (i.e., engaging in transactional sex often in conjunction with substance use and housing instability) having an irregular schedule, and concurrent substance use, which was high among both cohorts.

> *“I’m not fixing to take no pill every day. I smoke too much weed. I will forget” [PrEP-naïve, 25 years old]*

Some participants noted facilitators to PrEP adherence, including the absence of side effects and reinforcement of effectiveness by consistently testing negative. Many noted that a peer system or other pill reminders like alarms may help them successfully use PrEP. PrEP monitoring also seemed doable for most, as many were already seeking healthcare on a semi-regular basis for existing conditions or could see PrEP as a gateway to accessing more consistent healthcare.

"It would add more structure to my life, it would add more consistency, as far as seeing a doctor more regularly and paying attention to my health more than I have before." [PrEP-naïve, 31 years old]

Discussion

In this mixed-methods evaluation among WWID, we found that though awareness of and interest in daily oral PrEP were high, use was low, and many had misconceptions about PrEP. Over half of survey and IDI participants were interested in bimonthly injectable PrEP, with the latter citing lower concerns for daily adherence as the primary benefit of an injectable option. Unstable housing was prevalent among both study samples and was consistently noted as a barrier to both PrEP uptake and persistence, along with low perceived risk, and competing survival needs.

Compared with the 2021 National HIV Behavioral Surveillance survey conducted throughout the Seattle area, WWID from our survey cohort had a higher proportion of PrEP awareness (70% vs 36% reported in unpublished data).[40] Meta-analyses similarly described a range in gaps in PrEP awareness among WWID living in the US, with studies estimating that 7-66% are aware of PrEP.[26-28] Our sample was recruited from a small area in North Seattle, where survival sex and sex work are more visible and the same area as a 2018 outbreak of HIV among PWID.[25] In response to the outbreak, HIV prevention messaging and services in the immediate area were increased, which may have led to an increase in PrEP awareness among our study population. Although uptake of PrEP in our sample was higher compared to local estimates among WWID, only 13% had previously used PrEP, indicating that the increase in services has not adequately addressed the barriers to PrEP initiation and use.

Awareness of PrEP in our sample was nuanced. Though many had heard of PrEP, several participants noted that the messaging they had seen was mostly geared towards men or

the LGBTQ+ community. Higher awareness estimates among other populations like MSM may be rooted in PrEP campaigns and initiatives that have historically focused on those with the highest prevalence of disease.[28,44,53] When asked to explain what they knew about PrEP, several IDI participants were only able to provide cursory information, some of which was inaccurate. A recent study of WWID in Philadelphia indicated that inaccurate beliefs about PrEP were associated with perceived barriers to uptake, and that providing correct information about PrEP could result in increased use.[44] In our sample, 40% of those we deemed as PrEP candidates had not injected drugs in the previous six months and almost all participants met more than one criterion for PrEP candidacy. Our data indicate that a large proportion of those who are PrEP eligible have many risk factors for HIV acquisition that are important to consider, and multipronged approaches to education for PrEP and HIV awareness are needed.[54,55] Because awareness is the first pillar in the PrEP care continuum, it's imperative that initiatives focus on population-specific and accurate messaging around PrEP for WWID in order to ensure possibility of uptake and eventual population-level impact.[26,28,44,56] Due to significant mistrust in the healthcare system and pharmaceutical industry, harm reduction programs are likely to be necessary and effective venues for ensuring WWID receive accurate PrEP information.

Our data illustrated that using PrEP was generally acceptable. More than half of our sample was interested in taking daily oral PrEP, a finding consistent with the literature.[21,53,57,58] Those not interested reported low HIV risk perception, even if this was discordant with their self-reported risk behaviors. Interest in bimonthly injectable PrEP was also observed at similar levels. Participants positioned their preference for longer-acting PrEP as a way to overcome adherence issues or monitoring associated with needing to take a daily pill. As we expand implementation of longer-acting PrEP modalities, centering preference could increase uptake among WWID. However, currently available longer-acting options will not be without challenges, as they require more frequent interaction with the healthcare system, which was a reported barrier.

Several barriers to PrEP use were perceived by our participants. Fear of side effects has been noted as a barrier to use across several different populations, and our study sample was no exception.[44,45] Stigma was also a reported barrier, and many participants noted that they would likely conceal PrEP use if they decided to start the medication. PrEP- and drug-related stigma has been noted among the networks of WWID and could possibly be curtailed by destigmatizing use through social support and awareness interventions.[26,41,44-46,57,59,60] Structural factors including housing instability leading to chaos and concerns for safety and theft were noted as primary barriers to PrEP use. Qualitative work from the US supports our finding that HIV prevention may not be a priority when basic health and safety needs like housing are unmet.[21,27,41,44,58-60] In the absence of economic stability and access to basic needs such as housing, community-based care and expanded walk-in clinic hours could overcome some of the structural barriers to PrEP use for WWID.

Our study has some limitations. We used an eligibility criterion of lifetime injection use which eliminated possible participants who solely smoke or use their drugs another way, even if they were candidates for PrEP through other means of HIV exposure. Second, we used a convenience sample of those engaged in neighborhood services. Our findings are only representative of those seeking out services provided by our community sites, such as low-barrier health care and syringe exchange and cannot be extrapolated to those unable or unwilling to seek care or assistance. Third, almost all participants identified as cisgender women, the majority of whom were white, and experiences of transgender women and/or women of color, groups disproportionately impacted by both HIV and the structural barriers associated with accessing HIV prevention, are underrepresented in these data.[27] Finally, only 13% of our IDI participants had used PrEP in the past, and none had experience with long-acting injectable PrEP so many of the barriers and facilitators to use that are described are hypothetical.

Our study provides important estimates of PrEP awareness and interest, along with possible context for low uptake, among a population disproportionately impacted by HIV. We collaborated with three existing community sites with strong community connections and rapport for recruitment. Second, our mixed-methods approach provides a more comprehensive picture of PrEP awareness and attitudes than a purely quantitative study design may have provided. Third, our survey and IDI guide were reviewed for appropriateness and completeness by a CAB consisting of individuals with professional and lived experience. Finally, our eligibility criteria included lifetime use of injection drugs rather than recent use, which increased the representativeness of our sample.

Conclusion

WWID are at an increased risk of HIV acquisition and face unique, complex barriers to PrEP use. Our data fill an important gap in understanding how various factors facilitate and impede PrEP knowledge, interest, uptake, and sustained use among WWID. It will be crucial to address social and structural barriers to PrEP uptake specific to WWID to ensure increased use of existing and new options for HIV prevention.

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Chapter III: Individual- and relationship-level correlates of the use of HIV prevention strategies among cisgender gay, bisexual, and other men who have sex with men not on PrEP in Seattle, Washington

Individual- and relationship-level correlates of the use of HIV prevention strategies among gay, bisexual, and other men who have sex with men not on PrEP in Seattle, Washington

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Abstract

Background: Understanding the individual- and partnership-level correlates of non-use of HIV prevention among gay, bisexual, and other men who have sex with men (GBMSM) not using pre-exposure prophylaxis (PrEP) can help tailor prevention messaging and explain persistent disparities in HIV incidence.

Methods: From September 2015-August 2019, and August 2021-May 2024, we enrolled a convenience sample of GBMSM seeking HIV testing into Project DETECT and Project DETECT 2, respectively. Participants completed a self-administered behavioral survey that included detailed questions about their three most recent male anal sex partners. Among those not on PrEP, we compared participant- and partnership-level characteristics to the use or non-use of other HIV prevention strategies (i.e., condom use or sex with a HIV-negative partner or with a partner living with HIV who had an undetectable viral load) using modified Poisson regression.

Results: Of the 1261 GBMSM not on PrEP with at least one recent male anal sex partner, 77.2% always used another HIV prevention strategy in their recent partnerships. Never testing for HIV previously (prevalence ratio [PR]=1.76 and recent methamphetamine use (PR=2.20) were associated with non-use of prevention strategies. At least one HIV prevention strategy was used in the majority (87.9%) of the 2449 partnerships reported. Non-use of prevention was more likely when partner age was unknown (PR=3.28), if sex occurred once (PR=1.38), in instances of perceived non-commitment (PR=1.54), and if the pair met at a sex venue (PR=2.41).

Conclusions: Among GBMSM not on PrEP, use of HIV prevention strategies was situational and varied by both individual and partnership. Population- and context-specific efforts to increase the uptake of all types of prevention are needed for those disproportionately impacted by HIV.

Introduction

Since approval by the United States (US) Food and Drug Administration in 2012, the use of oral pre-exposure prophylaxis (PrEP) for HIV prevention has increased among gay, bisexual, and other men who have sex with men (GBMSM). Not all GBMSM who may benefit from PrEP are using it; 2022 US data from the Centers for Disease Control and Prevention (CDC) show that only 40% of those assigned male sex at birth who could benefit were prescribed PrEP.[8]

There are other risk reduction strategies that individuals can use to decrease the likelihood of HIV acquisition in the absence of PrEP.[38,61-63] Condoms provide protection against HIV but need to be used consistently and completely for full protective benefit. Furthermore, data indicate that condom use is declining, and some may opt to use other methods to prevent HIV.[39,64,65] Seroadaptive strategies, like seeking out partners with the same HIV serostatus, have been shown to be a common risk reduction strategy, but relies on accurate knowledge and disclosure of one's HIV serostatus and may have different degrees of effectiveness depending on population and context.[38,39,66-68] Moreover, partner PrEP use may provide an added layer of indirect protection for GBMSM who are HIV-negative and seeking out partners with the same HIV serostatus.[68,88] Finally, reliance on indirect protection from a partner's use of treatment if the partner is living with HIV is effective if the partner's HIV viral load is undetectable, but again depends on accurate knowledge and disclosure.[61,68,69-71]

The extent to which strategies are used likely changes with both circumstance and time and at the individual- and partnership-level. Understanding the correlates of use and non-use of HIV prevention strategies can help tailor sexual health messaging around the options for HIV prevention. On a population-level, as we continue to see increases in PrEP uptake and decreases in the use of other HIV prevention strategies, these nuances could help explain how disparities in HIV incidence persist. As such, we sought to describe associations between individual- and partnership-level characteristics and the use of HIV prevention strategies within

recent sexual partnerships among GBMSM not on PrEP and seeking HIV testing in Seattle, Washington.

Methods

Study Sample

We enrolled a convenience sample of participants into Project DETECT and Project DETECT 2 between September 2015 and August 2019 and from August 2021 to May 2024, respectively. Project DETECT methods are described in detail elsewhere.[72-76] Briefly, Project DETECT was a cross-sectional CDC-funded study designed to evaluate HIV and STI testing technologies in real-time. Project DETECT 2 was a continuation of Project DETECT.[77] The studies enrolled a convenience sample of participants with negative or of unknown HIV status who were seeking HIV and/or STI testing at the Public Health – Seattle & King County (PHSKC) Sexual Health Clinic (SHC). Participants were 18 years or older; cisgender men, transgender persons, or non-binary individuals who reported sex with men; self-reported negative or unknown HIV status; and could speak English. Study materials were translated to allow enrollment of Spanish-speaking participants in March 2018.

Participants were eligible to re-enroll after 90 days if they remained HIV negative or had an unknown HIV status. Across 1853 visits in our analytic sample, 1351 were among unique people, and 287 individuals contributed more than one visit (range: 2-8) to the analysis.

Data

Participants were asked to complete a computer-based behavioral survey using Questionnaire Design Studio (QDS, Nova Research Company) for Project DETECT or Research Electronic Data Capture (REDCap)[48] for Project DETECT 2. All data were self-reported and study staff were nearby to answer questions.

Data from the PSHKC SHC were linked to study data for participants from Project DETECT and were used if age, gender identity, race or ethnicity were missing from the Project

DETECT study survey. Supplemental data from the PHSKC SHC were not available for Project DETECT 2 participants.

Study survey questions asked about sociodemographic characteristics, healthcare utilization including HIV testing history, STIs, drug use, and sexual behaviors in both the aggregate and at the partner-specific level for their most recent male anal sex partners (up to three partners) from the past three months. Partner-specific questions asked about duration of the sexual relationship; how participants met the partner; level of commitment felt towards the partner; number of anal sex and condomless anal intercourse (CAI) encounters in the past three months; and disclosure of HIV status, partner PrEP use if HIV-negative, and partner antiretroviral therapy (ART) use and HIV viral load if partner was living with HIV (Supplemental Material 1). Unknown full dates were imputed using the first day of the month in order to calculate time since last HIV test or duration of a sexual relationship.

Partner-specific questions were only asked of participants who identified as cisgender men and reported at least one “male anal sex partner” in the previous three months. Our analysis sample was restricted to cisgender GBMSM with a negative or unknown HIV status, not on PrEP at their study visit, and who reported at least one “male anal sex partner” in the past 3 months.

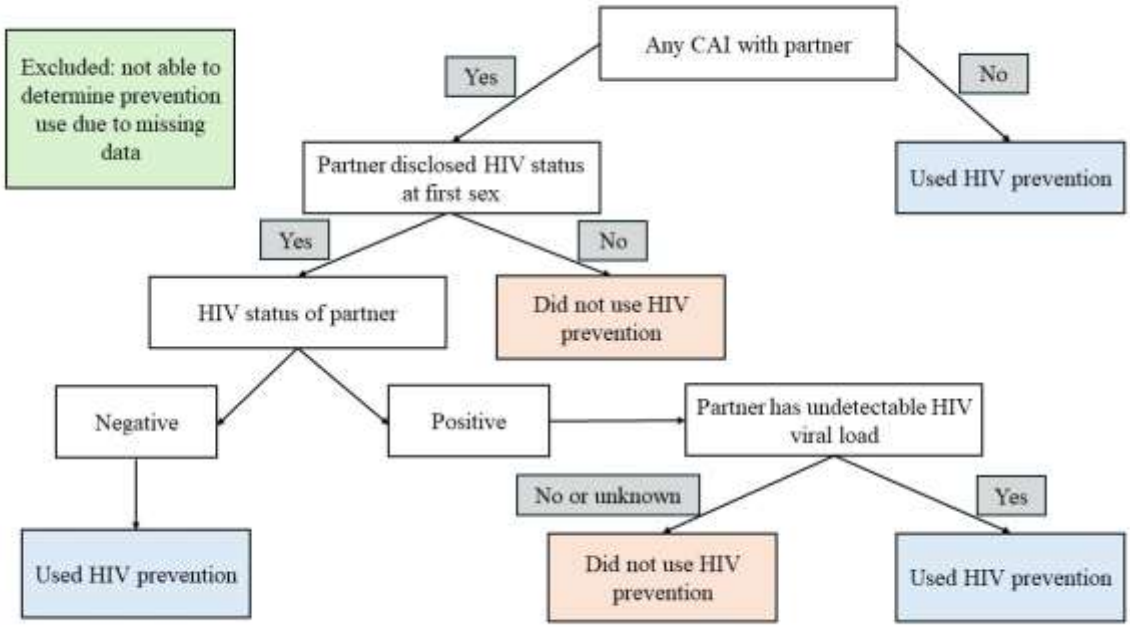
Statistical Analysis

We present descriptive statistics for participant visits and their three most recent male anal sex partners across the total cohort. We used Chi-square, Fisher’s exact, and Wilcoxon-Mann-Whitney tests as appropriate.

We described the types of HIV prevention strategies they reported with their recent male anal sex partners. Determination of HIV prevention strategy use is detailed in Figure 1. To summarize, we defined “used HIV prevention strategy” as any of the following: condom use with the partner or CAI with a partner who is HIV-negative (partner may or may not be on PrEP) or a partner living with HIV with an undetectable viral load. We considered there to be no use of an

HIV prevention strategy if the participant reported any CAI with the partner and either did not know the HIV status of the partner or the partner living with HIV had a detectable or unknown HIV viral load. Partnerships for which data were missing and HIV prevention strategy use could not be determined were excluded from analysis (N=228).

Figure 1. Defining HIV prevention strategy use among participants not on PrEP

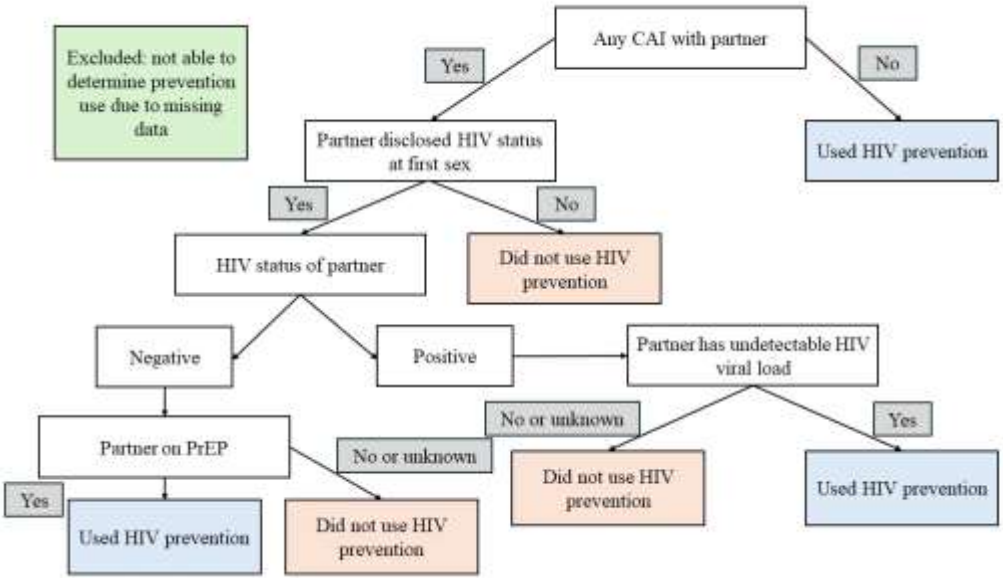


First, we estimated unadjusted prevalence ratios (PRs) and 95% confidence intervals (95% CI) using modified Poisson regression with robust standard errors among visits with participants not on PrEP to describe associations between participant-level characteristics and the non-use of an HIV prevention strategy with at least one partner. Second, among visits with participants not on PrEP, we explored unadjusted associations between partnership-level characteristics and non-use of HIV prevention strategies within the partnership using a modified Poisson model with robust standard errors fitted according to generalized estimating equation methods to account for multiple partnerships per participant visit. Because the use of different HIV prevention strategies changed on a population-level over the course of Project DETECT and Project DETECT 2, we fit both models with an interaction term between the participant or

partnership characteristics and study year to explore whether associations changed over time. We also controlled for study year in adjusted analyses and presented PRs with 95% Cis

We conducted several subgroup and sensitivity analyses. First, among participants with more than one partner, we explored associations between participant-level characteristics and not using an HIV prevention strategy in any named partnership (compared to participants who used a prevention strategy with all of their named partners). Second, to explore the extent to which partnership characteristics impact use of HIV prevention strategies, we conducted a partnership-level sensitivity analysis among participants who reported inconsistent use of HIV prevention strategies across partnerships (i.e., used an HIV prevention strategy in one partnership but did not use an HIV prevention strategy in another). Finally, because a partner's PrEP use may provide added indirect protection against HIV for GBMSM not on PrEP, we explored an alternative definition of HIV prevention where we defined "used HIV prevention strategy" as any of the following: condom use with the partner or CAI with a partner who is HIV-negative and on PrEP or a partner living with HIV with an undetectable viral load (Figure 2).

Figure 2. Sensitivity analyses: defining HIV prevention strategy use among participants not on PrEP



We used complete case analysis for all models. Statistical analysis was performed using SAS software, version 9.4 (SAS Institute, Cary, NC).

Ethical Considerations

All participants provided verbal informed consent and were reimbursed $40 USD or $25 USD for completion of Project DETECT 1 or Project DETECT 2 study visits, respectively. Study activities were approved by the University of Washington Human Subjects Division (STUDY00001637).

Results

Of 3065 Project DETECT and Project DETECT 2 participant visits 1261 (41.1%) were among cisgender GBMSM with a negative or unknown HIV status, not on PrEP, and reported at least one “male anal sex partner” in the previous three months. The median age of participants was 30 (interquartile range [IQR] 25-36), just over half (53.9%) were white, 13.7% had experienced homelessness in the previous year, and approximately two-thirds (69.7%) had some form of health insurance (Table 1). Almost all (94.6%) participants had tested for HIV at least once before. The median number of male anal sex partners and condomless male anal sex partners in the previous three months was 2 (IQR: 1-4) and 1 (IQR:1-2), respectively. The majority (n=1244, 98.7%) of GBMSM not on PrEP tested negative on all point-of-care and confirmatory laboratory HIV tests at their study visit; 7 (0.6%) had false-positive test results and 10 (0.8%) tested positive for HIV (data not shown).

Table 1. Characteristics of participant visits, N=1261 participant visits

	Total n (%)
	N=1258
Age (years) – median [IQR]	30 [25-36]
Race/ethnicity [a]	
American Indian or Alaska Native	8 (0.6%)
Asian	106 (8.4%)
Black or African American	104 (8.2%)
Hispanic or Latinx	245 (19.4%)
Multiracial	74 (5.9%)

Native Hawaiian or Other Pacific Islander	9 (0.7%)
White	680 (53.9%)
Refused or Unknown	35 (2.8%)
Highest level of education	N=1242
High school or lower	278 (22.4%)
Some college, a technical or associate's degree	416 (33.5%)
College graduate	399 (32.1%)
Graduate school	149 (12.0%)
Experienced homelessness in past year	N=1228
Yes	168 (13.7%)
No	1060 (86.3%)
Insurance status	N=1224
Insured	853 (69.7%)
Not insured	371 (30.3%)
Self-reported time since last HIV test	
Never tested for HIV	47 (3.7%)
Within past 3 months	449 (35.6%)
3-6 months ago	348 (27.6%)
6-12 months ago	202 (16.0%)
≥1 years ago	194 (15.4%)
Don't know/Refuse	21 (1.7%)
Bacterial STI diagnosis in past 3 months [b]	
Yes	180 (14.3%)
No	1081 (85.7%)
Methamphetamine use in the past 3 months [c]	N=1258
Yes	122 (9.7%)
No	1136 (90.3%)
Number of male anal sex partners in past 3 months – median [IQR]	2 [1-4]
Number of male condomless anal sex partners in the past 3 months – median [IQR]	N=1256 1 [1-2]

PrEP: pre-exposure prophylaxis. IQR: interquartile range. STI: sexually transmitted infection.
a. Persons who identified as Hispanic or Latinx ethnicity were classified as Hispanic or Latinx regardless of race.
b. Bacterial STIs include gonorrhea, chlamydia, and/or syphilis.
c. Methamphetamine includes any route of use.

Among 1261 participant visits, 397 had one partner, 312 had two partners, and 552 had three partners. Characteristics of the 2677 partnerships are described in Table 2. Across all partnerships, the majority (76.9%) of partners were within 10 years of the participant's age and 41.5% were the same race as the participant. Over half (57.1%) of the partnerships were initiated online, 56.6% were one-time, and most (76.9%) were perceived as non-committal. In 80.7% of partnerships, both the partner and participant disclosed their HIV status before their first sexual encounter.

Table 2. Partnership characteristics, N=2677 partnerships

	Total

	n (%)
Age of partner compared to participant	N=2572
>10 years younger	285 (11.1%)
Within 10 years	1977 (76.9%)
>10 years older	264 (10.3%)
Don't know partner's age	46 (1.8%)
Racial homophily between participant and partner [a, b]	
Yes	1111 (41.5%)
No	1566 (58.5%)
Where participant and partner met [c]	N=2525
Bar, club, or rave	179 (7.1%)
Gym or spa	36 (1.4%)
In public	77 (3.0%)
Online (website or app)	1442 (57.1%)
School or work	104 (4.1%)
Sex venue	121 (4.8%)
Social organization	64 (2.5%)
Through friends	502 (19.9%)
Duration of sexual relationship [d]	N=2513
One-time	1422 (56.6%)
<3 months	331 (13.2%)
3-12 months	154 (6.1%)
>1 year	606 (24.1%)
Participant felt/feels committed to partner [e]	N=2527
Yes	585 (23.1%)
No	1942 (76.9%)
Disclosure of HIV status before first sex	N=2575
Participant and partner both disclosed	2078 (80.7%)
Only participant disclosed	73 (2.8%)
Only partner disclosed	47 (1.8%)
Neither participant nor partner disclosed	377 (14.6%)
HIV status of partner at first sex if disclosed	N=2120
HIV-negative	2007 (94.7%)
HIV-positive	113 (5.3%)
Partner is on PrEP if partner is HIV-negative	N=1931
Yes	721 (37.3%)
No	1072 (55.5%)
Don't know	138 (7.1%)
Partner has undetectable HIV viral load if partner is living with HIV	N=114
Yes	102 (89.5%)
No	12 (10.5%)
Reports any CAI with partner in past 3 months	N=2465
Yes	1681 (68.2%)
No	784 (31.8%)

PrEP: pre-exposure prophylaxis. IQR: interquartile range. CAI: condomless anal intercourse.
a. Considered "no" if participant and/or partner information is unknown.
b. Persons who identified as Hispanic or Latinx ethnicity were classified as Hispanic or Latinx regardless of race.
c. "In public" includes vacation or cruise; "Online" includes chat/dating line and personal ad/newspaper; "School or work" includes jail; "Sex venue" includes adult bookstore, bath house, cruising area, sex club/resort, private sex party; "Social organization" includes church
d. Duration was calculated using date of most recent anal sex with the partner and date of first anal sex with partner. If day for either date was unknown, 1 (beginning of the month) was used.
e. Commitment was defined as "someone you might call your boyfriend, significant other, life partner, or husband."

Participant- and partnerships-level comparisons between our analytic sample and cisgender GBMSM with a negative or unknown HIV status and at least one "male anal sex

partner" in the previous three months on PrEP at their study visit are presented in Supplemental Tables 1 and 2, respectively. There were significant differences in sociodemographic and partnership characteristics between GBMSM on and not on PrEP.

Participant-level associations with non-use of HIV prevention strategies with any partner

Among 1261 participants not on PrEP, HIV prevention strategy use was determined for 1190 participants (94.4%, Table 3). Of those, 974 (81.8%) used an HIV prevention strategy with all their recent anal sex partners; 216 (18.2%) used no strategy with at least one of their partners. We found no significant associations between strategy non-use and participant age, education, recent homelessness, insurance status, recent bacterial STI diagnosis, or number of anal sex partners with or without condom use. Participants who had never tested for HIV (PR=1.76, 95%CI: 1.10-2.83) or who reported recent methamphetamine use (PR=2.20, 95%CI: 1.66-2.93) were more likely to not use HIV prevention strategies in their recent partnerships. Associations were qualitatively similar when adjusted for study calendar year.

Table 3. Associations between participant-level characteristics and the non-use of an HIV prevention strategy with ≥1 male anal sex partner among participants not on PrEP, N=1190 participant visits

	Used an HIV prevention strategy in all partnerships N=974 participants n (%)	**Did not use HIV prevention strategy in ≥1 partnership N=216 participants n (%)**	**Unadjusted PR for not using HIV prevention (95% CI)**	**Adjusted PR for not using HIV prevention [a] (95% CI)**	**p-value for interaction with study year [b]**
Age (years) – median [IQR]	N=972 30 [25-36]	N=215 31 [25-38]	1.00 (0.99-1.02)	1.00 (0.99-1.02)	0.750
Race/ethnicity [c]					
American Indian or Alaska Native	7/8 (87.5%)	1/8 (12.5%)	0.73 (0.12-4.60)	0.75 (0.12-4.81)	NA
Asian	83/105 (79.0%)	22/105 (21.0%)	1.22 (0.81-1.84)	1.20 (0.79-1.82)	
Black or African American	67/88 (76.1%)	21/88 (23.9%)	1.39 (0.93-2.10)	1.33 (0.88-2.03)	
Hispanic or Latinx	178/220 (80.9%)	42/220 (19.1%)	1.11 (0.81-1.54)	1.02 (0.73-1.41)	
Multiracial	59/72 (81.9%)	13/72 (18.1%)	1.05 (0.63-1.77)	0.97 (0.58-1.64)	
Native Hawaiian or Other Pacific Islander	8/8 (100%)	0/8 (0%)	NA [d]	NA [d]	
White	542/654 (82.9%)	112/654 (17.1%)	REF	REF	
Refused or Unknown	30/35 (85.7%)	5/35 (14.3%)	0.83 (0.36-1.91)	0.80 (0.35-1.83)	
Highest level of education	N=972	N=211			
High school or lower	198/253 (78.3%)	55/253 (21.7%)	1.17 (0.77-1.76)	1.18 (0.78-1.79)	0.1825
Some college, a technical or associate's	339/402 (84.3%)	63/402 (15.7%)	0.84 (0.56-1.27)	0.88 (0.58-1.33)	
College graduate	317/383 (82.8%)	66/383 (17.2%)	0.93 (0.62-1.39)	0.94 (0.63-1.41)	
Graduate school	118/145 (81.4%)	27/145 (18.6%)	REF	REF	
Experienced homelessness in past year	N=965	N=208			
Yes	120/156 (76.9%)	36/156 (23.1%)	1.36 (0.99-1.87)	**1.45 (1.06-2.00)**	0.9336
No	845/1017 (83.1%)	172/1017 (16.9%)	REF	**REF**	
Insurance status	N=961	N=209			
Insured	668/819 (81.6%)	151/819 (18.4%)	1.12 (0.85-1.47)	1.11 (0.85-1.47)	0.3258

Not insured	293/351 (83.5%)	58/351 (16.5%)	REF	REF	
Self-reported time since last HIV test					
Within past 3 months	344/422 (81.5%)	78/422 (18.5%)	REF	REF	0.5843
3-6 months ago	283/330 (85.6%)	47/330 (14.2%)	0.77 (0.55-1.07)	0.78 (0.56-1.09)	
6-12 months ago	161/193 (83.4%)	32/193 (16.6%)	0.90 (0.62-1.30)	0.94 (0.64-1.36)	
1+ years ago	144/186 (77.4%)	42/186 (22.6%)	1.22 (0.88-1.70)	1.16 (0.83-1.62)	
Never tested for HIV	29/43 (67.4%)	14/43 (32.6%)	**1.76 (1.10-2.83)**	**1.78 (1.10-2.89)**	
Don't know/Refuse	13/16 (81.3%)	3/16 (18.8%)	1.01 (0.36-2.87)	0.81 (0.28-2.29)	
Bacterial STI diagnosis in past 3 months [e]					
Yes	139/171 (81.3%)	32/171 (18.7%)	1.04 (0.74-1.45)	1.11 (0.79-1.56)	0.4113
No	835/1019 (81.9%)	184/1019 (18.1%)	REF	REF	
Methamphetamine use in the past 3 months [f]	N=972				
Yes	69/108 (63.9%)	39/108 (36.1%)	**2.20 (1.66-2.93)**	**2.17 (1.62-2.91)**	0.6993
No	903/1080 (83.6%)	177/1080 (16.4%)	REF	**REF**	
Number of male anal sex partners in past 3 months – median [IQR]	2 [1-4]	3 [2-5]	1.01 (1.00-1.02)	1.01 (0.99-1.02)	**0.0158**
Number of male condomless anal sex partners in the past 3 months – median [IQR]	1 [1-2]	2 [1-4]	1.01 (1.00-1.02)	1.01 (1.00-1.02)	**0.0044**

PrEP: pre-exposure prophylaxis. PR: prevalence ratio. CI: confidence interval. IQR: interquartile range. NA: not available. REF: referent. STI: sexually transmitted infection.
Bold values indicate statistically significant at $p<0.05$.
a. Adjusted for study calendar year (modeled continuously)
b. Included an interaction term for study calendar year (modeled continuously).
c. Persons who identified as Hispanic or Latinx ethnicity were classified as Hispanic or Latinx regardless of race.
d. Category was excluded from the regression model to ensure model would converge.
e. Bacterial STIs include gonorrhea, chlamydia, and/or syphilis.
f. Methamphetamine includes any route of use.

Partnership-level associations with non-use of HIV prevention strategies with any partner

Across all 2449 partnerships of participants not on PrEP, an HIV prevention strategy was used in 2153 (87.9%) partnerships; no strategy was used in the remaining 296 partnerships (Table 4). Non-use of HIV prevention strategies was more likely to occur in instances where partner age was unknown (PR=3.28, 95%CI: 2.03-5.30), if sex occurred only once (PR=1.38, 95%CI: 1.02-1.86), and if the participant did not feel committed to their partner (PR=1.54, 95%CI: 1.14-2.10). Those who met their partner at a sex venue were more than twice as likely to not use a prevention strategy in that partnership (PR=2.41, 95%CI: 1.57-3.70). When adjusted for study calendar year, the magnitude of the associations generally decreased but were similar to the unadjusted models. In adjusted analyses, meeting a partner online was significantly protective and participants were more likely to use prevention strategies within those partnerships (PR=0.72, 95%CI: 0.52-0.99).

Table 4. Associations between partnership-level characteristics and the non-use of an HIV prevention strategy with any male anal sex partner among participants not on PrEP, N=2449 partnerships

	Used an HIV prevention strategy in partnership N=2153 partnerships n (%)	Did not use an HIV prevention strategy in partnership N=296 partnerships n (%)	Unadjusted PR for not using HIV prevention (95% CI)	Adjusted PR for not using HIV prevention (95% CI) [a]	p-value for interaction with study year [b]
Age of partner compared to participant	N=2147				
>10 years younger	239/274 (87.2%)	35/274 (12.8%)	1.14 (0.77-1.68)	1.16 (0.78-1.71)	0.8203
Within 10 years	1668/1879 (88.8%)	211/1879 (11.2%)	REF	REF	
>10 years older	216/252 (85.7%)	36/252 (14.3%)	1.27 (0.87-1.85)	1.27 (0.88-1.85)	
Don't know partner's age	24/38 (63.2%)	14/38 (36.8%)	**3.28 (2.03-5.30)**	**2.67 (1.64-4.33)**	
Racial homophily between participant and partner [c, d]					
Yes	939/1057 (88.8%)	118/1057 (11.2%)	REF	REF	0.7508
No	1214/1392 (87.2%)	178/1392 (12.8%)	1.15 (0.90-1.47)	1.11 (0.87-1.42)	
Where participant and partner met [e]	N=2132	N=286			
Bar, club, or rave	152/172 (88.4%)	20/172 (11.6%)	0.92 (0.54-1.57)	0.93 (0.55-1.57)	0.5246
Gym or spa	30/36 (83.3%)	6/36 (16.7%)	1.32 (0.47-3.75)	1.30 (0.49-3.45)	
In public	58/73 (79.5%)	15/73 (20.5%)	1.63 (0.91-2.91)	1.59 (0.89-2.83)	
Online (website or app)	1266/1399 (90.5%)	133/1399 (9.5%)	0.75 (0.55-1.04)	**0.72 (0.52-0.99)**	
School or work	88/99 (88.9%)	11/99 (11.1%)	0.88 (0.46-1.69)	0.85 (0.44-1.62)	
Sex venue	78/112 (69.6%)	34/112 (30.4%)	**2.41 (1.57-3.70)**	**2.25 (1.45-3.48)**	
Social organization	51/59 (86.4%)	8/59 (13.6%)	1.08 (0.53-2.17)	1.07 (0.54-2.16)	
Through friends	409/468 (87.4%)	59/468 (12.6%)	REF	REF	
Duration of sexual relationship [f]	N=2116	N=284			
One-time	1190/1369 (86.9%)	179/1369 (13.1%)	**1.38 (1.02-1.86)**	**1.38 (1.02-1.87)**	0.0772
<3 months	289/324 (89.2%)	35/324 (10.8%)	1.14 (0.76-1.71)	1.17 (0.78-1.76)	
3-12 months	132/149 (88.6%)	17/149 (11.4%)	1.20 (0.71-2.02)	1.26 (0.75-2.12)	
>1 year	505/558 (90.5%)	53/558 (9.5%)	REF	REF	
Participant felt/feels committed to partner [g]	N=2120	N=287			
Yes	502/548 (91.6%)	46/548 (8.4%)	REF	REF	0.1817
No	1618/1859 (87.0%)	241/1859 (13.0%)	**1.54 (1.14-2.10)**	**1.52 (1.12-2.06)**	

PrEP: pre-exposure prophylaxis. PR: prevalence ratio. CI: confidence interval. REF: referent.
Bold values indicate statistically significant at p<0.05.
a. Adjusted for study calendar year (modeled continuously)
b. Included an interaction term for study year (modeled continuously)
c. Considered "no" if participant and/or partner information is unknown.
d. Persons who identified as Hispanic or Latinx ethnicity were classified as Hispanic or Latinx regardless of race.
e. "In public" includes vacation or cruise; "Online" includes chat/dating line and personal ad/newspaper; "School or work" includes jail; "Sex venue" includes adult bookstore, bath house, cruising area, sex club/resort, private sex party; "Social organization" includes church
f. Duration was calculated using date of most recent anal sex with the partner and date of first anal sex with partner. If day for either date was unknown, 1 (beginning of the month) was used.
g. Commitment was defined as "someone you might call your boyfriend, significant other, life partner, or husband."

Participant-level associations with non-use of HIV prevention strategies with all partner(s)

Of all participants not on PrEP, 83 (6.6%) did not use an HIV prevention strategy in any of their most recent partnerships. Among those 83, 36 (43.4%) had 2 or 3 partners and did not use a prevention strategy in any of their partnerships (data not shown). Compared to participants with more than 1 partner who used a prevention strategy in all of their partnerships (N=617), being Black (PR=4.50, 95%CI: 1.87-10.85), homelessness (PR=2.27, 95%CI: 1.07-

4.84), and recent methamphetamine use (PR=5.64, 95%CI: 2.99-10.63) were significantly associated with not using an HIV prevention strategy in any of their recent partnerships (Supplemental Table 3).

Inconsistent use of HIV prevention strategies

There were 133 participants who inconsistently used HIV prevention strategies with partners (i.e., used an HIV prevention strategy with at least one partner but did not with at least one other). Compared to meeting through friends, meeting a partner through school or work (PR=1.89, 95%CI: 1.20-2.97), or at a sex venue (PR=1.51, 95%CI: 1.10-2.08) were significantly associated with non-use of prevention strategy within their partnership (Supplemental Table 4).

Partner PrEP use as an HIV prevention strategy

When we adapted our definition of the use of an HIV prevention strategy to include partner PrEP use, we found that 442 (37.1%) had used an HIV prevention strategy in all partnerships and 748 (62.9%) did not use a strategy in at least one of their partnerships. Associations between participant-level characteristics and non-use of strategies were similar to the prior definition of HIV prevention that did not consider partner PrEP use, but with smaller effect sizes (Supplemental Table 5).

Associations between partnership-level characteristics and non-use of prevention strategies differed when partner PrEP use was considered HIV prevention. Notably, one-time partnerships or partnerships perceived as non-committal were more likely to use a prevention strategy within their partnership.

Discussion

In this analysis of data from GBMSM not on PrEP and seeking HIV testing and enrolled in Project DETECT, never testing for HIV, recent methamphetamine use, meeting a partner at a sex venue, one-time encounters, and non-committed partnerships were associated with the non-use of HIV prevention strategies among those not on PrEP. These data suggest that

populations with high incidence of HIV are not consistently using HIV prevention strategies within their partnerships, thus increasing the likelihood of acquisition.

At the individual level, recent methamphetamine use was associated with more than twice the likelihood of non-use of HIV prevention strategies. Estimates from the 2022 National HIV Behavioral Surveillance System conducted in Seattle show that GBMSM who use methamphetamine had an HIV prevalence of 40-60%.[9] Similarly, a 2018 study among GBMSM men and transgender persons who had sex with men found that persistent methamphetamine use was associated with more than 7 times the odds of HIV seroconversion.[78] High prevalence of HIV among individuals who use methamphetamine combined with the absence of HIV prevention strategies increases the likelihood of HIV acquisition among within networks of individuals who already face several barriers to testing and HIV care.[79,80] Concentrated, population-specific efforts to increase PrEP use among GBMSM who use methamphetamine could lessen HIV incidence, but must consider the barriers to PrEP initiation and sustained use that are unique to this population.[79,81-83] Strategies may include co-located PrEP programs in trusted spaces like syringe exchanges, low-barrier clinical models to allow for flexibility, or peer navigation.[83,84]

Further, those who had never tested for HIV previously were more likely to engage in CAI without the use of any HIV prevention strategy (PR 1.76, 95%CI: 1.10-2.83). As of 2022, an estimated 97% of people living with HIV in King County had been diagnosed, but 21% of new diagnoses were among individuals with no HIV testing history.[9] HIV testing can be intertwined with stigma, medical mistrust, anxiety, and other barriers that keep individuals from knowing their HIV serostatus, and data show that testing can be infrequent among populations disproportionately impacted by HIV and among those newly diagnosed.[85-87] In the absence of HIV testing and prevention, diagnosis and treatment initiation among those who acquire HIV could be delayed and lead to HIV progression[88-90] and transmission to others.[91,92] These data

reinforce the importance of engaging GBMSM in HIV testing as an entry point to prevention services.

At the partnership level, participants who met their partner at a sex venue, had one-time encounters, or reported perceived non-commitment in their partnership were significantly more likely to not use HIV prevention strategies. Disclosure of HIV serostatus was included as a prevention strategy in our analysis because it can allow for seroadaptive behaviors to occur and may reduce the likelihood of HIV acquisition. Studies among GBMSM in the US found that partnership duration and commitment level influenced HIV serostatus disclosure.[67,93] This was also found to be the case among GBMSM who were HIV negative and enrolled in the iPrEx Open Label Extension trial, and GBMSM in Ukraine, Beijing, and Lima found that stable partnerships were strong predictors of HIV serostatus disclosure, likely due to a greater degree of trust between parties.[86,94-96] Similarly, data from the US, France, and Portugal found strong associations between meeting partners in sex venues and CAI, non-disclosure of HIV serostatus, and undiagnosed HIV infection.[97-99] Evaluations have demonstrated that US-based HIV testing programs embedded in commercial sex venues are feasible, acceptable, and may be able to reach GBMSM who are not otherwise engaging in HIV prevention or testing services.[100,101] However, testing with rapid HIV tests at the point of sex could lead to false positive results, especially during acute HIV infection when levels of circulating virus are high and onward transmission is more likely, and adequate support for linkage to care is needed in the case of reactive results.[102] Continued provision of condoms or incorporation of venue-based PrEP programs could also increase the use of prevention strategies within partnerships that occur in these venues.

Only 6.6% of our GBMSM not on PrEP in our sample did not use any HIV prevention strategy in any of their partnerships, and less than half of those had more than one partnership. In sensitivity analyses, GBMSM with more than one male anal sex partner who reported methamphetamine use, were Black, or had recently experienced homelessness were

significantly more likely to have not used HIV prevention strategies with any of their anal sex partners compared to those who used strategies with all their partners. Intersecting social and structural factors including stigma and discrimination continue to drive disparities in HIV-related care, act as barriers to the use of HIV risk reduction strategies. and decrease their effectiveness against HIV acquisition.[103]

We considered reporting that a partner was HIV negative or that a partner living with HIV had an undetectable HIV viral load as a prevention strategy, however, there are known issues with HIV serostatus and ART use disclosure that could impact our findings. First, “sero-guessing”, or when individuals assume their partner’s HIV serostatus,[104] may have been prevalent and lead to misclassification of our outcome. Moreover, because sero-guessing often results in a bias towards believing a partner has the same serostatus (in this case, negative), it can undermine attempts to use seroadaptive strategies for HIV prevention if the assumption is incorrect.[86,104] Similar discordance has been noted among HIV viral load measures of people living with HIV.[69,105,106] Sufficient and frequent HIV testing is paramount to successful engagement in seroadaptive behaviors and can be particularly true in settings with low testing rates, poor access to care among those living with HIV, and high HIV prevalence.[68,85] We recruited from a sample of individuals seeking HIV testing, and prevalence of previous testing in our population was high (84.4% tested within the past year), but there are still local populations with low uptake of frequent HIV testing, which could impact the effectiveness of seroadaptive behaviors of an HIV prevention strategy among our sample.[9]

One way to decrease the likelihood of HIV among those not consistently using HIV prevention strategies is to increase access to and participation in PrEP programs. A major focus of the U.S. National HIV/AIDS Strategy is to make PrEP more accessible through the expansion of PrEP delivery in non-traditional clinical spaces, which could help eliminate structural barriers to PrEP use.[107] In our sample, reasons for not using PrEP were unknown, but newer longer-acting injectable PrEP modalities could address barriers related to taking PrEP as prescribed or

pill burden.[35,36] PrEP use not only reduces the need to intentionally use non-medication-based HIV prevention strategies at the point of sex but can offer an added layer of indirect protection at the population-level for others who may not be on PrEP. Ultimately, more options for HIV prevention are needed to engage a greater proportion of GBMSM.

Our study has limitations to consider. First, HIV-negative individuals could re-enroll in Project DETECT and Project DETECT 2 every 90 days. Our survey was designed to keep the identities of partners unknown to study staff, and there was not a way to track whether partnerships were the same across multiple study re-enrollments. It is possible that there was within-person correlation that was not accounted for because we considered all participant visits and not unique people, or that certain individuals are overrepresented in our individual-level data. Next, as detailed above, misclassification of our outcomes was possible. Further, there may be misclassification of exposures due to incomplete or imputed data, particularly for time since last HIV test and duration of partnerships. Partner-level exposures were reported by the participant, so perceived partner age and race may not have been accurate. Though we tested for presence of an interaction by year in our associations, we did not explore changes of HIV prevention strategies over time, and it was likely differences can be noted from the beginning to end of our nine-year study period. During that time, there was widespread scale up of PrEP and U=U messaging in Seattle, and local data indicates that use of HIV risk reduction strategies has decreased on a population-level since 2013.[39] Finally, the generalizability of our findings must be taken into context. Partner-specific survey questions were only asked of cisgender men who had sex with partners they identified as men. Populations who may not use PrEP but utilize different HIV prevention strategies, or those who have increased HIV incidence, including transgender persons, were excluded from our sample. Moreover, we enrolled individuals seeking HIV testing at a sexual health clinic in Seattle. Prevention messaging is common and PrEP use has been increasing in the area since its introduction in 2012.[9] Our results are less

generalizable to populations not engaged in clinical care or those in areas with less HIV prevention and treatment success.

Conclusion

As the use of biomedical HIV prevention continues to increase across populations, it is imperative to understand how those not using PrEP protect themselves against HIV. Our data fill an important gap in understanding how individual- and partnership-level characteristics are associated with non-use of HIV prevention, which could help explain persistent disparities in incidence and indicate shortcomings of current public health efforts to eliminate HIV. Though the majority of GBMSM in our sample were using an HIV prevention strategy at least some of the time, our findings highlight the need to strengthen HIV testing programs for those who have never tested or test infrequently, better focus HIV prevention efforts among GBMSM who use methamphetamine, and increase the accessibility of new and existing PrEP options for those who may benefit. Ultimately, population-specific efforts to increase uptake of HIV testing and prevention will be crucial for addressing the needs of those disproportionately impacted by HIV.

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Supplemental Tables and Figures

Supplemental Table 1. Characteristics of participant visits by participant PrEP use, N=1853 participant visits

	Participant not currently on PrEP N=1261 n (%)	**Participant currently on PrEP N=592 n (%)**	**p-value**
Age (years) – median [IQR]	N=1258 30 [25-36]	32 [27-37]	**<0.0001**
Race/ethnicity [a]			
American Indian or Alaska Native	8 (0.6%)	4 (0.7%)	0.0506
Asian	106 (8.4%)	47 (7.9%)	
Black or African American	104 (8.2%)	32 (5.4%)	
Hispanic or Latinx	245 (19.4%)	152 (25.7%)	
Multiracial	74 (5.9%)	32 (5.4%)	
Native Hawaiian or Other Pacific Islander	9 (0.7%)	2 (0.3%)	
White	680 (53.9%)	311 (52.5%)	
Refused or Unknown	35 (2.8%)	12 (2.0%)	
Highest level of education	N=1242	N=578	
High school or lower	278 (22.4%)	94 (16.3%)	**0.0155**
Some college, a technical or associate's degree	416 (33.5%)	202 (34.9%)	
College graduate	399 (32.1%)	196 (33.9%)	
Graduate school	149 (12.0%)	86 (14.9%)	
Experienced homelessness in past year	N=1228	N=572	
Yes	168 (13.7%)	60 (10.5%)	0.0580
No	1060 (86.3%)	512 (89.5%)	
Insurance status	N=1224	N=565	
Insured	853 (69.7%)	467 (82.7%)	**<0.0001**
Not insured	371 (30.3%)	98 (17.3%)	
Self-reported time since last HIV test			
Never tested for HIV	47 (3.7%)	10 (1.7%)	**<0.0001**
Within past 3 months	449 (35.6%)	439 (74.2%)	
3-6 months ago	348 (27.6%)	109 (18.4%)	
6-12 months ago	202 (16.0%)	17 (2.9%)	
≥1 years ago	194 (15.4%)	12 (2.0%)	
Don't know/Refuse	21 (1.7%)	5 (0.8%)	
Bacterial STI diagnosis in past 3 months [b]			
Yes	180 (14.3%)	160 (27.0%)	**<0.0001**
No	1081 (85.7%)	432 (73.0%)	
Methamphetamine use in the past 3 months [c]	N=1258	N=591	
Yes	122 (9.7%)	54 (9.1%)	0.7015
No	1136 (90.3%)	537 (90.9%)	
Number of male anal sex partners in past 3 months – median [IQR]	2 [1-4]	4 [2-8]	**<0.0001**
Number of male condomless anal sex partners in the past 3 months – median [IQR]	N=1256 1 [1-2]	N=590 3 [1-6]	**<0.0001**

PrEP: pre-exposure prophylaxis. IQR: interquartile range. STI: sexually transmitted infection.
a. Persons who identified as Hispanic or Latinx ethnicity were classified as Hispanic or Latinx regardless of race.
b. Bacterial STIs include gonorrhea, chlamydia, and/or syphilis.
c. Methamphetamine includes any route of use.

Supplemental Table 2. Partnership characteristics by participant PrEP use, N=4140 partnerships

	Participants not currently on PrEP N=2677 partnerships n (%)	Participants currently on PrEP N=1463 partnerships n (%)	p-value
Age of partner compared to participant	N=2572	N=1417	
>10 years younger	285 (11.1%)	146 (10.3%)	
Within 10 years	1977 (76.9%)	1022 (69.9%)	**<0.0001**
>10 years older	264 (10.3%)	186 (13.1%)	
Don't know partner's age	46 (1.8%)	63 (4.4%)	
Racial homophily between participant and partner [a, b]			
Yes	1111 (41.5%)	579 (39.6%)	0.2282
No	1566 (58.5%)	884 (60.4%)	
Where participant and partner met [c]	N=2525	N=1398	
Bar, club, or rave	179 (7.1%)	98 (7.0%)	**0.0004**
Gym or spa	36 (1.4%)	10 (0.7%)	
In public	77 (3.0%)	20 (1.4%)	
Online (website or app)	1442 (57.1%)	841 (60.2%)	
School or work	104 (4.1%)	48 (3.4%)	
Sex venue	121 (4.8%)	99 (7.1%)	
Social organization	64 (2.5%)	30 (2.1%)	
Through friends	502 (19.9%)	252 (18.0%)	
Duration of sexual relationship [d]	N=2513	N=1354	
One-time	1422 (56.6%)	762 (56.3%)	0.0516
<3 months	331 (13.2%)	143 (10.6%)	
3-12 months	154 (6.1%)	84 (6.2%)	
>1 year	606 (24.1%)	365 (27.0%)	
Participant felt/feels committed to partner [e]	N=2527	N=1379	
Yes	585 (23.1%)	281 (20.4%)	**0.0462**
No	1942 (76.9%)	1098 (79.6%)	
Disclosure of HIV status before first sex	N=2575	N=1407	
Participant and partner both disclosed	2078 (80.7%)	1174 (83.4%)	**0.0246**
Only participant disclosed	73 (2.8%)	43 (3.1%)	
Only partner disclosed	47 (1.8%)	12 (0.9%)	
Neither participant nor partner disclosed	377 (14.6%)	178 (12.7%)	
HIV status of partner at first sex if disclosed	N=2120	N=1184	
HIV-negative	2007 (94.7%)	1084 (91.6%)	**0.0005**
HIV-positive	113 (5.3%)	100 (8.4%)	
Partner is on PrEP if partner is HIV-negative	N=1931	N=1038	
Yes	721 (37.3%)	654 (63.0%)	**<0.0001**
No	1072 (55.5%)	263 (25.3%)	
Don't know	138 (7.1%)	121 (11.7%)	
Partner has undetectable HIV viral load if partner is living with HIV	N=114	N=99	
Yes	102 (89.5%)	98 (99.0%)	**0.0034**
No	12 (10.5%)	1 (1.0%)	
Reports any CAI with partner in past 3 months	N=2465	N=1352	
Yes	1681 (68.2%)	1085 (80.3%)	**<0.0001**
No	784 (31.8%)	267 (19.7%)	

PrEP: pre-exposure prophylaxis. IQR: interquartile range. CAI: condomless anal intercourse.
a. Considered "no" if participant and/or partner information is unknown.
b. Persons who identified as Hispanic or Latinx ethnicity were classified as Hispanic or Latinx regardless of race.

c. “In public” includes vacation or cruise; “Online” includes chat/dating line and personal ad/newspaper; “School or work” includes jail; “Sex venue” includes adult bookstore, bath house, cruising area, sex club/resort, private sex party; “Social organization” includes church
d. Duration was calculated using date of most recent anal sex with the partner and date of first anal sex with partner. If day for either date was unknown, 1 (beginning of the month) was used.
e. Commitment was defined as “someone you might call your boyfriend, significant other, life partner, or husband.”

Supplemental Table 3. Associations between participant-level characteristics and the non-use of an HIV prevention strategy with any male anal sex partner among participants not on PrEP with >1 partner, N=653 participant visits

	Used an HIV prevention strategy with all partners N=617 n (%)	**Did not use an HIV prevention strategy with any partner N=36 n (%)**	**Unadjusted PR for not using HIV prevention (95% CI)**
Age (years) – median [IQR]	N=616 29 [25-36]	34 [26-41]	1.02 (1.00-1.05)
Race/ethnicity [a]			
American Indian or Alaska Native	6/6 (100%)	0/6 (0%)	NA [b]
Asian	61/65 (93.8%)	4/65 (6.2%)	1.82 (0.61-5.47)
Black or African American	39/46 (84.8%)	7/46 (15.2%)	**4.50 (1.87-10.85)**
Hispanic or Latinx	110/118 (93.2%)	8/118 (6.8%)	2.01 (0.84-4.79)
Multiracial	35/38 (92.1%)	3/38 (7.9%)	2.34 (0.69-7.91)
Native Hawaiian or Other Pacific Islander	6/6 (100%)	0/6 (0%)	NA [b]
White	343/355 (96.6%)	12/355 (3.4%)	REF
Refused or Unknown	17/19 (89.5%)	2/19 (10.5%)	3.11 (0.75-12.94)
Highest level of education		N=35	
High school or lower	112/124 (90.3%)	12/124 (9.7%)	2.06 (0.69-6.16)
Some college, a technical or associate's degree	221/232 (95.3%)	11/232 (4.7%)	1.01 (0.33-3.08)
College graduate	203/211 (96.2%)	8/211 (3.8%)	0.81 (0.25-2.61)
Graduate school	81/85 (95.3%)	4/85 (4.7%)	REF
Experienced homelessness in past year	N=612	N=34	
Yes	69/77 (89.6%)	8/77 (10.4%)	**2.27 (1.07-4.84)**
No	543/569 (95.4%)	26/569 (4.6%)	REF
Insurance status	N=609	N=34	
Insured	418/444 (94.1%)	26/444 (5.9%)	1.46 (0.67-3.16)
Not insured	191/199 (96.0%)	8/199 (4.0%)	REF
Self-reported time since last HIV test			
Within past 3 months	225/236 (95.3%)	11/236 (4.7%)	REF
3-6 months ago	188/197 (95.4%)	9/197 (4.6%)	0.98 (0.41-2.32)
6-12 months ago	99/107 (92.5%)	8/107 (7.5%)	1.60 (0.66-3.87)
1+ years ago	80/85 (94.1%)	5/85 (5.9%)	1.26 (0.45-3.53)
Never tested for HIV	21/22 (95.5%)	1/22 (4.5%)	0.98 (0.13-7.21)
Don't know/Refuse	4/6 (66.7%)	2/6 (33.3%)	**7.15 (2.01-25.47)**
Bacterial STI diagnosis in past 3 months [c]			
Yes	108/118 (91.5%)	10/118 (8.5%)	1.74 (0.86-3.52)
No	509/535 (95.1%)	26/535 (4.9%)	REF
Methamphetamine use in the past 3 months [d]	N=615		
Yes	41/53 (77.4%)	12/53 (22.6%)	**5.64 (2.99-10.63)**
No	574/598 (96.0%)	24/598 (4.0%)	REF
Number of male anal sex partners in past 3 months – median [IQR]	3 [2-5]	3 [2-5]	1.01 (0.99-1.02)
Number of male condomless anal sex partners in the past 3 months – median [IQR]	2 [1-3]	2 [2-3]	1.01 (1.00-1.02)

PrEP: pre-exposure prophylaxis. PR: prevalence ratio. CI: confidence interval. IQR: interquartile range. NA: not available. REF: referent. STI: sexually transmitted infection.
Bold values indicate statistically significant at $p<0.05$.
a. Persons who identified as Hispanic or Latinx ethnicity were classified as Hispanic or Latinx regardless of race.
b. Category was excluded from the regression model to ensure model would converge.
c. Bacterial STIs include gonorrhea, chlamydia, and/or syphilis.
d. Methamphetamine includes any route of use.

Supplemental Table 4. Associations between partnership-level characteristics and the non-use of an HIV prevention strategy with any male anal sex partner among participants not on PrEP and are inconsistent with HIV strategy use across partnerships (N=133 participant visits, 354 partnerships)

	Used 1+ HIV prevention strategy in partnership N=196 partnerships n (%)	**Did not use HIV prevention strategy in partnership N=158 partnerships n (%)**	**Unadjusted PR for not using HIV prevention (95% CI)**
Age of partner compared to participant			
>10 years younger	22/37 (59.5%)	15/37 (40.5%)	0.93 (0.68-1.29)
Within 10 years	154/272 (56.6%)	118/272 (43.4%)	REF
>10 years older	16/34 (47.1%)	18/34 (52.9%)	1.22 (0.87-1.72)
Don't know partner's age	4/11 (36.4%)	7/11 (63.6%)	1.47 (0.93-2.33)
Racial homophily between participant and partner [a, b]			
Yes	89/156 (57.1%)	67/156 (42.9%)	REF
No	107/198 (54.0%)	91/198 (46.0%)	1.07 (0.87-1.32)
Where participant and partner met [c]		N=157	
Bar, club, or rave	14/26 (53.8%)	12/26 (46.2%)	1.05 (0.64-1.72)
Gym or spa	3/4 (75.0%)	1/4 (25.0%)	0.57 (0.10-3.22)
In public	5/9 (55.6%)	4/9 (44.4%)	1.01 (0.42-2.42)
Online (website or app)	119/196 (60.7%)	77/196 (39.3%)	0.89 (0.69-1.16)
School or work	1/6 (16.7%)	5/6 (83.3%)	**1.89 (1.20-2.97)**
Sex venue	11/33 (33.3%)	22/33 (66.7%)	**1.51 (1.10-2.08)**
Social organization	5/11 (45.5%)	6/11 (54.5%)	1.24 (0.72-2.13)
Through friends	38/68 (55.9%)	30/68 (44.1%)	REF
Duration of sexual relationship [d]	N=190	N=154	
One-time	118/223 (52.9%)	105/223 (47.1%)	1.32 (0.90-1.93)
<3 months	22/40 (55.0%)	18/40 (45.0%)	1.26 (0.77-2.06)
3-12 months	14/25 (56.0%)	11/25 (44.0%)	1.23 (0.73-2.09)
>1 year	36/56 (64.3%)	20/56 (35.7%)	REF
Participant felt/feels committed to partner [e]	N=194	N=154	
Yes	41/61 (67.2%)	20/61 (32.8%)	REF
No	153/287 (53.3%)	134/287 (46.7%)	1.42 (0.95-2.14)

PrEP: pre-exposure prophylaxis. PR: prevalence ratio. CI: confidence interval. REF: referent.
Bold values indicate statistically significant at p<0.05.
a. Considered "no" if participant and/or partner information is unknown.
b. Persons who identified as Hispanic or Latinx ethnicity were classified as Hispanic or Latinx regardless of race.
c. "In public" includes vacation or cruise; "Online" includes chat/dating line and personal ad/newspaper; "School or work" includes jail; "Sex venue" includes adult bookstore, bath house, cruising area, sex club/resort, private sex party; "Social organization" includes church
d. Duration was calculated using date of most recent anal sex with the partner and date of first anal sex with partner. If day for either date was unknown, 1 (beginning of the month) was used.
e. Commitment was defined as "someone you might call your boyfriend, significant other, life partner, or husband."

Supplemental Table 5. Sensitivity analysis: associations between participant-level characteristics and the non-use of an HIV prevention strategy (including partner PrEP use) with ≥1 male anal sex partner among participants not on PrEP, N=1190 participant visits

	Used an HIV prevention strategy in all partnerships N=442 participants n (%)	Did not use HIV prevention strategy in ≥1 partnership N=748 participants n (%)	Unadjusted PR for not using HIV prevention (95% CI)	Adjusted PR for not using HIV prevention [a] (95% CI)	p-value for interaction with study year [b]
	N=440	N=747			
Age (years) – median [IQR]	30 [25-36]	30 [25-37]	1.00 (1.00-1.01)	1.00 (1.00-1.01)	0.3307
Race/ethnicity [c]					
American Indian or Alaska Native	4/8 (50.0%)	4/8 (50.0%)	0.82 (0.41-1.64)	0.81 (0.41-1.64)	0.0588
Asian	38/105 (36.2%)	67/105 (63.8%)	1.04 (0.89-1.22)	1.04 (0.89-1.22)	
Black or African American	29/88 (33.0%)	59/88 (67.0%)	1.09 (0.93-1.28)	1.10 (0.94-1.28)	
Hispanic or Latinx	74/220 (33.6%)	146/220 (66.4%)	1.08 (0.97-1.21)	1.09 (0.97-1.22)	
Multiracial	20/72 (27.8%)	52/72 (72.2%)	1.18 (1.01-1.38)	1.18 (1.01-1.39)	
Native Hawaiian or Other Pacific Islander	5/8 (62.5%)	3/8 (37.5%)	0.61 (0.25-1.50)	0.61 (0.25-1.50)	
White	253/654 (38.7%)	401/654 (61.3%)	REF	REF	
Refused or Unknown	19/35 (54.3%)	16/35 (45.7%)	0.75 (0.52-1.08)	0.75 (0.52-1.08)	
Highest level of education	N=440	N=743			
High school or lower	83/253 (32.8%)	170/253 (67.2%)	1.06 (0.91-1.23)	1.06 (0.91-1.23)	0.4713
Some college, a technical or associate's degree	151/402 (37.6%)	251/402 (62.4%)	0.98 (0.85-1.14)	0.98 (0.85-1.14)	
College graduate	153/383 (39.9%)	230/383 (60.1%)	0.95 (0.82-1.10)	0.95 (0.82-1.10)	
Graduate school	53/145 (36.6%)	92/145 (63.4%)	REF	REF	
Experienced homelessness in past year	N=439	N=734			
Yes	55/156 (35.3%)	101/156 (64.7%)	1.04 (0.92-1.18)	1.04 (0.92-1.18)	0.3981
No	384/1017 (37.8%)	633/1017 (62.2%)	REF	REF	
Insurance status	N=438	N=732			
Insured	297/819 (36.3%)	522/819 (63.7%)	1.07 (0.96-1.18)	1.07 (0.96-1.18)	0.8240
Not insured	141/351 (40.2%)	210/351 (59.8%)	REF	REF	
Self-reported time since last HIV test					
Within past 3 months	161/422 (38.2%)	261/422 (61.8%)	REF	REF	0.2576
3-6 months ago	123/330 (37.3%)	207/330 (62.7%)	1.01 (0.91-1.13)	1.01 (0.91-1.13)	
6-12 months ago	75/193 (38.9%)	118/193 (61.1%)	0.99 (0.86-1.13)	0.99 (0.86-1.13)	
1+ years ago	57/186 (30.6%)	129/186 (69.4%)	1.12 (0.99-1.27)	1.12 (0.99-1.27)	
Never tested for HIV	18/43 (41.9%)	25/43 (58.1%)	0.94 (0.72-1.22)	0.94 (0.72-1.22)	
Don't know/Refuse	8/16 (50.0%)	8/16 (50.0%)	0.81 (0.49-1.33)	0.82 (0.50-1.34)	
Bacterial STI diagnosis in past 3 months [e]					
Yes	61/171 (35.7%)	110/171 (64.3%)	1.03 (0.91-1.16)	1.03 (0.91-1.16)	0.1002

No	381/1019 (37.4%)	638/1019 (62.6%)	REF	REF	
Methamphetamine use in the past 3 months [f]	N=441	N=747			
Yes	30/108 (27.8%)	78/108 (72.2%)	**1.17 (1.03-1.32)**	**1.17 (1.03-1.32)**	0.6864
No	411/1080 (38.1%)	669/1080 (61.9%)	REF	REF	
Number of male anal sex partners in past 3 months – median [IQR]	2 [1-3]	3 [1-4]	1.00 (0.99-1.01)	1.00 (0.99-1.01)	**0.0446**
Number of male condomless anal sex partners in the past 3 months – median [IQR]	1 [0-2]	2 [1-3]	1.00 (0.99-1.01)	1.00 (0.99-1.01)	0.0955

PrEP: pre-exposure prophylaxis. PR: prevalence ratio. CI: confidence interval. IQR: interquartile range. NA: not available. REF: referent. STI: sexually transmitted infection.
Bold values indicate statistically significant at p<0.05.
a. Adjusted for study calendar year (modeled continuously)
b. Included an interaction term for study calendar year (modeled continuously).
c. Persons who identified as Hispanic or Latinx ethnicity were classified as Hispanic or Latinx regardless of race.
d. Category was excluded from the regression model to ensure model would converge.
e. Bacterial STIs include gonorrhea, chlamydia, and/or syphilis.
f. Methamphetamine includes any route of use.

Supplemental Table 6. Sensitivity analysis: associations between partnership-level characteristics and the non-use of an HIV prevention strategy (including partner PrEP use) with any male anal sex partner among participants not on PrEP, N=2449 partnerships

	Used an HIV prevention strategy in partnership N=1367 partnerships n (%)	**Did not use an HIV prevention strategy in partnership N=1082 partnerships n (%)**	**Unadjusted PR for not using HIV prevention (95% CI)**	**Adjusted PR for not using HIV prevention (95% CI)** [a]	**p-value for interaction with study year** [b]
Age of partner compared to participant	N=1363	N=1080			
>10 years younger	146/274 (53.3%)	128/274 (46.7%)	1.07 (0.92-1.24)	1.07 (0.92-1.24)	0.6956
Within 10 years	1056/1879 (56.2%)	823/1879 (43.8%)	REF	REF	
>10 years older	144/252 (57.1%)	108/252 (42.9%)	0.98 (0.83-1.16)	0.98 (0.83-1.16)	
Don't know partner's age	17/38 (44.7%)	21/38 (55.3%)	1.26 (0.91-1.76)	1.26 (0.91-1.76)	
Racial homophily between participant and partner [c, d]					
Yes	591/1057 (55.9%)	466/1057 (44.1%)	REF	REF	0.5639
No	776/1392 (55.7%)	616/1392 (44.3%)	1.00 (0.91-1.11)	1.00 (0.91-1.11)	
Where participant and partner met [e]	N=1358	N=1060			
Bar, club, or rave	99/172 (57.6%)	73/172 (42.4%)	0.90 (0.72-1.12)	0.90 (0.72-1.12)	0.7642
Gym or spa	23/36 (63.9%)	13/36 (36.1%)	0.76 (0.46-1.27)	0.76 (0.46-1.27)	
In public	36/73 (49.3%)	37/73 (50.7%)	1.07 (0.83-1.39)	1.07 (0.83-1.39)	
Online (website or app)	815/1399 (58.3%)	584/1399 (41.7%)	**0.88 (0.78-1.00)**	**0.88 (0.78-1.00)**	
School or work	46/99 (46.5%)	53/99 (53.5%)	1.13 (0.92-1.40)	1.13 (0.92-1.40)	
Sex venue	78/112 (69.6%)	34/112 (30.4%)	1.04 (0.80-1.35)	1.04 (0.80-1.35)	
Social organization	35/59 (59.3%)	24/59 (40.7%)	0.86 (0.61-1.22)	0.86 (0.61-1.22)	
Through friends	247/468 (52.8%)	221/468 (47.2%)	REF	REF	
Duration of sexual relationship [f]	N=1343	N=1057			
One-time	829/1369 (60.6%)	540/1369 (39.4%)	**0.71 (0.63-0.78)**	**0.71 (0.63-0.78)**	0.5038
<3 months	185/324 (57.1%)	139/324 (42.9%)	0.77 (0.66-0.89)	0.77 (0.66-0.89)	
3-12 months	83/149 (55.7%)	66/149 (44.3%)	0.79 (0.65-0.97)	0.79 (0.65-0.97)	
>1 year	246/558 (44.1%)	312/558 (55.9%)	REF	REF	
Participant felt/feels committed to partner [g]	N=1345	N=1062			
Yes	198/548 (36.1%)	350/548 (63.9%)	REF	REF	0.1470
No	1147/1859 (61.7%)	712/1859 (38.3%)	**0.60 (0.55-0.66)**	**0.60 (0.55-0.66)**	

PrEP: pre-exposure prophylaxis. PR: prevalence ratio. CI: confidence interval. REF: referent.
Bold values indicate statistically significant at p<0.05.
a. Adjusted for study calendar year (modeled continuously)
b. Included an interaction term for study year (modeled continuously)
c. Considered "no" if participant and/or partner information is unknown.

d. Persons who identified as Hispanic or Latinx ethnicity were classified as Hispanic or Latinx regardless of race.
e. “In public” includes vacation or cruise; “Online” includes chat/dating line and personal ad/newspaper; “School or work” includes jail; “Sex venue” includes adult bookstore, bath house, cruising area, sex club/resort, private sex party; “Social organization” includes church
f. Duration was calculated using date of most recent anal sex with the partner and date of first anal sex with partner. If day for either date was unknown, 1 (beginning of the month) was used.
g. Commitment was defined as “someone you might call your boyfriend, significant other, life partner, or husband.”

Chapter IV: Preferences for HIV PrEP Products and Delivery Models Among Cisgender Men, Transgender Persons, and Non-binary Individuals Who Have Sex with Men in Seattle, Washington: A Discrete Choice Experiment

Preferences for HIV PrEP Products and Delivery Models Among Cisgender Men, Transgender Persons, and Non-binary Individuals Who Have Sex with Men in Seattle, Washington: A Discrete Choice Experiment

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Abstract

Background: Understanding preferences for HIV pre-exposure prophylaxis (PrEP) products can lead to more delivery models and better choices and ultimately increase uptake among populations disproportionally affected by HIV.

Setting: Public Health – Seattle & King County (PHSKC) Sexual Health Clinic (SHC).

Methods: Between August 2022-December 2023, a convenience sample of individuals seeking HIV testing and participating in Project DETECT2 completed a discrete choice experiment (DCE). We used a D-efficient blocked fractional design and asked participants to choose between two hypothetical PrEP options composed of five attributes (modality, efficacy, dosing frequency, prescriber, and monitoring appointment format). We used multinomial logistic regression models to estimate preference weights and relative importance for the cohort overall and stratified by PrEP experience.

Results: 325 participants completed the DCE; 96 (29.5%) were PrEP-naïve and 229 (70.5%) were PrEP-experienced. Ninety-nine percent efficacy (weight=0.848, 95%CI= 0.769-0.927), 6-month dosing interval (weight=0.381, 95%CI= 0.293-0.469) and pill form (weight=0.173, 95%CI= 0.085-0.261) were most preferred. There was a stronger preference for PrEP delivery within a pharmacy (weight=0.144, 95%CI= 0.059-0.228) or community-based organization (weight=0.097, 95%CI= 0.011-0.183). Efficacy had the highest relative importance (52.1%) and format of monitoring appointments was the least important attribute (7.0%). Stratifying by PrEP experience did not change preference.

Conclusions: Participants preferred products with high efficacy and longer dosing intervals delivered in non-clinical spaces with a hybrid approach to follow-up appointments. Product efficacy had the strongest impact on decision-making. A greater future variety of highly efficacious long-acting PrEP options could increase PrEP use.

Introduction

Daily oral HIV pre-exposure prophylaxis (PrEP) is a safe and efficacious method of reducing HIV acquisition, but effectiveness of daily medications relies on high adherence, which is often a barrier to use.[1,2,34] An extended-release injectable form of PrEP, long-acting injectable cabotegravir, was approved by the United States (US) Food and Drug Administration (FDA) in 2021,[4-7] and trials of various novel PrEP modalities including dermal implants, longer-acting pills, and additional injectable agents are currently in progress.[108-110] As the HIV prevention landscape advances, there may soon be several PrEP options, each with different dosing regimens, efficacy, and other properties.[34,111,112]

End-user perspectives on the design and delivery of new HIV prevention options are crucial to inform the product pipeline and optimize implementation strategies for scale-up. Discrete choice experiments (DCEs) provide an efficient and robust approach to assessing end-user preferences by identifying the impact of changes in product attributes on participant choice.[113,114] DCEs can also be a helpful tool to identify which attributes of a product are of greatest importance when choosing between multiple options. This can prioritize product formulation and rollout.[114,115] Consideration of end-user preference can increase acceptability and better reach those for whom current PrEP products and/or delivery strategies are not appealing enough to lead to actual use.

As new PrEP modalities roll out and efforts to maximize implementation of existing PrEP options expand, it is imperative to better understand how these products meet the needs of populations who continue to face barriers to PrEP use. Further, as several PrEP options become available to end-users, it is important to identify the degree to which different product attributes will influence uptake in populations for which PrEP is recommended. To address this need, we conducted a DCE among cisgender gay, bisexual, and other men who have sex with men (GBMSM), transgender individuals, and non-binary persons seeking HIV testing at the

Public Health – Seattle & King County (PHSKC) Sexual Health Clinic (SHC) to estimate preference for different PrEP product formulations and delivery models.

Methods

Parent Study

Between August 2021 and May 2024, we enrolled a convenience sample of participants into the parent study, Project DETECT 2. Project DETECT 2 was an adapted continuation of Project DETECT for which methods are described elsewhere.[72-76] Briefly, Project DETECT 2 was a cross-sectional Centers for Disease Control and Prevention (CDC)-funded study designed to evaluate HIV/sexually transmitted infections (STI) testing technologies in real-time. The study enrolled participants with negative/unknown HIV status seeking HIV/STI testing at the PHSKC SHC. As part of Project DETECT 2, participants were tested with three HIV and one HIV/syphilis point-of-care tests with laboratory-based confirmatory testing.

Study Sample

All Project DETECT 2 participants presenting to the PHSKC SHC for HIV/STI testing from August 2022-December 2023 were invited to complete a PrEP preferences survey during their study visit. Participants were ≥18 years; cisgender men, transgender persons, or non-binary individuals who reported sex with men; self-reported negative or unknown HIV status; and spoke English and/or Spanish.

Experimental Design

DCE attributes and levels were developed using key informant interviews, literature review, and expert consultation. We included characteristics relevant to both PrEP products and delivery models in our final design (Table 1). Briefly, attributes included PrEP modality, efficacy, dosing frequency, prescriber, and format of PrEP monitoring appointments. Attribute selection for PrEP provider were based on key informant interviews from a previous project exploring PrEP navigation services in King County, Washington. Interviewees had previously accessed

PrEP navigation services from local community-based organizations and had varied PrEP experience. PrEP modality, efficacy, and dosing frequency were selected based on a literature review of products either currently available for use or in development as of June 2021.[116] Levels for PrEP monitoring were created based on consultation with three PrEP providers and HIV prevention experts. The final design was restricted to omit implausible combinations of levels (e.g., an injection by a PrEP provider just before and right after sex). Figure 1 presents an example choice set.

Table 1. Discrete choice experiment attributes and levels

Attribute	Attribute Label	Levels
Modality	How you take your PrEP	Pill
		Injection by my PrEP provider
		Injection I do myself
Efficacy	Level of protection against HIV	Protects 99 out of 100 people against HIV
		Protects 90 out of 100 people against HIV
		Protects 75 out of 100 people against HIV
Dosing frequency	When or how often you take your PrEP	Daily
		Just before and right after sex
		Every 2 months
		Every 6 months
Prescriber	Who you get your PrEP from	Sexual health clinic
		Primary care provider
		Community organization
		Pharmacy
Format of monitoring appointments	How you attend your PrEP follow-up appointments	Go in person to see my PrEP provider and get my blood drawn at the clinic
		See my PrEP provider over a videocall and get my blood drawn separately at a clinic or lab
		See my PrEP provider over a videocall and I collect my own blood to mail to a lab

Figure 1. Discrete choice experiment choice set example

	Option A	Option B
How you take your PrEP	Injection I do myself	Pill
Level of protection against HIV	Protects 99 out of 100 people against HIV	Protects 90 out of 100 people against HIV
When or how often you take your PrEP	Every 2 months	Every 2 months
Who you get your PrEP from	Sexual health clinic	Primary care provider
How you attend your PrEP follow-up appointments	See my PrEP provider over a videocall and I collect my own blood to mail to a lab	Go in person to see my PrEP provider and get my blood drawn at the clinic

We used a D-efficient blocked fractional factorial design with no inclusions of priors.[117,118] The most efficient design (D-error=0.0127) resulted in 144 alternatives that were grouped into 12 random blocks of 12 choice sets per participant. For each choice set, participants were asked “If both types of PrEP were real and an option for you, which would you choose?” and given two unlabeled (i.e., Option A and B) alternative options. Choice sets did not include a status quo or opt-out alternative to maximize our ability to estimate preference without additional data censoring.[118-121]

Data Collection

Participants completed the PrEP preferences survey using Research Electronic Data Capture (REDCap) on a study tablet.[48] All data were self-reported and optional, and study staff were nearby to answer questions. The PrEP preferences survey contained the DCE and questions about PrEP experience; where participants received PrEP; types of PrEP used; dosing frequency; barriers to PrEP initiation, adherence, and persistence; and reasons for PrEP discontinuation if applicable (Supplemental Digital Content 1). Parent study survey questions included sociodemographic characteristics, healthcare utilization, STI history, drug use, and

sexual behaviors (Supplemental Digital Content 2). Both surveys were offered in English and Spanish.

Analysis

We present descriptive statistics for the whole cohort and by PrEP experience. We defined PrEP experience as either PrEP-naïve if the participant reported never using PrEP or as PrEP-experienced if they reported currently or previously using PrEP. We compared characteristics of PrEP experience groups using Chi-square, Fisher's exact, or Wilcoxon-Mann-Whitney tests as appropriate.

Data were analyzed with multinominal logistic regression using levels within attributes as model covariates. Levels were effects-coded, and the reference category was calculated using the negative sum of the point estimates of the other levels within the attribute. We presented mean preference weights normalized around zero with 95% confidence intervals (95% CI) overall and stratified by PrEP experience. Greater preference weights represent stronger preference, and smaller, more negative weights indicate a less preferred option within the attribute. Overlapping 95% CIs for the preference weights indicate similar preference between levels; non-overlapping 95% CIs represent a statistically significant difference in preference.

We calculated the relative importance of the attribute to the decision-making process by calculating the difference in preference weights between the most and least preferred level within the attribute. Attributes with larger relative importance values can be interpreted as more important to decision-making than those in the DCE with smaller values.[122] Relative importance values were then normalized across attributes and presented as a percentage out of 100%.[122]

We used SAS version 9.4 for DCE experimental design and all analyses (SAS Institute, Cary, NC).

Ethical Considerations

All participants provided verbal informed consent and were reimbursed $25 USD for participating in Project DETECT 2 and an additional $10 USD for completing the PrEP

preferences survey. Study activities were approved by the University of Washington Human Subjects Division (STUDY00001637).

Results

Participant characteristics

Of the 378 Project DETECT 2 participants offered enrollment, 325 (86.0%) completed the PrEP preferences survey. Demographics of those who declined to complete the PrEP preferences survey were similar to those who did complete the survey (data not shown). Table 2 presents characteristics by PrEP experience (naïve versus current/former use). Median age was 31 years (interquartile range (IQR): 27-36), the majority (87.4%) were cisgender men, and just under one-third (29.2%) were Hispanic/Latinx. More than half (54.8%) had a college degree or higher. Prevalence of drug use in the previous 3 months was low; only 5.9% reported methamphetamine use and 2.8% injection of any drug. Of those assigned male sex at birth, the median number of male anal sex partners in the previous three months was 2 (IQR: 1-5).

Table 2. Discrete choice experiment participant characteristics overall and by PrEP experience

	Total N=325	PrEP naïve N=96	PrEP experienced[1] N=229	p-value[2]
Median age [IQR] – years	31 [27-36]	30 [25.5-35]	32 [28-36]	0.0955
Gender identity[3]				
Cisgender man	284 (87.4%)	84 (87.5%)	200 (87.3%)	0.9327
Non-binary or genderqueer	32 (9.9%)	10 (10.4%)	22 (9.6%)	
Transgender man	3 (0.9%)	1 (1.0%)	2 (0.9%)	
Transgender woman	6 (1.9%)	1 (1.0%)	5 (2.2%)	
Race/ethnicity[4]				
Asian	35 (10.8%)	10 (10.4%)	25 (10.9%)	**0.0062**
Black or African American	20 (6.2%)	0 (0%)	20 (8.7%)	
Hispanic or Latinx	95 (29.2%)	26 (27.1%)	69 (30.1%)	
Multiracial	22 (6.8%)	6 (6.3%)	16 (7.0%)	
White	143 (44.0%)	49 (51.0%)	94 (41.1%)	
Another race or ethnicity not listed	2 (0.6%)	0 (0%)	2 (0.9%)	
Refuse to answer	8 (2.5%)	5 (5.2%)	3 (1.3%)	
Highest completed level of education				
High school diploma/GED or lower	50 (15.4%)	21 (21.9%)	29 (12.7%)	0.1358
Some college, associates, or technical	90 (27.7%)	23 (24.0%)	67 (29.3%)	
College degree	128 (39.4%)	32 (33.3%)	96 (41.9%)	

Post-graduate degree	50 (15.4%)	17 (17.7%)	33 (14.4%)	
Refuse to answer	7 (2.2%)	3 (3.1%)	4 (1.8%)	
Experienced homelessness in past year				
No	292 (89.9%)	86 (89.6%)	206 (90.0%)	0.9064
Yes	21 (6.5%)	7 (7.3%)	14 (6.1%)	
Refuse to answer	12 (3.7%)	3 (3.1%)	9 (3.9%)	
Insurance status				
None	76 (23.4%)	28 (29.2%)	48 (21.0%)	0.1242
Insured	230 (70.8%)	61 (63.5%)	169 (73.8%)	
Don't know	7 (2.2%)	4 (4.2%)	3 (1.3%)	
Refuse to answer	12 (3.7%)	3 (3.1%)	9 (3.9%)	
Has a regular medical provider				
No	129 (39.7%)	41 (42.7%)	88 (38.4%)	0.0745
Yes	181 (55.7%)	47 (49.0%)	134 (58.5%)	
Don't know	11 (3.4%)	5 (5.2%)	6 (2.6%)	
Refuse to answer	4 (1.2%)	3 (3.1%)	1 (0.4%)	
Diagnosed with bacterial STI in past 3 months[5]				
No	289 (88.9%)	88 (91.7%)	201 (87.8%)	0.3075
Yes	36 (11.1%)	8 (8.3%)	28 (12.2%)	
Methamphetamine use in past 3 months				
No	304 (93.5%)	89 (92.7%)	215 (93.9%)	0.1514
Yes	19 (5.9%)	5 (5.2%)	14 (6.1%)	
Refuse to answer	2 (0.6%)	2 (2.1%)	0 (0%)	
Injection drug use in past 3 months				
No	313 (96.3%)	93 (96.9%)	220 (96.1%)	**0.0025**
Yes	9 (2.8%)	0 (0%)	9 (3.9%)	
Refuse to answer	3 (0.9%)	3 (3.1%)	0 (0%)	
Median number of male sex partners in past 3 months [IQR][6,7]	N=309 4 [2-7]	N=87 3 [2-5]	N=222 4 [2-9]	**0.0352**
Median number of male anal sex partners in past 3 months [IQR][6]	N=304 2 [1-5]	N=86 2 [1-4]	N=218 3 [1-6]	**0.0022**

1. Includes participants who reported previous or current PrEP use
2. Chi-square or Fisher's exact test (when cells <5) to compare differences in categorical variables by PrEP experience and Wilcoxon-Mann-Whitney tests to compare differences in continuous variables by PrEP experience. Bold values indicate statistically significant differences where p<0.05.
3. Two-step process using self-reported sex assigned at birth and gender. One participant who identified as "agender" is categorized as "Non-binary or genderqueer".
4. Participants who identify as "Hispanic or Latinx" are categorized as such regardless of any selected race.
5. Includes self-reported diagnosis of chlamydia, gonorrhea, and/or syphilis. One participant who responded "don't know" is categorized as "No".
6. Only asked of participants who reported male sex assigned at birth.
7. Includes both anal and oral sex partners identified as "men" by participants.

Ninety-six participants (29.5%) were PrEP-naïve, 75 (23.1%) previously used PrEP, and 154 (47.4%) were on PrEP at the time of the study. Of those with PrEP experience (229, 70.5%)

the 185 (80.8%) used oral PrEP daily, 16 (7.0%) used PrEP on-demand, 6 (2.6%) used PrEP on another schedule, only one had used injectable PrEP, and the rest reported not knowing what type of PrEP they had used (21, 9.2%). Demographics except for race/ethnicity were similar between PrEP experience groups. Those who were PrEP-experienced more frequently reported recent injection drug use (3.9% vs 0%, p=0.0025) and more total sex partners (median=4 vs 3, p=0.035) and anal sex partners (median=3 vs 2, p=0.0022) in the previous three months.

Overall preference

Overall, mean preference weights with 95% CIs are presented in Table 3 and Supplemental Figure 1. Higher efficacy was associated with significantly stronger preference. Less frequent dosing (i.e., every 6 months) was the most preferred (preference weight=0.381, 95% CI=0.293, 0.469) and was significantly greater than the other dosing schedules. Daily and on-demand dosing were least preferred (weights=-0.217 and -0.192, respectively) with almost entirely overlapping 95% CIs. The most preferred PrEP modality was a pill (weight=0.173, 95% CI=0.085, 0.261) followed by a provider injection (weight=0.097, 95% CI=0.009, 0.185), though the 95% CIs overlapped. Self-injection was least preferred (weight=-0.270, 95% CI=-0.361, -0.179) and was significantly less preferred than other modalities. There was a stronger preference for PrEP delivery outside of clinical settings from either a pharmacy (weight=0.144) or community-based organization (weight=0.097); 95% CIs were similar between the two and both were significantly greater than sexual health clinic (weight=-0.068) and primary care provider's office (weight=-0.172). Preference for PrEP monitoring in-person and over telehealth with laboratory-based blood collection were similar (weights=0.061 and 0.086, respectively) but significantly different than the less-preferred option of telehealth monitoring with home-based blood collection (weight=-0.146, 95% CI=-0.223, -0.069).

Table 3. Discrete choice experiment attribute preference weights among all participants, with attributes ordered by relative importance and levels ordered by preference

Attribute	Levels	Point Estimate	95% Confidence Interval	Relative Importance[1]
Efficacy	Protects 99 out of 100 people against HIV	0.848	0.769, 0.927	52.1%
	Protects 90 out of 100 people against HIV	0.029	-0.038, 0.096	
	Protects 75 out of 100 people against HIV	-0.877	-0.961, -0.792	
Dosing frequency	Every 6 months	0.381	0.293, 0.469	18.0%
	Every 2 months	0.028	-0.073, 0.129	
	Just before and right after sex	-0.192	-0.306, -0.078	
	Daily	-0.217	-0.328, -0.106	
Modality	Pill	0.173	0.085, 0.261	13.4%
	Injection by my PrEP provider	0.097	0.009, 0.185	
	Injection I do myself	-0.270	-0.361, -0.179	
Prescriber	Pharmacy	0.144	0.059, 0.228	9.5%
	Community organization	0.097	0.011, 0.183	
	Sexual health clinic	-0.068	-0.148, 0.011	
	Primary care provider	-0.172	-0.270, -0.075	
Format of monitoring appointments	See my PrEP provider over a videocall and get my blood drawn separately at a clinic or lab	0.086	0.017, 0.154	7.0%
	Go in person to see my PrEP provider and get my blood drawn at the clinic	0.061	-0.023, 0.144	
	See my PrEP provider over a videocall and I collect my own blood to mail to a lab	-0.146	-0.223, -0.069	

1. The relative importance is percent (out of 100%) to which the attribute contributed to the decision to select the PrEP type. Relative importance is the difference between the point estimates of the most preferred level and the least preferred level within the attribute, normalized across all attributes.

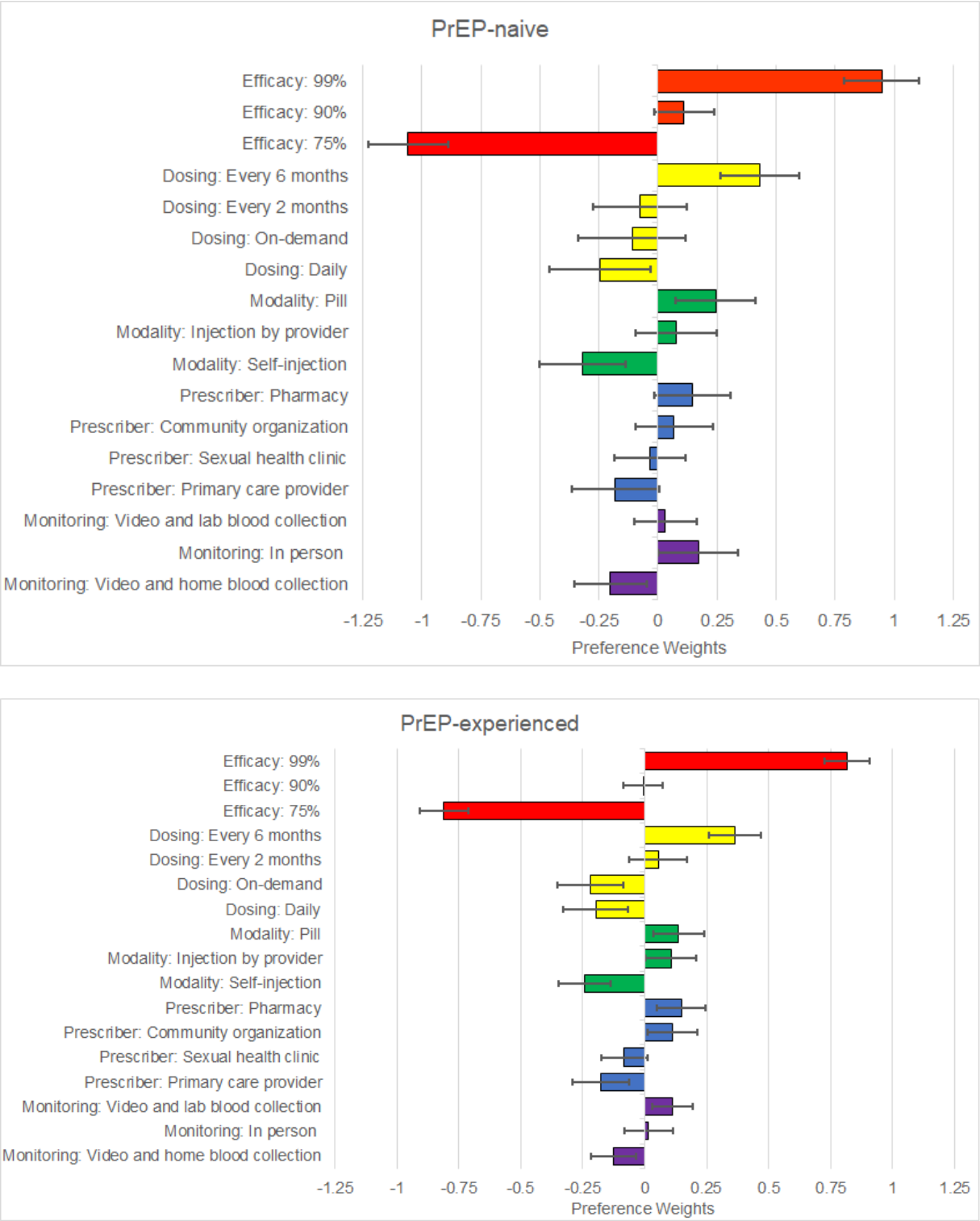
Efficacy was the attribute with highest relative importance (52.1%) across the entire cohort, followed by dosing frequency (18%), modality (13.4%), prescriber (9.5%), and format of monitoring appointments (7.0%).

Preferences comparing PrEP experience with non-experience

Preference for efficacy among both PrEP experience groups mirrored that of the entire cohort, with stronger preference for more efficacious PrEP options (Figure 2). Among those who

were PrEP-naïve, any dosing schedule that was more frequent than biannually was less preferred though the overlapping 95% CIs of the bimonthly, on-demand, and daily dosing options indicate similar preference. PrEP-naïve participants had stronger modality preferences compared to PrEP-experienced participants. Among those who were PrEP-naïve, a pill was most preferred (weight=0.245, 95% CI=0.077, 0.413) compared to provider injection (weight=0.075, 95% CI=-0.097, 0.247) or self-injection (weight=-0.319, 95% CI=-0.503, -0.135). The same pattern was present for those who were PrEP-experienced, though preference for pills and provider injection were more similar (weights=0.136 and 0.106, respectively). Preference for PrEP prescriber for both experience groups was similar to that of the entire cohort. Among those who were PrEP-naïve, the most preferred monitoring option was in-person (weight=0.170, 95% CI=0.002, 0.338) compared to stronger preference for telehealth with laboratory-based blood collection among PrEP-experienced participants (weight=0.112, 95% CI=0.0211, 0.193), though 95% CI are overlapping between these two levels among both groups.

Figure 2. Discrete choice experiment attribute preference weights, by PrEP experience



Among both groups, efficacy had the highest relative importance and was therefore the strongest determinant of choice (Supplemental Table 1). Dosing frequency was the second-

most important attribute in decision-making for both PrEP-naïve (17.1%) and PrEP-experienced (18.4%), followed by modality (14.3% and 12.0%, respectively). The least important attribute was prescriber (8.2%) for the PrEP-naïve group compared to monitoring format (7.6%) for the PrEP-experienced participants.

Discussion

In a sample of cisgender men, transgender persons, and non-binary individuals seeking HIV/STI testing at a sexual health clinic in Seattle, drug efficacy was the strongest determinant of PrEP choice, indicating that maintaining high levels of efficacy across PrEP options is critical. Participants preferred less frequent dosing intervals and PrEP in pill form. Where individuals received their PrEP and how they attended follow-up monitoring visits were less likely to influence decision-making, and the difference between preferences for levels within those attributes was not significant. Despite previous product experience, the preferences of PrEP-experienced participants were largely similar to those of PrEP-naïve participants. These data suggest that, while products with longer intervals between doses are preferred, a range of different modalities, prescribers, and monitoring methods may be needed to ensure the preferred choices for everyone who may benefit from PrEP.

Product efficacy has been shown to be a driver of decision-making in several preference studies.[121,123,124] When taken as prescribed, daily oral PrEP efficacy estimates exceed 90%,[1, 2] and data from cabotegravir trials demonstrated similar high levels of efficacy.[4-7] Our findings may have implications for less efficacious methods that may be in development or ones that rely more heavily on user adherence. Though our data demonstrate a preference for products with higher degrees of protection against HIV, efficacy should not be the only consideration for new products. Ultimately, more choices for HIV prevention will be crucial to meet the unique needs of different populations.

Participants preferred to take PrEP less frequently, consistent with dosing intervals of longer-acting formulations in various stages of development. A twice-yearly product was significantly preferred. This option aligns with the dosing interval for lenacapavir, an HIV capsid-inhibitor administered as subcutaneous injection that is currently FDA approved for treatment of HIV infection. Lenacapavir has shown 100% efficacy in preventing HIV acquisition among cisgender women, and Phase III trials among GBMSM, transgender women, non-binary individuals, and people who inject drugs are on-going.[108,110] Other studies among GBMSM, transgender women, and adolescent girls and women have indicated that longer dosing intervals are preferred because effectiveness relies less on daily adherence, leads to reduced interaction with the healthcare system, and allows for more discretion.[35,36]

Participants generally preferred a hybrid approach to PrEP use and care over a completely remote option. Both self-injections and telehealth with home-based blood collection for PrEP monitoring were the least preferred modality and monitoring options, respectively. Yet, several self-injectable medications are in widespread use for other conditions (e.g., insulin, in vitro fertilization medications, hormone replacement therapy), and pilot studies have found high acceptability and feasibility of home-based blood collection for PrEP monitoring.[125-127] Our survey gave few details regarding what self-injection or self-collection of blood would entail and may be the least familiar options to people in general, which may have impacted participants' understanding of and preferences for these levels. Preference for less-remote options may also be impacted by our clinic-based sample of participants who were already seeking in-person care at the time of study enrollment. Additionally, some may be averse to needles or handling their own blood, but this may vary by population.

In our sample there was a preference for pharmacy- and CBO-based PrEP delivery. Pharmacy-based PrEP delivery is becoming more common in the US, and pharmacist-led programs in Washington and Iowa have shown high acceptability and increased PrEP use among GBMSM.[128,129] Similar successes among community-based PrEP delivery have been

noted globally and can simplify PrEP access while addressing barriers of stigma, concerns for confidentiality, and convenience.[130-133] In our study, both clinic-based options (a sexual health clinic and a primary care provider's office) were the least preferred models of PrEP delivery despite 40% of our participants currently receiving PrEP from a sexual health clinic at the time of their survey and 56% reported having a primary care provider. Separate sensitivity analyses limited to those receiving PrEP at the PHSKC SHC and to those with a primary care provider revealed similar prescribing preferences to that of the entire cohort (data not shown). While this discordance merits further investigation, our data reinforce the need for a variety of venues for PrEP delivery to meet the preferences of all potential users.

Finally, we found that preferences stratified by PrEP experience were largely similar. We anticipated that past product experience may impact choice, and preferences would differ by PrEP use.[134] The preference similarities between experience groups in this analysis may be explained by high product familiarity among the population in general. In Seattle, PrEP awareness among GBMSM is almost universal; nearly 100% of GBMSM reported knowing about PrEP in the 2023 Seattle-area Pride Survey.[9] Moreover, our survey was conducted at the site of one of the largest PrEP programs in Washington State,[9] which may have contributed to a high degree of PrEP familiarity, even among those were PrEP-naïve. Experience may have a greater impact on preferences when compared to groups of PrEP-naïve individuals with less exposure to PrEP or among those surveyed outside of a clinical setting.

Our study has limitations to consider. First, our sample was limited to those seeking HIV/STI testing at a local sexual health clinic, 40% of whom were currently receiving PrEP at the clinic, which limits generalizability. Second, we excluded out-of-pocket costs as an attribute in our DCE, despite the fact that out-of-pocket costs have been shown to have a major influence on decision-making in other PrEP-related DCEs.[124,135-139] Costs may vary drastically by PrEP type and insurance coverage, and at the time of the experimental design, per-person costs of injectable PrEP were largely unknown. Additionally, PrEP can be provided at low or no cost in

Washington with enrollment in the state's PrEP Drug Assistance Program.[140] As such, we assumed full cost coverage. Third, we did not pilot our DCE due to both data collection timelines and decreased research priority in the PHSKC SHC during the response to the mpox outbreak in the summer of 2022.[141] It is possible that cognitive testing through a pilot study could have resulted in different and more appropriate attributes or levels. We did, however, use formative work to guide attribute and level development. Fourth, preferences may have varied based on demographic or behavioral characteristics, but our analysis did not explore such differences. Future work may include analyses to determine how preferences differed by subgroup including race and ethnicity, educational status, and age. Finally, as with any stated preference design, the preferences and decisions participants make in a DCE may not reflect their actual use if presented with the same options in the real world.[142-145] We tried to minimize this threat to external validity by including participants who were either formerly or currently using PrEP (70.5%), as their stated preference may better reflect real world decision-making because they have product experience. Using forced choice design (i.e., exclusion of an opt-out option) also may have decreased external validity because participants may not choose either alternative from a given choice set when faced with the option in the real world.[120,121,146] This design, however, minimized censoring of our data which resulted in higher power.

Our study has several strengths. We used a combination of key informant interviews, literature review, and expert consultation for attribute and level selection, which positions our findings in a relevant way that centers end-user choice and clinical feasibility. Our study considers how PrEP modality is situated in the bigger picture of PrEP service delivery, which provides a more comprehensive understanding of PrEP preferences and could help better predict uptake and persistence. We also omitted non-sensical combinations of levels in our DCE design. Though restricting combinations decreased the statistical efficiency of the design, it provided participants with choice sets containing more realistic hypothetical PrEP options. This likely increased participant understanding and decreased bias or measurement error. Our

design included characteristics of existing PrEP options like daily pills, new PrEP options like long-acting injectables delivered by a healthcare provider, and PrEP options that may be available in the future like self-injectable formulations. This allows our findings to inform both existing PrEP implementation and development of other products that could better suit end-user needs than what is currently available. Lastly, our DCE was offered in both English and Spanish which increased representativeness of our sample. Though our final sample size was too small allow for analysis by survey language, it is possible to use our design in future recruitment efforts prioritizing Spanish-speaking individuals.

Our findings present several opportunities for future work. Our study provides opportunities for additional analyses to understand heterogeneity of preferences among subgroups in our sample. Our DCE could also be used in other settings to explore preference among other populations with lower PrEP uptake. Both can help better tailor the messaging and design of PrEP programs to specific populations and create programs centered around end-user preference. Our findings indicate a preference for longer-acting efficacious PrEP options delivered in non-traditional settings (e.g., a pharmacy or community-based organization), which aligns with U.S. National HIV/AIDS Strategy priorities.[107] Investment in additional PrEP products at various stages of development and expansion of programs that offer PrEP in varied locations is necessary to reflect preferences of communities who may benefit from more HIV prevention options. Finally, qualitative and cost-effectiveness work could provide additional context to our findings by revealing unmeasured factors in decision-making and by positioning preferences in terms of feasibility, respectively.

Conclusion

Taken together, our results strongly suggest that a greater variety of products with high efficacy is preferred and support the call for choice in the field of HIV prevention.[147] Delivery of longer-acting PrEP options in non-traditional, preference-centered programs could engage a

greater proportion of the population and increase PrEP use. Ultimately, sustained implementation of existing PrEP options and implementation of new modalities and models of care should be done in parallel to successfully meet the needs of all individuals who could benefit from HIV prevention.

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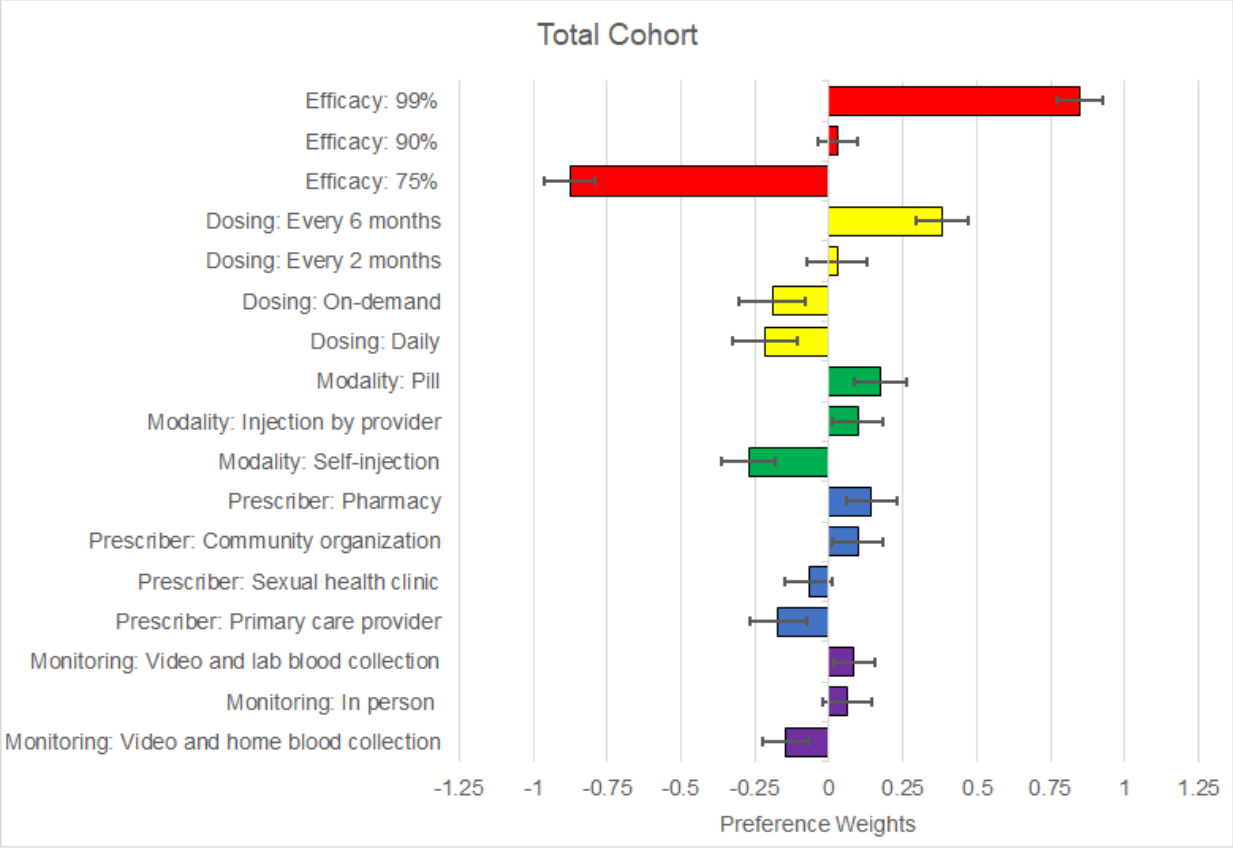
Supplemental Tables and Figures

Supplemental Figure 1. Discrete choice experiment attribute preference weights among all participants, with attribute ordered by relative importance and levels ordered by preference



Supplemental Table 1. Discrete choice experiment attribute preference weights, by PrEP experience

Attribute	Levels	PrEP-naive			PrEP-experienced		
		Point Estimate	95% Confidence Interval	Relative Importance[1]	Point Estimate	95% Confidence Interval	Relative Importance[1]
Efficacy	Protects 99 out of 100 people against HIV	0.948	0.790, 1.106	50.9%	0.816	0.724, 0.908	51.6%
	Protects 90 out of 100 people against HIV	0.110	-0.016, 0.236		-0.005	-0.084, 0.074	
	Protects 75 out of 100 people against HIV	-1.058	-1.228, -0.888		-0.811	-0.909, -0.713	
Dosing frequency	Every 6 months	0.431	0.265, 0.597	17.1%	0.363	0.259, 0.467	18.4%
	Every 2 months	-0.076	-0.276, 0.124		0.054	-0.063, 0.171	
	Just before and right after sex	-0.110	-0.336, 0.116		-0.218	-0.350, -0.086	
	Daily	-0.245	-0.458, -0.032		-0.198	-0.330, -0.066	
Modality	Pill	0.245	0.077, 0.413	14.3%	0.136	0.033, 0.239	12.0%
	Injection by my PrEP provider	0.075	-0.097, 0.247		0.106	0.003, 0.209	
	Injection I do myself	-0.319	-0.503, -0.135		-0.242	-0.348, -0.136	
Prescriber	Pharmacy	0.145	-0.017, 0.307	8.2%	0.148	0.049, 0.247	10.3%
	Community organization	0.069	-0.100, 0.234		0.112	0.010, 0.214	
	Sexual health clinic	-0.033	-0.184, 0.118		-0.082	-0.177, 0.013	
	Primary care provider	-0.180	-0.367, 0.007		-0.178	-0.294, -0.062	
Format of monitoring appointments	See my PrEP provider over a videocall and get my blood drawn separately at a clinic or lab	0.031	-0.102, 0.164	9.4%	0.112	0.031, 0.193	7.6%
	Go in person to see my PrEP provider and get my blood drawn at the clinic	0.170	0.002, 0.338		0.016	-0.081, 0.113	
	See my PrEP provider over a videocall and I collect my own blood to mail to a lab	-0.201	-0.355, -0.047		-0.127	-0.217, -0.037	

1. The relative importance is percent (out of 100%) to which the attribute contributed to the decision to select the PrEP type. Relative importance is the difference between the point estimates of the most preferred level and the least preferred level within the attribute, normalized across all attributes.

Chapter V: Discussion

Summary of key findings

The work included in this dissertation fills an important gap in our understanding of perspectives on HIV and PrEP, use of prevention strategies in the absence of PrEP, and preferences for PrEP products and delivery models among two priority populations disproportionately impacted by the HIV epidemic. Our key findings include:

- Awareness of and interest in daily oral PrEP were high among WWID, use was low, and many had reported barriers to PrEP including misconceptions, unstable housing, low perceived risk, and competing survival needs.
- Among GBMSM not using PrEP, non-use of HIV prevention strategies was significantly higher among individuals who reported recent methamphetamine use or had never previously tested for HIV. At the partnership level, perceptions of non-commitment, one-time partnerships, and meeting partners at sex-based venues were associated with non-use of HIV prevention strategies.
- Drug efficacy was the strongest determinant of PrEP choice among a clinic-based sample of GBMSM, transgender individuals, and non-binary persons. Products with longer dosing intervals, either as a pill or an injection by a provider, delivered in non-clinical spaces with flexible options for appointment format were most preferred. Preferences did not differ by PrEP experience.

Limitations and implications

External validity: study setting

Our work has overall and chapter-specific limitations that should be considered. The greatest limitation is the generalizability of our findings. This research was conducted in Seattle, Washington, where both HIV awareness and PrEP use are high.

King County was the first jurisdiction to hit the Joint United Nations Programme on HIV/AIDS' 90-90-90 goals where 90% of those living with HIV know their status, 90% of those diagnosed receive treatment, and 90% of those on treatment achieve viral suppression.[9,148] More recently, the US Department of Health and Human Services outlined an "Ending the HIV Epidemic" plan in which the goal is to reduce the number of new HIV by 75% by 2025 and 90% by 2030, and Washington State set similar goals with their End AIDS Washington initiative.[9] Data from 2022 indicate that King County has either met or is moving towards the 2025 goals for many HIV testing, treatment, and prevention metrics, though disparities by race, ethnicity, and behaviors do still exist.[9]

Successes in HIV within King County reflect several factors, all set in the background of pioneering efforts in HIV treatment and prevention. Since 1982 when the first case of AIDS was diagnosed in Seattle, there have been several longstanding clinical, governmental, and community organizations focused on addressing the impact of HIV among the city's residents.[149,150] Many take a whole-human approach and provide services beyond HIV, including food banks and care for other conditions. The Seattle area has also been a trailblazer in harm reduction efforts since 1989 when PHSKC opened a syringe exchange in the city, modeled after the first publicly-funded exchange in nearby Tacoma, Washington.[149,151] As of 2022, the more than five brick and mortar exchanges within city limits, along with several other private or mobile exchanges in operation distributed more than 2.5 million syringes.[152,9]

Moreover, Seattle has been a leader in the development and use of differentiated care models for delivery of HIV prevention and treatment. Differentiated care models allow individuals to seek services outside of a traditional clinical setting, thus addressing several barriers to care. One-Step PrEP, the first pharmacist-led PrEP program in the US began in Seattle's Kelley-Ross pharmacy and showed high rates of initiation and retention among clients.[128] Telehealth and community-based models for PrEP at Seattle's LGBTQ+ Center

(formerly known as Gay City) and at the MOCHA PrEP Clinic through POCAAN, have expanded access to HIV prevention by allowing remote healthcare and through engagement of communities underserved by traditional clinical care models.[153,154] Finally, several low-barrier clinics exist in partnership with Harborview Medical Center, part of the healthcare system at the University of Washington. These include but are not limited to the Max Clinic, the Moderate Needs Clinic, and the SHE Clinic, which are incentive-based, allow for flexible attendance, and/or are situated in trusted community spaces.[155-159]

Finally, Washington State adopted the Affordable Care Act's Medicaid expansion, providing increased medical coverage for residents. Additionally, the Washington State Department of Health offers coverage of PrEP medication and related services through their Pre-Exposure Prophylaxis Drug Assistance Program (PrEP DAP).[140] These two programs can help address barriers to preventative care for those who wish to start PrEP or utilize sexual health services. Cost and insurance coverage are often primary concerns with seeking health care, and the availability of financial assistance programs provided in Washington must be considered when comparing PrEP uptake or access to other locations that may lack such options. Data from the 2017 NHBS system confirmed this; GBMSM residing in a Medicaid expansion state, including Washington, were significantly more likely to discuss PrEP with a provider (60% vs 44%) and use PrEP (31% vs 18%) compared to those in states that did not expand Medicaid.[160]

Together, partnerships between the Washington State Department of Health, PHSKC, the University of Washington, and community groups have combined applied public health practice, research, clinical care, and advocacy to address the HIV epidemic in King County.

Set in Seattle, our findings illustrate that there are several opportunities to expand upon existing work to improve access, engagement in care, and options for HIV prevention among WWID and GBMSM. Compared to the rest of the country, HIV prevention efforts have been

largely successful in Seattle. The 2023 Annual Pride survey showed that PrEP awareness was almost universal among GBMSM.[9] Approximately half of GBMSM in Seattle are on PrEP, and among those with several clinical indications for PrEP, 62% were using it as of 2022.[9] Though estimates of awareness and use for WWID are lower (70% awareness in our study, 36% in Seattle according to unpublished 2021 NHBS data), they are still significantly higher locally compared to national estimates. As part of the SHEMobile formative work detailed in Chapter III, we also surveyed 30 WWID living in Minneapolis, Minnesota. There, less than half had heard of PrEP, and only one (3% of our sample) was on PrEP currently [unpublished data].

Higher awareness of HIV and PrEP allowed us to have more detailed and nuanced conversations with WWID in Chapter II to better understand barriers to uptake. In settings where knowledge about HIV and PrEP are much lower, findings may not have uncovered themes that were both PrEP-oriented and actionable. A 2018 outbreak of HIV in North Seattle among 14 individuals living homeless – 11 of whom were cisgender women, 9 of whom reported transactional sex, and 12 of whom had recently injected drugs – resulted in an increase of public health activities in an area that had previously been a service desert.[25] The establishment of clinical services and community outreach likely increased overall awareness of HIV and PrEP among those in the neighborhood. Our research detailed in Chapter II recruited from the same geographic location, which may at least partially explain the high degree of awareness among our sample. Despite the fact that the influx of resources was reactionary, communities of WWID in other service deserts likely do not have the same exposure to public health messaging.

Though disparities in the use of HIV prevention strategies were highlighted among higher-incidence subgroups of GBMSM in Chapter III, we found that both use of PrEP (approximately 32%) and other HIV prevention strategies in the absence of PrEP were higher than national estimates, and the former increased over time. Again, the increases of PrEP uptake indicate that progress has been made with PrEP coverage in Seattle, a finding that is

unique to this area compared to several other places in the US. It is possible that GBMSM not using HIV prevention in our sample are less likely to acquire HIV due to indirect protection from their partners.[38] In locations where PrEP use or rates of sustained viral suppression are lower across all populations, non-use of any HIV prevention could result in a higher likelihood of acquisition. While our findings highlight the need for more concentrated prevention efforts, the consequences of non-use of prevention are likely lower on a population-scale when compared to settings with higher HIV incidence.

The generalizability of our findings for Chapter IV were explained in the discussion. We hypothesized that preferences would differ by PrEP experience, but found that qualitatively, preferences were similar. We believe this may be explained by a high degree of product familiarity, which in this case may have been a proxy for product experience among PrEP-naïve GBMSM. It is possible that in a setting with less background knowledge of PrEP, especially among GBMSM who are product-naïve, preferences may have differed by experience.

External validity: recruitment

Recruitment for all studies occurred within clinical or community sites. Because of this, our study samples consisted of WWID and GBMSM who were actively seeking out services. In Chapter II, WWID were recruited from a day shelter with a drop-in clinic, a mobile methadone unit, and a syringe exchange. Consequently, our study sample was exposed to public health messaging, had access to HIV prevention strategies including PrEP and injection supplies, and were engaged in some form of health care. It is conceivable that our findings would be different if we recruited individuals not engaged in these services. We would anticipate that awareness and knowledge of HIV would be lower, and barriers to accessing care would be higher.

We recruited from the PHSKC SHC, one of the largest PrEP programs in Washington State, for the research presented in Chapters III and IV.[9] All participants enrolled in Project

DETECT and Project DETECT 2 were seeking HIV and/or STI testing at the time of study participation, therefore, all participants were actively engaging in HIV prevention by getting tested. A non-clinical sample may be less likely to utilize HIV prevention strategies in their partnerships or may have different preferences for PrEP products and delivery.

External validity: study sample

Across all chapters, our study samples largely consisted of white, cisgender women and men. In King County, HIV incidence is highest among Black and Latinx individuals. The rate of new diagnoses among Black and Latinx GBMSM locally is almost six and four times that of white GBMSM, respectively.[9] Disparities persist through PrEP utilization, HIV treatment, and sustained viral suppression.[9] It is crucial to better understand the population-specific barriers to care, non-use of HIV prevention strategies, and preferences for PrEP to decrease HIV incidence among those disproportionately impacted. Unfortunately, while these communities are overrepresented in the HIV epidemic, they are underrepresented in research, including the studies presented here. Intersecting identities result in compounded discrimination due to racism, homophobia, HIV-related stigma, and more.[161] Structural factors up to the policy level can further perpetuate stigma and act as barriers to the use of HIV risk reduction strategies and decrease the effectiveness of them against HIV acquisition.[103,162]

Bias

Chapters II through IV were all subject to information bias, especially due to the sensitive nature of the topics covered in each study. We attempted to minimize the impact of bias in the design of each project. Recall periods were limited to three or six months with the exception of lifetime reports. For Chapter III, recall of partnerships was limited to the three most recent anal sex partners from the previous three months. While it is still possible that participants could not

report or inaccurately reported details due to recall issues, we attempted to address this by restricting both number of partners and timeline follow-back.

In all studies, social desirability bias may have impacted our findings. To increase the likelihood of disclosure of sensitive information, we used computer-based surveys to minimize the need for face-to-face disclosure (Chapters III and IV). For the research included in Chapter II, we partnered with trusted community sites to increase rapport with participants and interviewers (for both the survey and in-depth interviews) were cisgender women who had extensive experience working with those in the study population. In most cases, our results would be biased towards the null due to an underreporting of exposures including but not limited to drug use and sexual behaviors. For our mixed-methods work, an underreporting of these behaviors may have impacted PrEP candidacy. We considered several possible criteria for candidacy, so underreporting one behavior (e.g., transactional sex) may not have changed candidacy categorization.

Chapter-specific limitations

Though limitations are described within each chapter, it bears repeating some of the key caveats to each study as we consider the implications of our findings. In Chapter II, very few participants, especially in the IDI sample, had previously used PrEP. As such, barriers and facilitators to PrEP uptake that were described are hypothetical. It may be true that barriers and facilitators noted were done so with general healthcare or other medications in mind. Even so, we would anticipate that these barriers hold true for PrEP. There would also be consideration of additional HIV- or PrEP-related stigma that may further impact PrEP uptake and use.[44,46,79]

In Chapter III, unmeasured data may impact our findings. Due to concerns for cognitive burden, the behavioral survey used in Project DETECT and Project DETECT 2 was limited to the three most recent male anal sex partners among GBMSM. Across the entire sample, the

median number of anal sex partners in the previous three months was 3 (IQR: 1-5). Among those not on PrEP, it was 2 (IQR: 1-4). It is possible that our findings may have been impacted by not collecting partnership-level data on more three partnerships, however, we considered balance with participant response burden. It is also likely that we missed nuance around sexual encounters and relationships that may be important to consider in thinking about the likelihood of HIV acquisition. For example, we did not collect information on perceived stigma, relationship power dynamics, or pleasure, all of which may impact both partner selection and use of HIV prevention strategies within those partnerships.[93-95,163-168] We also did not describe concurrency in relationships, which may compound likelihood of HIV acquisition or be more prevalent in subpopulations of GBMSM.

Finally, our findings in Chapter IV were subject to hypothetical bias, which is one of the main criticisms of stated preference data.[142-145] Hypothetical bias arises when an individual's stated preference may not match their choice in real life (i.e., revealed preference) and is a threat to external validity. Choice modeling is often conducted under the assumption of the random utility theory (i.e., individuals are rational and will make the choices that are most useful to them), and as such, DCEs typically approximate choice in reality.[145] We know, however, that individuals are not always rational, and that other factors unmeasured by DCEs may influence them to choose differently outside of the survey. A meta-analysis by Quaife et al. found that DCE models can accurately predict individual-level choice approximately 85% of the time.[145] Findings from vaccination-delivery and tuberculosis treatment DCEs revealed similar estimates.[143,144] Though DCEs are not completely predictive of behavior, the relatively high sensitivity is evidence for the utility of these designs in preference research and policy planning.

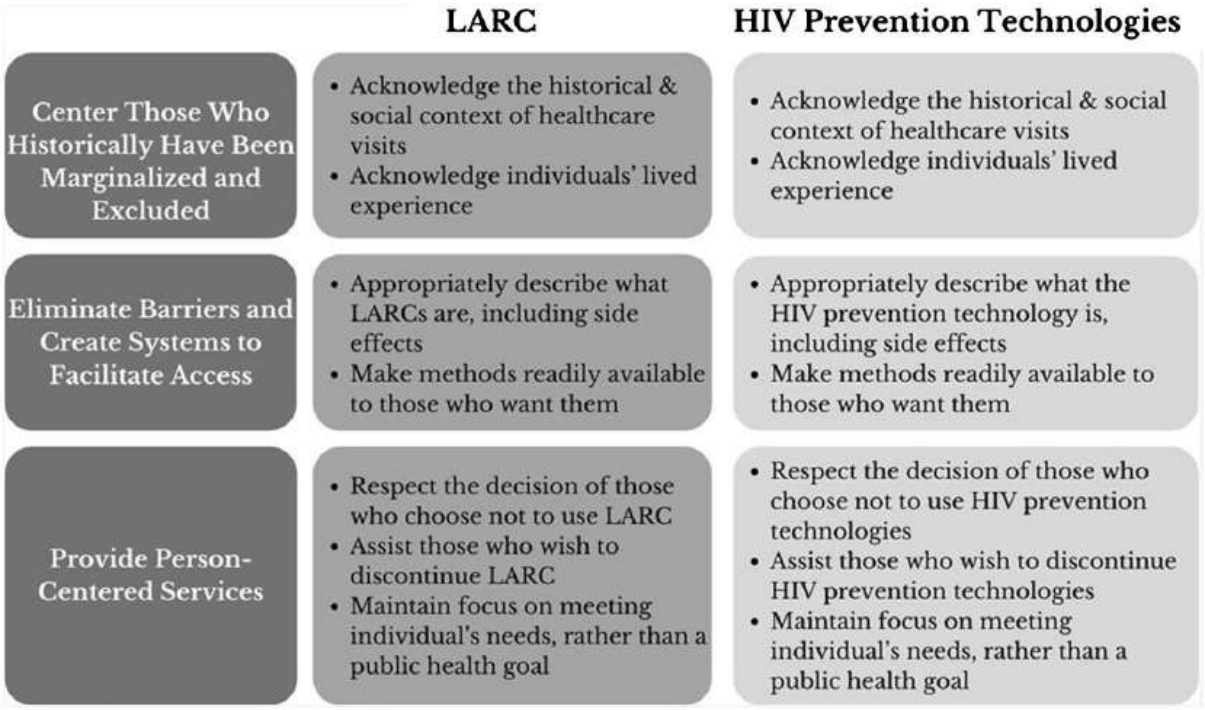
The intention-behavior gap overlaps with hypothetical bias and is another concern for external validity.[145] The gap occurs when individuals ultimately behave in ways that do not align with how they think they will behave. This is mostly commonly seen when individuals mentally

make a decision a long way ahead of being faced with that decision.[145] Many of the product attributes in our DCE match those of PrEP options either available or in various stages of development. As we've seen with the scale-up of oral PrEP, and are beginning to see with the lags in bringing long-acting injectable cabotegravir to scale post-FDA approval, product introduction and implementation takes time. Because of this, we must consider a potentially long lag between interpretation of results and the scale-up of these products in the real world, if they become available. Moreover, perceived need for PrEP can change over time for an individual. One of the benefits of having multiple available products is that a person can use the PrEP product that is the best fit for them at that moment in time. This may not be static; what is most preferred for someone at one point may not be most preferred later when circumstances change.

Public health impact and opportunities for future work

Our work fills important gaps in our understanding of HIV prevention among local populations and provides several opportunities for future work. To conceptualize our findings and understand how they may fit into current and future HIV prevention research, we have mapped our findings to a framework described by Logan and Seidman in a 2021 review.[169] In their review, they highlighted key principles of reproductive justice and applied them to the expansion of both long-acting reversible contraceptives (LARC) and HIV prevention technologies (Figure 1). Consistent with reproductive justice, they emphasize centering communities who have been historically marginalized, creating systems that eliminate barriers to accessing healthcare or health promotion activities, and employing person-centered approaches in implementation.

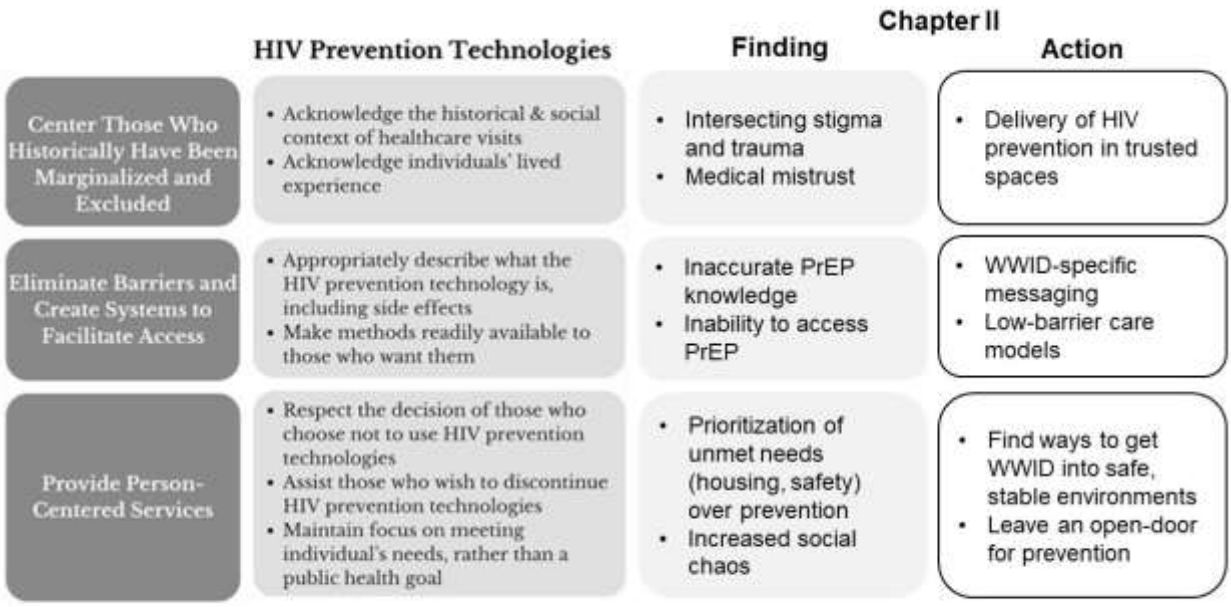
Figure 1. Logan and Seidman's application of principles of reproductive justice to sexual and reproductive health technologies[169]



The major findings of Chapter II and possible next steps mapped to Logan and Seidman's framework can be found in Figure 2. First, we need to better prioritize WWID in HIV prevention messaging. Incorporating HIV prevention into low-barrier sexual health services could increase uptake of HIV prevention among this population. In unpublished data, many participants from Chapter II reported significant mistrust in the healthcare system from past traumatic and stigmatizing exchanges with providers. Alternatively, many endorsed the venues from which they were recruited, citing a greater sense of community, a less clinical feel, appreciation of other services offered (e.g., food and clothing), and less stigma. Harm reduction and community-based programs are likely to be necessary and effective venues for ensuring WWID receive compassionate, appropriate, and effective care. Our data make a strong case for providing venue-based, low-barrier care to improve access. This may include expanded operating hours, medication storage, vouchers for or arranged transportation, flexibility for

follow-up monitoring, and more. Future work including feasibility, acceptability, and cost-effectiveness studies could be used to evaluate the success of this approach.

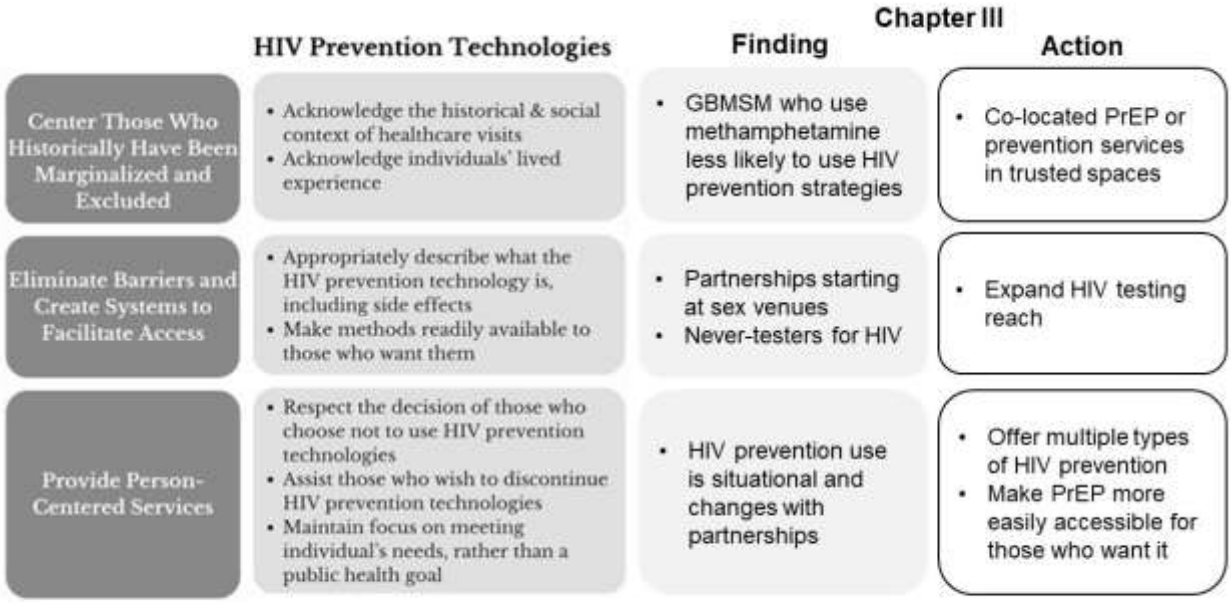
Figure 2. Chapter II findings mapped to Logan and Seidman's framework[169]



Above all, a deep investment in housing is necessary for this population. Work from throughout the US reinforces that HIV prevention is not a priority when basic needs like housing and safety are unmet.[21,27,41,44,58-60] We see the impacts of this in 2022 data from King County: 15% of those newly diagnosed with HIV were living homeless or unstably housed.[9] Among WWID, lack of stable housing, along with other structural barriers like poverty are compounded by substance use and transactional sex.[19-21,58,170] To engage more WWID in HIV prevention, we must make it easier to be in a stable, safe environment where they can have the ability to focus on preventative healthcare. Moreover, even in the absence of housing or safety concerns, WWID in our sample cited increased social chaos stemming from substance use or "the hustle" as a competing priority to health. Keeping an "open-door" approach to HIV prevention would enable situations where WWID could decide to pursue PrEP when they are ready and able.

The major findings from Chapter III and possible next steps mapped to Logan and Seidman's framework can be found in Figure 3. Our findings from Chapter III also highlight the importance of understanding the prioritization of HIV prevention relative to other needs. Our data show that use of HIV prevention is situational. More event-level data may reveal points at which we can intervene to increase use of HIV prevention within partnerships. Attempts at increasing PrEP use among populations not currently using HIV prevention could be successful, but ultimately, using a harm-reduction approach to include all types of HIV prevention strategies may result in more sustained protection.

Figure 3. Chapter III findings mapped to Logan and Seidman's framework[169]

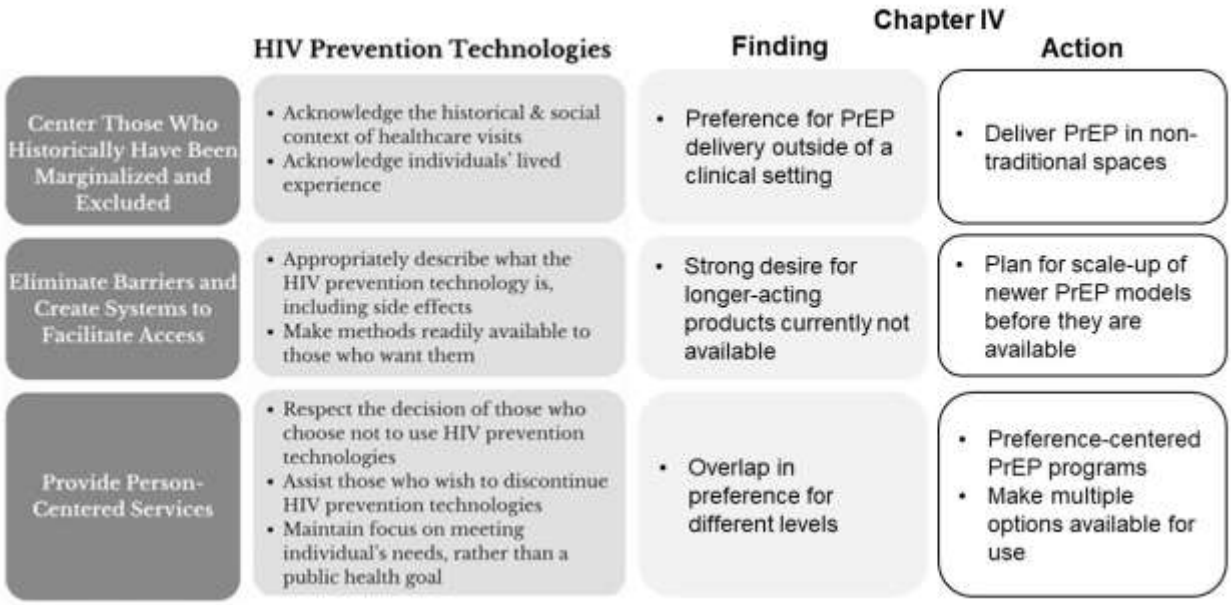


Our data also reinforce HIV testing as an entry point to HIV prevention. We found that never testing for HIV was associated with non-use of prevention strategies. These findings make a case for increased efforts to incorporate conversations about sexual health and HIV testing into routine medical care, or for expansion of rapid HIV testing in the community or at-home. Mail-distributed tests provide another avenue for increasing access; CDC-funded

"Together TakeMeHome" program found that almost one-quarter of those who ordered a test kit had never previously tested for HIV, showing the mail-based distribution of self-tests can reach individuals who are testing for the first time.[171] Given the association we found between meeting a partner at a sex venue and non-use of HIV prevention, alternative strategies to increase testing could include sex venue testing programs.

The major findings of Chapter IV and possible next steps mapped to Logan and Seidman's framework can be found in Figure 4. In response to the findings detailed in Chapter IV, it is clear that current PrEP options may not be most preferred, even among those who are currently using PrEP. We found a clear preference for longer-acting options, none of which are available for use. This work should add to the body of evidence to drive pipeline development of efficacious PrEP modalities with less frequent dosing intervals. Additionally, subsequent qualitative or cost-effectiveness work could provide additional context for our findings: qualitative work could reveal unmeasured factors in decision-making and cost-effectiveness studies could position preferences in terms of feasibility.

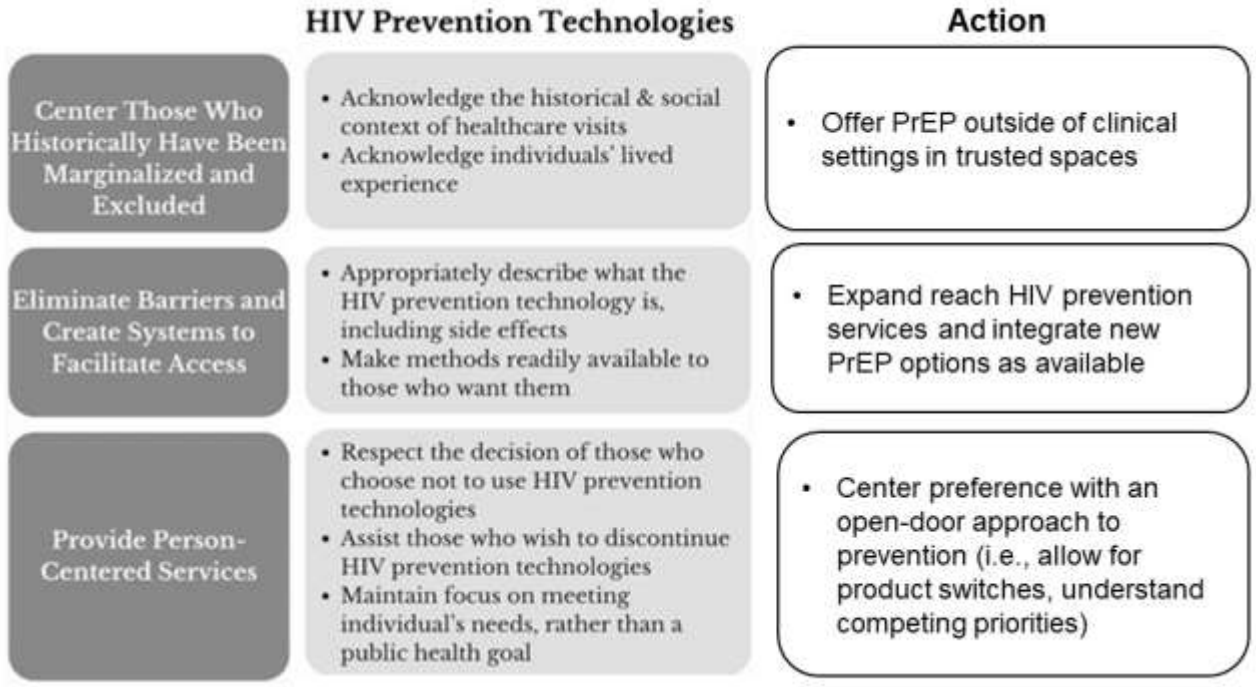
Figure 4. Chapter IV findings mapped to Logan and Seidman's framework[169]



Our research was positioned to describe the access-related issues that may exist for oral PrEP and will likely exist for other modalities. Further analyses should explore preference heterogeneity across subgroups, both within our DCE and among different populations. Similar to previous chapters, this can tailor prevention efforts to those who could benefit from PrEP but are not using it. The preference for non-traditional, hybrid delivery models makes a compelling case for policy that promotes differentiated care. Future guideline development should allow more flexibility for pharmacy- or community-based programs. Similarly, funding and training mechanisms should strive to meet the needs of potential end-users by finding ways to demedicalize PrEP.

Finally, we summarized actionable items that are common across all chapters in this body of work (Figure 5). Taken together, our findings emphasize the need to offer PrEP in trusted, non-traditional spaces including but not limited to pharmacies, community-based organizations, and harm reduction programs. Second, these data support the expansion of all HIV prevention services and the push to make new HIV prevention technologies accessible to all as soon as they are available. Lastly, HIV prevention services including PrEP programs should center preference and take an open-door approach to prevention. Systems should allow individuals to easily switch between HIV prevention options. Importantly, clinicians and providers should be aware of competing priorities and offer judgment-free care that emphasizes the individual's goals for their own health (which may or may not include HIV prevention).

Figure 5. Action items and next steps for HIV prevention mapped to Logan and Seidman's framework[169]



This work comes at a time in HIV prevention where there may soon be multiple PrEP options available for use, each with different properties that may address the needs of more people. Taken together, our data illustrate that a variety of options for HIV prevention, available through flexible, non-traditional programs could ultimately cater to more people and cover a greater span of prevention needs, resulting in decreased HIV incidence.

Concluding thoughts

In summary, the research presented in this dissertation signals that there is currently no one product or strategy that is the panacea for HIV prevention. Different populations, even within the same geographic area, have unique needs and experiences that are not adequately addressed by PrEP as it is currently available. Efforts to increase engagement in HIV prevention, or PrEP more specifically, should focus on all aspects of prevention, starting with awareness and continuing forward to ensure sustained use. Our work highlights the shortfalls of

our current public health efforts to expand PrEP locally to all whom may benefit and provides a roadmap for the development of newer products or delivery models that can better engage populations disproportionately impacted by the HIV epidemic.

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